Volume I

Volume II

Pacific Telecommunications Council Fifteenth Annual Conference

PTC'93 ®

Proceedings

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Session 1.1.1 to 2.3.8

SESSION 3.1.1 TO 4.4.1

Edited by
James G. Savage and Dan J. Wedemeyer

January 17–20, 1993
Sheraton Waikiki Hotel ▼ Honolulu, Hawaii

northern telecom

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THE PACIFIC TELECOMMUNICATIONS COUNCIL

PTC'93 is organized by the Pacific Telecommunications Council, an international non-governmental, non-profit organization. The council is regional in nature, embracing members from all the countries that play a role in the development of Pacific telecommunications. Its 357 members from industry, academia and government are dedicated to promoting the understanding and beneficial use of telecommunications throughout the entire Pacific Hemisphere--North, Central, and South America, East, South and Southeast Asia, Australia, New Zealand, Melanesia, Micronesia and Polynesia.

FOREWORD

These two volumes comprise the majority of papers presented at the Fifteenth Annual Pacific Telecommunications Council Annual Conference (PTC'93), held in Honolulu on 17-20 January 1993. This milestone gathering has brought together over 1,100 participants from over 40 countries. These volumes follow the general course of the Conference, ranging from general Discussion Papers offering a broad overview of telecoms issues to a collection of conference papers unparalleled in their scope and depth. The Proceedings are carefully indexed and are combined with a comprehensive contents list.

In addition, the PTC' 93 Session Summaries are included following the index in Volume 1. These Summaries provide a useful guide to every paper presented at PTC'93, including those not included in the current Proceedings. A volume of late papers will be produced following PTC'93, and copies may be purchased from the PTC office.

PTC's annual conference has become the region's premier venue for those interested in the world of international telecommunications. A perusal of the index or table of contents will quickly reveal the sheer breadth of coverage for which PTC is now famous. Analyzing our industry's latest technologies from ATM to LEOs to VSATs, and all acronyms in between, these papers provide a much-needed understanding of the technical, political, regulatory, and social challenges ahead. The country and region studies - see the separate "Country and Region Index" - provide expert reviews of developments in the Pacific hemisphere's key states.

The Council brings together telecoms leaders and leading commentators from across the region. This expertise is reflected in the papers found in these volumes. Of particular interest in this year's collection is the marked increase in efforts to put technological progress in the social context of development - and not just in developing countries. More efforts are being made to better understand how telecoms technology can and must be harnessed to improve education, social welfare, and not just provide new toys for a technologically-literate elite. It is particularly heartening to see how PTC's corporate and private-sector members have embraced this theme. The international telecoms industry, as a part of society, relies upon growing and, by necessity, more technologically sophisticated markets for its wares. The distance education, health care, and other social applications of new technologies are now seen as at the forefront, and an essential prerequisite for profitable business applications. These papers show that the optimism of the telecoms domain is possibly even greater now than it was during the Roaring 80s, but is now tempered by a more comprehensive view of how telecoms development and progress must benefit society.

If the educational challenges in the developed OECD states are great, then what of the developing countries? In reviewing the years since the Maitland Commission, the countries of the Pacific hemisphere have come to a collective recognition of the importance of telecoms to infrastructural development. Many countries have made massive progress in a few short years. Some of the papers in these Proceedings outline the strategies, philosophies, and policies that allowed this progress to take place. Other countries still have a long road to follow, but it is increasingly apparent in these papers that the political will for telecoms development is there, and that is more than half the battle.

The Pacific Telecommunications Council has throughout this period acted as a leading forum for analysis of these dramatic changes. The annual conference Proceedings date back to 1979 and provide a fascinating historical record of the issues. These back issues are available from the PTC office, as is the new Pacific Telecommunications Review, the PTC's latest contribution to the understanding of international telecommunications. This new PTC quarterly journal seeks to reflect the strengths of the annual conferences by acting as a "gathering place" of leading telecoms comment and analysis on a continuing basis.

These Proceedings are organized by conference days, beginning with a comprehensive table of contents and an index. The index, which appears immediately following the table of contents, cites papers by paper number rather than by page number. Once you've found the paper number, flip back to the table of contents to find the page number. Our tight production schedule necessitates this two-part index, but with practice you should be able to accomplish this two-step process in seven seconds flat (we've timed it). The index is itself in two parts and is divided into a "subject index" and a "country and region index".

James Savage
Dan Wedemeyer
Honolulu, 1993

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AUTHOR INDEX

SESSION SUMMARIES

NOTES

2.1.1 PLANNING AND IMPLEMENTING SERVICES

2.1.1.1 Telecommunications Development in Taiwan, ROC, A Study Case for Modernization

P.Y. Lee, Director General, Directorate General Telecommunications, Taiwan, *R.O.C.*

In recent years, the worldwide developmental trends have reflected the rise of democracy, economic liberalization, and social diversification. The speaker reviews how Taiwan, one of Asia's "miracle economies", has utilized telecommunications to help achieve dramatically rapid growth. The Directorate General of Telecommunications has, according to the speaker, surmounted great difficulties over the years in providiing what is today a fully developed service.

2.2.1 TECHNO-APPLICATIONS

2.2.1.1 Development of Multipoint Teleconference System Using Multipoint Control Unit (MCU)

Tatsuhide Arakaki, Systems Engineer; **Etsuo Kenmoku**, Supervisor; **Toyonori Ishida**, Supervisor; and **Masanori Sawai**, Systems Engineer, NEC Engineering, Ltd., *Japan*

Teleconferencing technologies have advanced quickly in recent years. The speaker outlines a newly-developed multipoint teleconference system that interconnects three or more sites. Using a Multipoint Control Unit (MCU), this NEC-developed system uses voice-activated switching and sophisticated video technology to create a realistic meeting environment, irrespective of distance.

2.2.1.2 The New Generation of ISDN Applications and Beyond

Dale T. Rogers, Marketing Manager, Global ISDN Services, AT&T and **Jerry A. Nowicki**, Vice President, ESI Systems, Inc., *USA*

The speaker addresses several new societal applications of ISDN in North America and the Pacific Rim, with a particular focus on the keys to successful deployment and mass marketing. Key areas to be addressed will include the technical, regulatory, financial, and educational domains. Actual customer applications and experiences are covered, and the role of cooperative and strategic alliances is analyzed.

2.2.1.3 Video on Demand Without Compression: A Review of the Technology, Business Model, Regulation and Future Implications

Jack A.M. Van Der Star, Chairman, Image Systems Corporation, *Canada*

The employment of frequency reuse, not compression, will make video-on-demand increasingly viable and important. The speaker looks at a typical demand video enterprise; how demand video applications will conform to regulatory environments; and the impact demand video will have on various industries such as film production and television. A demand video implementation strategy is put forward for different parts of the world.

2.2.1.5 **Optimization of VSAT Systems and Application in Asia-Pacific Area**
Kazuyoshi Miyoshi, Manager Communication Systems, Systems Engineering Center, Mitsubishi Electric Corporation, *Japan*

The speaker presents a VSAT system optimization method, looking at how costs may be minimized in the use of star-shaped VSAT networks. The costs of developing domestic VSAT systems in the Asia-Pacific region are analyzed, as are cost factors of introducing codec technologies.

2.2.2 ECONOMICS OF TELECOM DEVELOPMENT

2.2.2.1 **The Nexus Between Telecommunications Technology, Telecommunications Regulatory Policy, and Labor Law and its Effect on the Division of Labor in Information Economies**
Meheroo Jussawalla, Research Associate, Institute of Culture & Communications, East-West Center and **Mark D. Lofstrom**, *USA*

Telecoms technology and regulatory flexibility are at the heart of national economic development. But the connections between new technology, regulatory policy, national labour legislation, and the division of labour are not well understood. The presenter attempts to forge the links between these often conflicting imperatives by comparing labour policy in selected Asia-Pacific countries in the context of national telecoms development porgrams. Australia, New Zealand, Singapore, Hong Kong, Thailand, and the Philippines are analyzed and compared.

2.2.2.2 **Business, Legal, and Technical Implications of the Proliferation of Global Data Communications Networks**
Hyung-Min Michael Chung, Professor, Department of Business Analysis and Research, Graduate School of Business, Texas A & M University and **Tee Ee Tan**, Systems Analyst, Anderson Consulting, *Malaysia*

The speaker examines business, legal, and technical issues in the application of global data communication networks. Diverging standards adopted by different countries result in substantial costs in money, time, and personnel. While all agree harmonization is vital, the burden to create industry standards devolves upon the CCITT and its regional counterparts. The speaker analyzes new avenues of cooperation in this area.

2.2.2.3 **New Multilaterally Agreed Rules For International Trade In Services**
Raymond Krommenacker, Counsellor, GATT, *Switzerland*

The speaker analyzes the latest developments in the Uruguay Round of the GATT, with a particular focus on the General Agreement on Trade in Services (GATS). The success or failure of the GATS has massive implications for all Pacific hemisphere countries, and especially in the telecommunications industry.
The speaker provides a personal view in the context of his expertise as Counsellor at GATT headquarters.

2.2.2.4 **A Comparative Analysis of Governance Costs for Information Technology**
Ruchadaporn Lertphokanont, Policy and Plans Analyst, National Economic and Social Development Board, Royal Government of Thailand and **A. Lee Gilbert**, Senior Fellow, Information Management Research Centre, Nanyang Technological University, *Singapore*

International transfers of technology involve exchanges between organizations based in sovereign states, influenced by domesitc antitrust, contract, liability and other policies, in addition to a host of other factors. These domestic factors, combined with the imperatives of international law, determine the economic and social impact of telecoms technology transfers. The speaker presents a new perspective, based upon recent research, on the transaction costs of technology transfers.

2.2.3 STANDARD BEARERS AND NEW APPLICATIONS

2.2.3.1 **Standards and Convergence: New Realities**
David Allen, Fellow, Harvard University, Kennedy School of Government, *USA* and **John Gilbert**, Principal, John A. Gilbert & Associates, *Canada*

The convergence of telecommunications, information technology and broadcasting around multimedia applications adds complexity to the essential participation of users in the evolution of standards for telecommunications and related IT products and services. The speaker outlines the role of innovation and user influence in an ideal standardization process. Recent international standardization activities are reviewed, and future scenarios outlined.

2.2.3.2 **European Telecommunications--New Dimensions**
L. Schnurr, Professor and Chair, Telecommunications System, Anglia University and **F. Ask**, Deputy Director, European Telecommunications Standard Institute, *United Kingdom*

The evolution of the European telecommunications environment harbours a great impact for developments in the Pacific hemisphere. The speaker sets out the principal components of the new European telecoms world, discusses the role of regional and national regulation processes, and places in context the revised technical and regulatory role of standards and how they come to be.

2.2.3.3 **Joint Planning for Global Virtual Network Services to Accelerate Multi-National Deployment**
Raymond Butkus, Director, International Business Services, AT&T, *USA*

The presenter summarizes the progress to date of the Global Virtual Network Services Forum (GVNS), which comprises 30 international telecoms carriers from 22 countries. The GVNS Forum was initiated by AT&T with the purpose of fostering the multinational interconnection of Global Virtual Networks. While it is not meant to supplant existing standards bodies, it may put forward proposals to be submitted to standards organizations.

2.2.3.4 **GSM, Intelligent Networks & Personal Communications**
Hans Diemel, Director, Market Development & Marketing Cellular Networks, Northern Telecom Europe Limited, *United Kingdom*

The speaker addresses the evolution of current and future GSM standards in the Asia-Pacific, Europe, and North America, focusing on the relationship between GSM and intelligent networks. GSM possesses several advantages, and is described as a total network specification.

2.2.3.5. **Application of GIS Technology to Wireless**
Chandan W. Seernani, Senior Technical Consultant, *USA*

In a competitive cellular environment, key differentiating factors include quality of service, customer care, responsiveness to problems, timely billing, attractive pricing, enhanced services, network reliability, and reduced fraud. Applications based upon Geographic Information System (GIS) technology may assist in many of these areas, and the speaker outlines how GIS operates and reports on results of GIS applications.

2.2.4 DISTANCE EDUCATION TECHNOLOGY AND EVALUATION

2.2.4.1 The Strategic Function of Educational Technology Evaluation

Jean-Claude Marot, Head of Department, IDATE, *France*

Several European countries, most notably France, have seen a rapid increase in the number of advanced telecoms applications in the fields of training and education. The speaker looks at the effectiveness of these programs for users, and reviews the European Commission's incorporation of a detailed evaluation process within new distance education programs.

2.2.4.2 Computers and Telecommunications for Distance Education

R. William Maule, Assistant Professor, Department of Organizational Studies, University of San Francisco, College of Professional Studies, *USA*

The presenter discusses an operating structure for new telecoms services utilizing computer networks to deliver distance learining programs. The system differs from traditional computer-delviered education in a variety of innovative ways, and the network serves as an inofrmation routing and processing mechanism through which students, instructors, or employers may accommodate specific industry and individual interests.

2.2.4.3 The Contribution of Distance Higher Education to National Development in Pacific Island Countries

Hayato Yamanaka, Associate Professor & Project Coordinator; TOSHIO KOBAYASHI, Professor, National Institute of Multimedia Education, *Japan*; and MICHAEL R. OGDEN, Instructor & Research Associate, Center for Pacific Islands Studies, University of Hawaii at Manoa, *USA*

The presenters review the success of the satellite-delivered distance education programs of the University of the South Pacific. Japan's National Institute of Multimedia Education (NIME) has collaborated with USP to evaluate the impact of these programs, and the presenters discuss their results against the background of national development aspirations in the Pacific Islands, the potential applications of satellite instruction, and what role advanced countries such as Japan may have in new distance education applications.

2.2.4.4 The Georgia Vocational Education Network: Training, Economic, and Technical Implications

Eric N. **Barnhart**, Director, Communications Laboratory, Georgia Tech Research Institute, *USA*

The Georgia Vocational Educational Network is a response to the imperative of integrating Georgia's rural population into the global information economy. The speaker discusses the creation and development of this program, desired services and benefits, and the expected results. This unique program works through the Georgia Centre for Advanced Telecommunications Technology, a university-government-industry partnership.

2.2.4.5 **First Steps in Multimedia Telecommunications: User Views of ISDN for Educational Delivery**

Linda Harasim, Associate Professor, Communication Department, Simon Fraser University, *Canada*

The speaker describes the experiences of an ISDN Distance Learning Trial held in Vancouver during 1991-92. As a pioneering application, the project poses important questions about the impact of new technologies upon teaching and learning. Also studied are the critical success factors of the project, lessons of design and implementation, and how well instructors and students adapted to these new technologies.

2.2.5 ISDN EXPERIENCES

2.2.5.1 **NTT's Four-Year ISDN Experience and Future of Japan's Market**

Koichi Nobukuni, Manager and **Fumihisa Bamba**, Assistant Manager, ISDN Promotion Department, NTT Corporation, *Japan*

The presenter discusses NTT's four-year experience in developing ISDN service and the issues presently facing NTT, as well as efforts to expand the market through the provision of new service offerings. NTT's contracted lines now exceed 150,000 across Japan. INS-Net is now expected to move from the introductory phase to the "take-off" phase as the service is commercially promoted.

2.2.5.2 **ISDN Compress Video - The Logical Next Step**

John F. Archdeacon, Branch Chief, IRMS, Pacific Zone, General Services Administration, *USA*

The speaker's organization is a leading user of videoconference services. The presentation describes extensive tests of dial-up and reservation videoconference systems using a 56 Kbps circuit, Basic Rate Interface (112 Kbps) or T-1 facility (112 Kbps - 1.5 Mbps). Also evaluated is the Px64 Video Coding Standard. The goal of these efforts is to achieve a high use of videoconference facilities at the lowest possible cost.

2.2.5.3 **An Evolution Strategy Toward Digitalized Inter-exchange Network Structure in Seoul Metropolitan Area**

Jeong-Wook Kim, Director, Department of Project Development and **Hee-Soo Ahn**, Executive Vice President, Korea Telecom International, *Republic of Korea*

The digitalization of a large metropolitan network has been best achieved through an underlying architecture based upon a double-hub with only tandem-routing, according to the speaker, who describes the development of digitized double-hub architecture in Seoul - one of Asia's largest cities

2.2.5.4 **Realization of EDI Message Transfer of an MHS System Using ISDN**

Haruhito Yamaguchi, Yukio Saito, Yoshikazu Tanaka, NTT Network Systems Development Center, *Japan*

Since ISDN service was first introduced in Japan in 1988, various applications and devices for ISDN data communications have been developed. The speaker discusses one specific technical application for EDI use, including how to utilize and opitmize the functions of an MHS system on transferring EDI messages.

2.2.6 THE CONVERGENCE OF WIRELESS TECHNOLOGIES: SOCIAL AND REGULATORY IMPLICATIONS

2.2.6.1 The Wristwatch as a Personal Communications Device

Hiroshi Komatsu, President, SEIKO Telecommunication Systems, Inc.; RYOICHI NOROSE, General Manager of SEIKO Corporation; and STEVEN SYMONDS, Vice President of Business Development for SEIKO Telecommunictions Systems, *USA*

PCS - personal communications service - is the current "hot" topic in wireless communications. The speaker looks at the Seiko Receptor "message watch", a mass-market wristwatch PCS unit offering personal messaging andf a host of information services. This device is seen as the harbinger of a new generation of PCS equipment.

2.2.6.4 The Expansion and Liberalization of Mobile Telecommunications in Korea

Yong Son, Professor & Dean; **Sang-Chul Lee**; and **Juneil C. Ryee**, Graduate School of Mass Communication, Chung Ang University, *Republic of Korea*

The presenter analyzes the situation of mobile telecoms services in South Korea. The Korean mobile communications sector has grown at an unparalleled rate in recent years, and the speaker reviews the establishment of competitive mobile systems in Korea and how the mobile communications environment is expected to perform through the rest of the decade.

2.2.6.5 Wireless Communications and Personal Freedom

Philip Spector, Partner, Paul, Weiss, Rifkind, Wharton & Garrison, *USA*

Does PCS imply personal freedom or an invasion of privacy. The speaker strongly advocates the former view, outlining PCS as a "liberating" technology for individuals. Constraints of time and place will become irrelevant to communications. Innovative companies are promising to integrate wireless voice and data communications over seamless networks.

2.2.7 REGIONAL SATELLITE SYSTEMS

2.2.7.1 PEACESAT: A Pacific Island Users Perspective on Searching for a Satellite

William Cooperman, PEACESAT Program Manager; **Dennis Connors**, Associate Administrator, Office of Telecommunications Applications; and **Charles Franz**, NTIA US Department of Commerce, *USA*

The speaker presents a progress report on satellite activities in the Pacific region, based upon his PTC'92 presentation on "Communications Satellites in the Pacific Islands". This overview presentation presents a comparative perspective, harnessing newly-released figures from the IFRB, US FCC, and contact with satellite operators.

2.2.7.2 Unicom: Moving into Asia

Steve Collin, President and Chief Operating Officer, Unicom Satellite Corp, *USA*

The speaker introduces the private satellite ventures of Unicom Satellite Corporation, and its plans to provide an alternative to regional and Intelsat satellite services. The evolution and development plans of Unicom's activities in the Asia-Pacific region are also discussed.

2.2.7.3 The Rise of Competing Satellite Systems and the Fall of the INTELSAT Monopoly

Shirley S. Fujimoto, Partner and **Marc Berejka**, Associate, Keller and Heckman, *USA*

The presenters review the rise of a competitive environment in the international satellite services market, review the history of Intelsat, and look at the future of the Intelsat system in the context of a highly-competitive satellite world. Particular attention is paid to substantive and far-reaching conculsion about the international satellite market.

2.2.8 WARC'92 RESULTS AND THE FUTURE OF ITU

2.2.8.1 Robert M. Frieden

The recently concluded World Administrative Radio Conference (WARC-92) provides a view of the "New Telecommunications World Order" as old alliances and paradigms dissolve. The means by which nations agree on spectrum allocations and service definitions increasingly will depend on whether and how advocates show benefits to developing and non-alinged nations. The speaker reports on general and specific outcomes of WARC-92, and possible future scenarios.

2.2.8.2 WARC'92 and Future Considerations

Richard E. Butler, AM, *Australia*

WARC'92 has set the framework for many innovative and new technology applications as well as expanded services and radio communications uses. New services include an array of mobile services, including application of low earth orbit (LEO) satellites with hand-held telephony. Digital audio broadcast will also soon be a reality, as will film quality HDTV. The speaker, the former secretary-general of the ITU, will address the impact of new L and S band allocations.

2.3.1 INNOVATIVE APPLICATIONS

2.3.1.1 Multimedia Presentation System using ISDN

Youichi Kihara, Senior Research Engineer; **Yoshihiro Shimazu**, Research Group Leader and **Yoshihiro Shimokawa**, Research Engineer, Network Information Systems Laboratories, NTT, *Japan*

The speaker describes an experimental on-line multimedia presentation system that provides multimedia information consisting of sound, full-colour still pictures, subtitles, and pointing information via N-ISDN. The design and features of the system are analyzed, and the applications of the multimedia presentation system to karaoke are illustrated.

2.3.1.2 "Project Lindbergh": Gateway to Public Information Networking

Scott Morgan, Executive Director, Southwestern Bell International Development, *USA*

"Project Lindbergh" is a unique information age development under way in the city of St. Louis. The speaker outline how the project developed as St Louis has evolved as a "Digital City" using fibre optics, SS7, ISDN, broadband ISDN, packet switching, SONET, and Metropolitan Area Network (MAN) technologies. The speaker explains the revolutionary features of this project, and how it adapts to changing customer needs and technology trends.

2.3.1.3 **Educational Models for Virtual Environments**
Bruce Long, Doctoral Candidate, Teachers College, Columbia University, *USA*

Excessive hype continues to obscure some of the more substantial benefits of new developments in telecommunications, multimedia, and the human-computer interface. The presenter reviews current research in virtual reality and its application on how we learn and how we structure knowledge. New technologies provide new opportunities for more equitable and comprehensible access to information and education, and is less elite-oriented than print-based education.

2.3.1.4 **Broadband Delivery through the Last Mile**
Reg A. Kaenel, WavePhore Inc., *USA*

The speaker illustrates the techniques of transparently piggy-backing high-speed data over television signals for the purpose of overcoming access problems in the local loop (the "last mile"). Delivery of data in a user-friendly form requires high-speed telecom infrastuctures - but this capacity is not required in the other direction. Hence, by using a newly-developed multiplexing system, high-speed data can be delivered transparently on top of TV signals, showing that broadband local distribution need not wait for technological brakthroughs.

2.3.2 SERVICE CONSEQUENCES

2.3.2.1 **The Marketing Challenges of Telecommunication Services in Thailand**
Prateep Thirati, Chief, Corporate Marketing Section, Telephone Organization of Thailand, *Thailand*

The speaker provides a comprehensive review of Thailand's telecommunications infrastructure, policy, and development. Thai economic growth averages 11.7% per year, and telecoms development is at the heart of this tremendous growth. The speaker outlines current government policies, the development of private sector players, the changes to TOT (Telephone Organization of Thailand) and CAT (Communications Authority of Thailand), and the scope for other investors in the Thailand's massive telecoms development program.

2.3.2.2 **Telecommunications and Urban Development in the Pacific Rim: A Teleport Proposal for Hongkong**
Grant D. Hume, Post-Graduate Student, Faculty of Architecture, University of HongKong, *Hong Kong*

Teleport development is, in many ways, an embodiment of how telecoms is central to "city building" in the Asia-Pacific region. The speaker outlines Hong Kong's use of telecoms as the economic base of building competitive advantge, and how the development of a teleport harnesses the advantages of telecoms development with the requirements of modern-day urban planning and urban social theory.

2.3.2.3 **Maximizing Revenue for Inmarsat Signatories**
James Kemp, Director of Research and Development and **Jack Bright**, Regional Sales Manager, Mobile Satellite Systems, Scientific-Atlanta, Inc., *USA*

Why do less than one-third of Inmarsat signatories have Coastal (Land) Earth Stations (CES/LES)? The speaker analyzes this problem and details new digital standards that offer new opportunities to Inmarsat signatories. New low-cost CES/LES and Mobile Earth Stations (MES) are reviewed, as are expected revenue streams.

2.3.2.4 **Convergence of Telecommunications and Crime: Liability for Toll Fraud in the United States**

Martin A. Mattes, Partner, San Francisco Office, Graham & James in association with Deacons/Sly and Weigall, *USA*

Toll fraud is an issue of vital importance to telecom carriers - but it is not often analyzed. The speaker reviews the enormous increase in the risk and incidence of toll fraud in the USA, and recent attempts to introduce legislation to shield customers from liability. But current efforts to control toll fraud are only a beginning in attempts to address this crisis. The speaker maintains that fair resolution of these issues may have an impact on the viability of competition in certain areas.

2.3.2.5 **Service Consequences: Evaluating the Role of Insurance**

William L. Mayo, Managing Director, Willis Corroon Inspace, Inc., *USA*

Satellites and launches require some of the most complex, risky, and expensive insurance policies ever issued. Global satellite insurance is largely provided by brokers, who provide the risk evaluation for underwriters. This giant, and hugely expensive, topic is discussed with an analysis of where satellite insurance premiums are headed, the unique aspects of the Intelsat VI-F3 recovery mission policy, and what underwriters look for in risk assessment.

2.3.3 TELCO/CATV ISSUES

2.3.3.1 **The Roles of Copper and Fiber in the Evolution to Broadband: A Network Planning Perspective**

Thomas M. Super, Vice President and **Edward A. Walvick**, Executive Director and NYNEX Science & Technology, Inc., *USA*

Much has been discussed about the future of broadband. The speaker looks at some of the considerations that must be taken into account in dealing with early service demand. Using fibre now makes economic sense for urban business districts. It remains possible to employ the existing copper network to introduce broadband services before it is economically viable to move to fibre. How copper can "bridge the gap" is explained.

2.3.3.2 **MAMI: The New Direction of Interactive TV**

N. **Kotani**, Research Engineer; **J. Kishigami**, Senior Research Engineer, Supervisor; **N. Sakurai**, Senior Research Engineer; and **A. Ishikawa**, Senior Research Engineer, NTT Network Information Systems Laboratories, *Japan*

The speaker proposes a new system for rendering cable television truly interactive: Multiple Access Moving picture Information server (MAMI)). The first prototype, MAMI-1, will permit access of any natural moving image from a single storage system. Extensions of this system are under investigation, such as the concept of "indirect communications" through software-manipulated moving images.

2.3.3.3 **Calling All Televisions? The Convergence of the Cable Television and Telephone Industries in the United States**

Richard Goldberg, Senior Associate, Graham & James, *USA*

Political, regulatory, technological, economic and historical forces have created growing incentives for cable and telephone industries to operate in each other's bailiwicks. The speaker reviews the evolution of convergence in the USA, and invesitgates why it is less clear whether direct competition between the cable and telephone industries will be allowed to take place. It is far from certain whether either industry wants to challenge on the other head-on.

2.3.3.4 **Fiber in the Local--Loop an Alliance Between Telco, CATV and Interactive Multimedia Services**

Thomas A. Reiman, Executive Vice President, Live Oak/Sutter Bay--South Sutter Cable, Inc., *USA*

The introduction of fibre into the local loop in not yet widespread in the USA. At PTC'92, the framework for an alliance between the cable TV industry, the RBOCs, and land developers was introduced. The speaker reports on progress made since then, and how strategic alliances will be the basis for network sophistication in the 21st century.

2.3.4 TELECOMS TO ENHANCE QUALITY OF LIFE

2.3.4.1 **Harnessing Telecommunication Technologies for Enhancing National Competitiveness and Quality of Life: The Singapore IT2000 Project**

Boon Siong Neo, Senior Lecturer and **Christina Soh**, Lecturer, School of Accountancy and Business, Nanyang Technological University, *Singapore*

The presenters describe the planning process for the Singapore IT2000 project. IT2000 is to identify strategic strategic business applications by industry sector, and develop a national integrated network to deliver these applications and other services. Also outlined is the process by which national consensus has been built to creat and achieve this massive plan.

2.3.4.2 **Propulsion for Activation of Community in the Region with PC Networking Services**

Junko Fukamizu, Systems Engineer, Fujitsu Limited, *Japan*

The speaker reviews the progress of a model networking project in Japan: the "Nishinomiya City New Media Community Centre (NMC)". The NMC is a UNIX-based package linking the local citizenry in a state-of-the-art value added networking package. The NMC story illustrates how municipalities can harness new telecoms technology to buil upon urban strengths.

2.3.4.3 **Developments and Application of Telecommunications for Emergency Services - An Australian Perspective**

Geoff Schomburgk, Principal Engineer-Telecommunications, The Ambidji Group Pty Ltd, *Australia*

Telecommunications and information technology are regarded as essential "tools of trade" by emergency service organizations. Such organizations run the gamut from police, fire and ambulance to air traffic control and rail transport. The speaker reports on the current status of telecom facilities in use by emergency service organizations in Australia and how they are positioning themselves to take advantager of convergence and deregulation.

2.3.4.4 **NTT's VI&P Vision**

Hisao Yamamoto, Senior Research Engineer, Supervisor, Network Architechture Laboratory, NTT Telecommunication Networks Laboratories, *Japan*

The speaker introduces the aims and objectives of NTT's proposed "VI&P" vision of the future communications environment. VI&P stands for Visual, Intelligent, and Personal. The goal is seamless service over broadband, intelligent ISDN networks. The speaker looks at recent and future development undertaken in Japan towards that goal.

2.3.5 BROADBAND TECHNOLOGY

2.3.5.1 An Implementation of Common Channel Signalling Capabilities on TDX-1 Switching System

Sunmoo Kang, Senior Technical Staff; **Woonyoung Han**, Head of Section; **Youndgsi Kim**; and **Hanggu Bahk**, Electronics & Telecommunications Research Institute, *Republic of Korea*

The speaker describes design concepts, system architecture, performance evaluation, and test results of the common channel signaling function in TDX-1 switching systems. On the basis of the TDX-1 scheme, a CCS Number 7 signaling ne work will provide the backbone for Korea's commerical ISDN service, to be launched in July 1993.

2.3.5.2 Technology Enablers for Residential Broadband Services in Today's Loop Environment

Robert W. Lawrence, Technical Director, NYNEX Science and Technology, *USA*

The presenter provides an insight into the variety of technologies that may be used in the short term within a telco's copper loop environment to support residential broadband services. Such services range from video-on-demand to flexible distance learning to other multimedia applications. This technology will be incorporated into new loop electronics called Asymmetrical Digital Subscriber Lines (ADSL), which will be outlined.

2.3.5.3 Frame Relay and Evolution to ATM

Mehmet Unsoy, Director, Data PLM Asia/Pacific, Northern Telecom, *Japan* and **Kenneth G. Hayward**, Bell-Northern Research, *Canada*

Frame Relay is currently deployed actively to support LANs and LAN interworking over Wide Area Networks (WANs). In parallel, there has been extensive standardization and development of Asynchronous Transfer Mode (ATM) technology and services. The speaker explores the evolution alternatives for the two technologies, as well as their interrelationships.

2.3.5.4 Enterprise Networking Using Frame Relay

K.S. Ram Mohan, Systems Engineer, Network Planning, Infonet, *USA*

The speaker presents a detailed look at frame relay technology and how it can be used as an internetworking option for implementing Enterprise Networks (EN), which itself encompasses a wide range of standards-based technologies and netowrking products. In essence, an EN is a single Wide Area Network (WAN) providing an infrastructure for systems interoperability in a multiplatform, multivendor enterprise computing environment.

2.3.5.5 ATM Service Node: A Step Toward Broadband Telecommunication Networks

K. Akiba; **S. Iwasaki**; **H. Fuchigami**; NEC Corporation, *Japan*, **K. Kou**; and **A. Arutaki**, NEC America, Inc., *USA*

The speaker presents a technical introduction of an ATM Service Node, a high-speed switching system based on ATM technology and utilizing broadband. Also reviewed are ATM networking topology, system implementation methodologies, and mechanisms to accommodate Frame Relay and SMDS services into the ATM backbone network.

2.3.6 MOBILE SERVICES

2.3.6.1 Japanese Digital Cellular Telecommunication System

Minoru Tanaka, Vice President, and **Yuji Kitahara**, Assistant General Manager, NEC Corporation, *Japan*

The speaker introduces the Japanese Digital Cellular System issued by the Research and Development Centre for Radio Systems in Japan (RCR). In Japan, the 1.5 GHz frequency band (24 MHz bandwidth) has been developed for digital cellular telecommunication systems to accommodate the high subscriber demand of the mobile communications domestically.

2.3.6.2 The Evolution of Wireless: Meeting the Mobile User's Needs

Eric F. Ensor, Assistant Vice President - Worldwide Wireless Strategy, BellSouth Enterprises, Inc., *USA*

The presenter will address the ongoing evolution of wireless communications into personal communications services and the effect of user needs on that evolution. Various technological developments will be covered, but the focus will centre on what is being done to assess user needs for future wireless communications. Data from several ongoing US PCS trial will be reviewed, as will some innovative future uses of mobile communications in Latin America.

2.3.6.3 Digital Cellular Opportunities in the Pacific Region

Gary Cannalte, Senior Technical Consultant, Motorola, Inc., *USA*

The Asia Pacific region knows there is no "law" stating that terrestrial wired networks are obligatory for telecoms development. Development may be better served by the use of Wireless Local Loops (WILL) in place of coppe: ·) connect land network phones to the PSTN. This is one example of new technologies and new applications put forward by the speaker's broad overview of exciting new trends in the Asia-Pacific region.

2.3.6.4 CELSAT's Hybrid Personal Communications System

David D. Otten, President and CEO and **Albert J. Mallinckrodt**, CELSAT, *USA*

The speaker describes the first hybrid (satellite and ground based) cellular telephone system to be proposed to the US Federal Communications Commission (FCC). The system described proposes to cover vast areas at low cost, using a small handset and employing satellite delivery in remote areas and ground cells in urban areas.

2.3.7 SATELLITE SERVICES

2.3.7.1 Transponder Capacity in Asia - An Update

Andrew Jordan, Marketing Manager, Asia Satellite Telecommunications Company, Ltd., *Hong Kong*

Why have satellite become so popular in Asia? The speaker "steps back from the glamour and hype" to ask hard questions about the future of satellites in the region and to analyze the benefits derived from satellites. Satellites have proven themselves to be the best way to quickly, efficiently and affordably develop or enhance a telecommunications and broadcasting infrastructure.

2.3.7.2 International Digital TV Service Via INTELSAT

Edward A. Faine, Director, Systems Planning, COMSAT World Systems, *USA*

The speaker describes the various international field trials and commercial applications of digital television transmissions conducted over the Intelsat system. Summary results of laboratory tests are presented, illustrating the transitional stages in switching satellite TV transmission over from analogue to digital formats.

2.3.7.3 Emerging Technologies and Future Satellites

Linda M. Rankin, Vice-President, Business Development and **Abdul H. Lakhani**, Network Planning Specialist, Fundamental Planning, Telesat Canada, *Canada*

The presenter looks beyond the year 2000 to the next generation of satellites. It is clear that satellite service providers are becoming increasingly aware of market needs as well as the initiatives put forward by terrestrial network operators. A variety of new technologies and new applications for satellite technology are reviewed, showing what is needed to ensure satellites have a role in the communications networks of the future.

2.3.7.4 Papua New Guinea: A New Satellite Telecommunications Network

Edward Walter Triebell, Regional Sales Director, Network Systems Group, Scientific-Atlanta, Inc., *USA* and **Steven Gagau**, Executive Manager, International Telecommunication Department, Post and Telecommunications Corporation, *Papua New Guinea*

The speaker describes the implemenation of a new satellite-based telecommunications infrastructure in Papua New Guinea (PNG), where the limitations of existing telecoms networks, geographical diversity problems, and limited telecommunications budgets were all overcome. Among topics addressed are the functional requirements of each system, design elements, applications, and benefits of this new system.

2.3.7.5 KOREASAT Technology Development and Services

Han Hwangbo, Executive Vice President, Satellite Business Group, Korea Telecom, *Republic of Korea*

KOREASAT is Korea's "first generation" satellite for communications service. It will play a central role in Korea's 21st Century telecommunications development, asserts the speaker in this presentation detailing the evolution and characteristics of this major new domestic satellite system.

2.3.8 PRC DEVELOPMENTS

2.3.8.2 Building Telecom Networks to the People's Republic of China - Infrastructure and Services the Hong Kong Gateway

Flora tung, Director of International Operations, Hongkong Telecom, *Hong Kong*

An economic revolution in China has captured the attention of the world's businesses. China, with outside participation, has become the world's fastest growing economy in the world's fastest growing economic region - the Asia-Pacific rim. To support this economic powerhouse, China is modernizing its infrastructure in an ambitious program the includes the provision of high quality telecommunications. The speaker reviews steps taken by Hongkong Telecom and other Hong Kong actors in integrating China into the modern network.

3.2.1 APPLICATIONS OF NEW TELECOM TECHNOLOGIES

3.2.1.1 The Evolution of Markets for Multi-Media in Canada

Richard J. Simpson, Director/Assistant Vice-President, Commonwealth of Learning, *Canada*

What is commonly called "multimedia", the convergence of voice, text, and visual communication through advanced computer (digital) technology, provide the foundation for both the "Networks" and "Content" dimensions of the New Media. Based on a recent program of research, the speaker examines the evolution of markets for multimedia techonolgies, pointing out the main areas of potential growth and the key institutional and public policy issues involved.

3.2.1.2 New Communication Technologies Applied to Services of Social Benefit

Arturo Serrano, Telecommunications Consultant and **Enrique Melrose**, Director of Research, Mexican Institute of Communications, *Mexico*

The speaker describes a major project sponsored by the Organization of American States (OAS) investigating the implementation and operation of new communication technologies in rural and other underpriviledged areas. The project applies innovative solutions to permit the widespread use of these new technologies. The obstacles are enormous, but the project seeks to involve the population - the "users" - from the outset, and not impose techonology from above.

3.2.1.3 The Imaging Advantage for Developing Countries

Dean Johnston, Senior Vice President, Image Management Division and **Jim Hamblin**, Managing Director, CBIS International, *USA*

Over 95% of information continues to be exchanged through paper. Paper-intensive communication environments are particularly prevalent in developing countries. The speaker outline the use of imaging as a solution for this problem, focusing on the benefits of image- and workflow-enabling business applications.

3.2.1.4 Digital Television Compression

Robert M. Zitter, Senior Vice President, Technology Operations, HBO, *USA*

Digital video compression is expected to revolutionize the international television delivery environment. Both satellites and cable are expected to harness these new technologies, and the speaker reviews his firm's objective evaluations of different systems. Deployment of these systems in expected in early 1993, and the speaker reviews how the systems being used were selected, and why.

3.2.1.5 Wireless Evolution in the Asia-Pacific: Not Just a Technology Issue

Joanne Molyneaux, Principal, Sequoia Telecom Associates, *USA*

The presenter will provide a regional overview of the existing wireless infrastructure in the major Asia-Pacific countries and plans for new services, as well as looking at the underlying key indicators of market potential for new wireless services. Forecasts for each Asia-Pacific country will be put forward, showing which are the most likely wireless services and technologies to meet users' needs.

3.2.2 CHALLENGES TO REGULATION, TRADE AND ACCOUNTING RATES

3.2.2.1 The Inequality of Equal Accounting Rates

Peter Jackson, Regional Director Asia Pacific, Cable & Wireless PLC, *Hong Kong* and **John Sullivan**, Regional Manager Asia Pacific, Cable & Wireless PLC, *United Kingdom*

International accounting rates remain a contentious issue. The presenter seeks to examine the current international rate mechanism, its effect on developing countries, and to propose a variety of innvoative alternatives.

3.2.2.2 The Dynamics and Impact of U.S. Telecom Policy on Accounting Rates and International Simple Resale

Robert J. Aamoth, Partner, Reed Smith Shaw & McClay, *USA*

The speaker examines the impact of the trend toward lower international accounting rates upon telecommunications financing and the development of international resale and IVAN opportunities in the USA and other countries. Relevant developments within the CCITT, OECD, and in US bilateral relationships with Canada and the UK will be reviewed.

3.2.2.3 Technological Change and Incentive Regulation in Telecommunications

S.L. Jang, J.R. Norsworthy, J. Macdonald, School of Managment, Department of Economics, Rensselaer Polytechnic Inst., *USA*

The presenters analyze the linkage between the spread of new technologies and the choice of regulatory instruments, with a particular focus on price-cap agreements as a type of incentive regulation. Alternative incentive regulation plans are reviewed as responses to the opportunities and uncertainties created by technological change.

3.2.2.4 International Trade and Telecommunications Services: Implications for Domestic Policy and Regulation

Debra Slaco, Senior Policy Advisor - Telecommunications, Government of British Columbia, *Canada*

The speaker addresses the recent developments of the inclusion of telecommunication services as an element of international trade agreements. The Canada-US Free Trade Agreement was the first international agreement to broach the area of services as a "commodity" for trade. The proposals put forth for the negotiation of the GATS and NAFTA will be analyzed.

3.2.2.5 Monitoring Shifts in Market Share Among Information Industry Sectors

Una Mmansfield, Senior Lecturer, Info. Technology & Communication Unit, Faculty of Informatics, University of Woolongong, *Australia* and **Gatot Mardianto**, Staff Engineer, Pt. Industri Telekommunikasi Indonesia, *Indonesia*

The presenters review the outcome of a special Australian research project desinged to: (a) provide a new approach to modelling the major information industry sectors, from telecommunications to publishing; (b) indicate the dynamic relationships among the sectors; (c) validate the model by looking at developments in six Australian cities; and (d) using the model to develop a method for estimating the market share of each information technology sector.

3.2.3 RESTRUCTURING TELECOM ORGANIZATIONS

3.2.3.1 Australia's New Telecommunications Regime - A Review of the First Eighteen Months

Raymond Kiley, Senior Associate, Baker & McKenzie, *Australia*

The speaker reviews Australia's nascent telecommunications liberalization, one year and six months later. In part, discussion will focus on AUSTEL's performance as the regulator, how Optus has emerged as the competitor to AOTC, and how AOTC has reacted. Also reviewed are the levels of competition for "eligible services" following the issue of relevant class licences, and the impact of the introduction of pay television.

3.2.3.2 Knowing What to Ask For: Privatization of Telecommunications After the Digital Revolution Guidelines for the Host Country

Robert A. Reisner, Principal, Putnam, Hayes & Bartlett, *USA*

The speaker discusses guidelines for host governments to consider in the next wave of privatization of telecommunication enterprises. To keep pace with the implications of convergenece, host countries will have to adopt a more creative model for privatization - a competitive privatization model. In the new wave, host governments must become the partners of the new competitors while retaining a perspective on the opportunities that exist in change.

3.2.3.3 Global Telecommunications Standardization in Transition

David Lassner, Director of Information Technology, University of Hawaii and **Meheroo Jussawalla**, Research Associate, East-West Center, *USA*

The vitally important area of telecommunication standards is considered by the speaker in the context of four Southeast Asian nations: Indonesia, Malaysia, Singapore, and Thailand. What is the impact on these growing telecoms powers of standardization activity, so much of which remains centred in Europe, North America, and Japan? The movement to regional standards organizations may institutionalize the limited involvement of non-manufacturing nations, no matter how important they may be in the overall telecoms environment.

3.2.3.4 The Dramatically Different Canadian Telecommunications Industry

Jocelyne Cote-o'Hara, President and Chief Executive Officer, Stentor Telecom Policy, Inc., *Canada*

Canada's telecommunications environment has changed enormously in the brief 12 months since PTC'92. The speaker will describe the full implications of events such as the formation of Stentor from Telecom Canada, the introduction of new federal telecoms legislation, the CRTC decision permitting long-dostance competition, and other new developments. New pulbic policy and technological developments will be outlined and discussed.

3.2.4 HEALTHCARE ENHANCED THROUGH TELECOM

3.2.4.1 Medical Applications Through Numeris, The French ISDN

Claudino Biquillon, Manager for Asian Countires at the International Directorate, France Telecom, *France*

Some of the most innovative and significant telecoms applications are found in the health and medical service sectors. The speaker looks at France's model telematics system for centralized medical diagnosis facilities from anywhere in France.

3.2.4.2 Convergent Needs, Divergent Technology: Nursing Education for Rural Practitioners

J.L. Tucker, Dean of Professional Studies and GAIL RAY, Director and Chair of Nursing, Gonzaga University, *USA*

The speaker describes Gonzaga University's unique and innovative videotape-based distant education program, and how this award-winning system might evolve into a full interactive compressed-video, on-line environment. Such an environment is under consideration by the University for distance education delivery to rural areas.

3.2.4.3 Multimedia Broadband Communications Health-Care Applications

Kenneth R. Raymond, Director-Technology Strategies Analysis, NYNEX Telesector Resources Group, *USA*

The presenter describes multimedia broadband communications and its potential impact on the health care industry in the USA. He will address the technical and operation aspects of the system, the health care crisis, the overall market, and the results of a NYNEX trial implementation in Boston.

3.2.5 ENTERPRISE NETWORKS

3.2.5.1 Enterprise Networking & National ISDN Synergy

Joseph J. Hobbs, Manager-Training & Education, Bellcore Technical Education Center, *USA*

Enterprise networking (EN) is the term used to define the global information transfer of voice and data signals of "typical" mid-size and large businesses. The presenter establishes the premise that strong synergy exists between EN and National ISDN (NI). The entire telecommunications requirements of this vast enterprise will be an accumulation of "real world" implementations of PBXs, key systems, LANs, FEPs, applications software, dumb terminals, protocols, dial-up lines, PCs, and other telecom services.

3.2.5.2 Network Management Technology - A Paradigm for Future Enterprise Control

Mark Wall, Vice President, Consultive Engineering and **Jeffrey Whitehill**, Director of Sales Support, NYNEX ALLINK, *USA*

This presentation will first review the major elements which have been developed to facilitate enterprise networking (EN) management. These concepts are then expanded to a number of related fields to show the impact of this technology on the conduct of a wide range of business and other applications. Some of the more striking applications include the intelligent oversight of industry, power generation, transportation services, and service deliveries.

3.2.5.3 FDDI II Multi-Media LAN

John F. Mazzaferro, Vice President, Sales and Marketing and **Alexa A. Dell'acqua**, President, JAM Enterprises, *USA*

The presenters review the Fibre Distributed Data Interface II (FDDI II) multimedia LAN system. FDDI II is often misrepresented as a faster, larger FDDI, while in fact the systems are quite different and FDDI II si best viewed as an enhanced FDDI. The technical and performance charateristics of FDDI II are described.

3.2.5.4 The Study of Telecommunication Network Configuration in the Greater Taipei Area

Shan-Hsin Tsao, Chief Research Engineer; **Shyang-Ming Lin**, Research Engineer; **Yeh-Chyn Her**, Associate Research Engineer; **Hong-Ling Wang**, Associate Research Engineer; **Min-Gume Cheng**, Research Engineer; **Ching-Chir Shyur**, Research Engineer; and **Ying-Ming Wu**, Associate Research Engineer, Telecommunication Labs, DGT Taiwan, *ROC*

This team undertook an evaluation plan of the Greater Taipei telecommunications network, comprising one of Asia's larger and more dynamic metropolises. Over US$ 10 billion will be invested in new technology and new network installations. The presenter reviews the results of this monumental study, and the development plans to be undertaken as a consequence of its recommendations.

3.2.5.5 Enterprise Networking in Asia

Ken Zita, Managing Partner, Network Dynamics Associates, Inc., *USA*

Corporate network globalization has been underway for years, but including southeast Asia on the network map is new. Thailand, Indonesia, and Malaysia have been "black holes" for private enterprise networks. The speaker addresses how countries within the region are cathcing up at great speed, and the dynamics of the new southeast Asian enterprise network environment.

3.2.6 DIGITAL AUDIO RADIO

3.2.6.1 WARC'92 and the Implications for Digital Audio Broadcasting

Ralph Zeitoun, Broadcasting Regulation Branch, Communications Canada, *Canada*

The digital technology on which computers are based has been applied to audio broadcasting, making it possible for the first time to receive CD-like quality in the difficult portable and mobile environment. WARC-92 allocated frequency bands for providing digital audio broadcasting services from terrestrial and satellite transmitters. The implications of the decision reached at WARC-92 for DAB and its implementation are highlighted by the speaker.

3.2.6.2 DAB Systems for the Western Hemisphere: Satellite System Designs

Edward Reinhart, Telecommunications Consultant, *USA*

The speaker describes the designs of several satellite digital sound broadcasting (DAB) systems intended either for domestic service within the USA or for US-based regional and/or global service. These systems are categorized according to their service requirements. The nature of the relationship between the service requirements and the regulatory, environmental, and technological aspects of systems design is described.

3.2.6.4 Satellite CD Radio System Trades

Klaus G. Johannsen, Senior Scientist, Hughes Aircraft Company and **Robert D. Briskman**, President, Satellite CD Radio, *USA*

The search for an economical technical solution for nationwide satellite DAB of 30 digital compact disc (CD) quality music channels to mobile users has led to a dual satellite, single carrier time division multiplex (TDM) transmission system. The technical specification of this system are reviewed by the speaker.

3.2.6.5 United States Satellite Digital Audio Radio Service

Robert D. Briskman, President, Satellite CD Radio, *USA*

The presenter reviews a digital audio radio (DAB radio) service to be provided by satellites to automobiles and other mobile terminals within the USA. The proposed service will be by user subscription, with subscribers able to select from 30 channels of CD quality. The system confinguration, technical innovations and major engineering parameters are presented.

3.2.7 LITESATS

3.2.7.1 Small Satellites for Mobile and Environmental Data Communications: Effectively Solving Economic, Social and Technological Issues

Fulvio Ananasso, Director, Advance Studies and Experimentations Division, Telespazio, *Italy*

The presenter reviews "small" satellites such as "little" LEOs as an alternative to traditional, large satellites, often exploiting orbital characteristics different from GEO-sats, e.g. circular or elliptical orbits. Mobile communications and remote sensing are some of the likeliest applications, according to the speaker, who envisages a rapid expansion of systems such as TEMISAT, which is described in detail.

3.2.7.2 Economics of the New Smaller and Shorter Lifetime Geostationary Communications Satellites

James R. Stuart, Consultant; Randall E. Coffey, Senior Systems Analyst, Ball Space Systems Division, USA; and Janet Gleave Stuart, Ph.D. Candidate, University of Colorado at Boulder, *USA*

The speaker compares the characteristics, prices and economics of currently available large, medium, and small geostationary (GSO) communications satellites, focusing on specific GSO "light-sats" currently in production. The selection of a proper size and lifetime of a GSO communications satellite for a particular project is addressed.

3.2.7.3 Export Control: Current Legal and Policy Issues Affecting Satellite and Telecommunications Ventures

Thomas Crocker, Counsel and Jill Abeshouse Stern, Counsel, Shaw Pittman Potts & Trowbridge, *USA*

Export controls are an important issue for US-based companies pursuing satellite and telecommunications business opportunities in the Pacific Rim, and for their foreign investors, partners, and customers. The presenter reviews how fundamental changes in export contrls are occurring which reflect shifts in the global geopolitical situation, increased concern about missile proliferation, and the emerging global marketplace for satellite and telecoms technology and services.

3.2.8 COUNTRY STRATEGIES

3.2.8.1 Convergence, Universal Service and Public Policy

Rein P. Mere, Senior Manager, Strategic Planning and Development, KPMG Peat Marwick, *Australia*

The speaker examines what is meant by convergence and how that relates to the telecommunications and information technology industries. The key areas of convergence are indentified and service applications reviewed in the context of users and providers. Users have embraced the changes produced by the "cauldron of convergence", but a wide variety of technical, commercial, and public policy concerns remain.

3.2.8.2 Canada Embraces Long Distance Competition

Laurence J.E. Dunbar, Partner, Johnston, Buchan & Dalfen Barristers & Solicitors, *Canada*

After lenghty debate and amid continuing controversy, Canada's regulator ruled in favour of permitting long-distance competition. The speaker reviewes this landmark CRTC decision, which would permit, among other things, one of the world's most liberalized resale regimes. The impact of proposed legislative amnedments will be addressed, as will the ongoing political and commercial battle over the coompetition issue.

3.2.8.3 Network Interconnect in New Zealand

Ainsley Van Cuylenburg, Senior Consultant, CLEAR Communications Limited, *New Zealand*

New Zealand is the most open and competitive of the developed world's telecommunications markets. In such a liberalized environment, how are interconnection and standard of service guaranteed? The speaker anwers those questions with a detailed illustration of how network interconnect takes place in New Zealand and how new entrants may evolve and emerge.

3.2.8.4 Determining Optimal Supply Level of Switching Systems and Local Cables: An Inventory Model

Kyu-Tack Nam, Member of Technical Staff and **Bo-Sang Lee**, Member of Technical Staff, Korea Telecom Research Center, *Republic of Korea*

Korea Telecom adopted a "more is better" policy in the 1980s in order to meet Korea's massive and fast-growing telecoms demand. This was successfully accomplished by the end of the decade, and challenge for the 1990s is to move from universal service to state-of-the-art systems. The speaker focuses on attempts to find an optimal supply interval and an optimal quantity of switching systems and local cables.

3.3.1 USER PERSPECTIVES

3.3.1.1 Network Management for Users in Japan

Toru Tsuchiya, Researcher, Institute for Future Technology, *Japan*

The speaker describes the current objectives of network management in Japan, looking at the changes of users' requrements and implications for network management. As information technology becomes more important, a given organization's distinct computer and telecom network branches will require restructuring, whether this occurrs through the creation of a network management section of through out-sourcing.

3.3.1.2 Privacy and Intellectual Property Rights

Sheila Mcgregor, Partner, Freehill Hollingdale & Page, *Australia*

An often overlooked issue in the furor over convergence is the area of privacy issues and intellectual propoerty rights. The speaker discusses why laws of confidentiality and intellectual property do not adequately deal with the privacy of personal data which are amassed. A new approach is called for, and the speaker examines the European Commission's personal data directives as one possible solution. The privacy imlications of new services such as Caller ID, which is dealt with in contrasting ways - eg, between the US and Australia.

3.3.1.3 Government as a Telecommunications User: Maximising the Opportunities

Terry Charman, Senior Advisor, Policy, Department of Finance, *Australia*

The presenter explores some of the issues confronting national governments as major telecom users. Some of the issues include the internal conflict between government as telecom user and government as telecom policy-maker; the implications of convergence and new multimedia technologies; the government user as driver of industry; potential benefits to society; and, in Australia's case, the federa-state-local level dimensions.

3.3.1.4 The Politics of Telecommunications Reform in Developing Countries

Ben Alfa Petrazzini, Department of Communications, University of California, San Diego, *USA*

The presenter, winner of the 1992 PTC Research Prize, examines in comparative perspective the politics of privatization and liberalization of the telecoms sector in Asia (Malaysia and Thailand) and Latin America (Argentina and Mexico). The central aim of the study is to explore why countries with similar socioeconomic profiles, trying to implement shared telecom reform goals under similar historical circumstances, achieved divergent outcomes in their restructuring efforts. The speaker posits that the openness of national political systems suggests an answer.

3.3.2 BUSINESS STRATEGIES

3.3.2.1 Network Outsourcing: A New Paradigm for Global Business

Gerald W. Thames, President and Chief Executive Officer, Syncordia Corporation, *USA*

Global network outsourcing has gained widespread interest and attention among multinational customers, and among major players in the telecommunications industry. The speaker reviews how this option provides an alternative to the multinational corporation, which has heretofore been compelled to dedicated increasing percentages of resources to international network management. The outsourcing concept has been embraced enthusiastically by businesses seeking to conserve resources, but the concept remains nevertheless poorly understood. The meaning, goals, and future of outsourcing are outlined.

3.3.2.2 The Small-to-Medium Business Sector and the Increasing Convergence of Telecommunications and Information Technology: The Hong Kong Scenario

Lee G. Lam, Manager, Business Sales Branch, Hong Kong Telecommunications Limited, *Hong Kong*

The speakers looks at the telecom market characteristics of Hong Kong's small-to-medium business sector, the recent massive telecoms growth of that sector, the relationship with the People's Republic, marketing considerations, and the role of the public network provider. This overview of the Hong Kong situation is based upon a comprehensive case study.

3.3.2.3 International Telecommunications Is Shifting Paradigms: How Will It Affect Your Business?

Gregory C. Staple, Communications Lawyer, Koteen & Naftalin, *USA*

A new telecom service paradigm is emerging globally. Traditional "Heavy" carriers are country-specific, historically enjoyed monopoly status, is essentially sovereign on its own territory, and participated bilaterally is setting tariffs, etc. It has been challenged and undermined by new "Light" operators that may provide international service through resale, rerouting, and reprogramming the offerings of the Heavy carriers. "Light" carriers are especially characterized by their harnessing of new technologies, and the speaker details their future and how they will influence the future global telecommunications regime.

3.3.2.4 Study on the Measurement of Economic Benefits of Telecommunication Project in the Developing Countries - Proposing New Method

Mikio Danno, Senior Researcher, InfoCom Research, Inc., *Japan*

The speaker puts forward a thorough and comprehensive study of the effects of telecommunications development on developing countries. The influences of telecoms are omnipresent and become more profound as telecoms services spread. While the benefits of telecoms are accepted as a truism within the industry, this study is particularly valuable in the strong empirical research verifying these benefits.

3.3.2.5 The Software Export Industry of Developing Countries

George Lissandrello, President, Information Products International, *USA*

The United Nations International Trade Centre has sucessfully undertaken several missions focusing on developing country telecom and information technology <u>exports</u> to developed countries. The speaker looks at a number of these increasingly numerous success stories, such as Philippine software exports to North America and Sri Lankan exports to Australia and Japan.

3.3.3.3 Political Challenges to the Globalisation of Public Telecommunications Operators

Yoshiko Kurisaki, Administrator, Organisation for Economic Co-operation and Development, *France*

Globalization of the economy and the liberalization of telecommunications have motivated major public telecommunications operators (PTOs) to extend their business activities in the international sphere. All the PTOs in major economies are becoming competitive with one another. The speaker looks at the rising policy issues that are not covered by the framework of existing telecommunications policies.

3.3.4 TELEWORK/TELELEARN

3.3.4.1 Tips, Tricks and Techniques for Trouble-free Telework

Gil E. Gordon, President, Gil Gordon Associates, *USA*

For all the discussion about telework at past PTC meetings, precious little time has in fact been devoted to the practical implementation of telework within organizations. The speaker addresses this issue with a series of checklists and guidelines, and puts forward the managerial challenge of advancing this effective and efficient application of telecoms technology.

3.3.4.2 The Tri-Centre Project: Action Research and the Development of a National Tele-educational Network in New Zealand

John Tiffin, David Beattie Professor of Communications; **Lalita Rajasingham**, Chairperson, Dept. of Communications; and **Anthony J. Pennings**, Senior Leturer, Communications Studies, Victoria University of Wellington, *New Zealand*

The presenters review the ongoing results of the Tri-Centre Project at the Communications Studies Depratment of the University of Wellington, a research project leading to a national telelearning infrastructure thoroughout New Zealand. This project offers a tele-learning "virtual classroom" environment, engaging lecturers and students.

3.3.4.3 Utilization of Interactive Video Conference Systems for Teaching English in Australia and Japan

Yoko Fujii, Associate Professor and **Masako K. Hiraga**, Associate Professor, English and Linguistics Faculty of Liberal Arts, The University of the Air, *Japan*

The speaker reports the results of a project on the use of an interactive videoconference system to teaching English as a foreign language, jointly undertaken by Japan's University of the Air (UA) and the University of New England, Australia. The project has indicated that face-to-face instruction by a low-bit rate video conference system is a viable alternative to direct classroom teaching.

3.3.4.4 Global Teaming: Meeting the Challenge of Global Business with Help from Telecommunications and Information Technology -- and a Lot of Management Savvy!

Pamela J. Johnson, Senior Consultant, Organization Consulting Group, Digital Equipment Corporation, *USA*

Telecommunications and information technology can be used to manage widely-dispersed organizations. The speaker outlines her group's experiences with "teams" assigned to a given project and linked by telecommunications. While such teams are a key means of facilitating global business, the challenges of geography, culture, functional specialization, etc., are not to be underestimated.

3.3.5 NETWORK MANAGEMENT

3.3.5.1 Bandwidth On Demand Metered Service

Paul A. Stern, COMSAT World Systems, *USA*

Heightened competition and growing global interdependencies are causing telecommunications managers to seek operating methods that enhance efficiency and profits. COMSAT is developing a Bandwidth-on-Demand service to help firms achieve these goals.

3.3.5.2 Effects of the NPG in Constructing a Private Network

Takashi Fujimori, System Engineer, Corporate Network Engineering Department, Busines Network Systems Division, Fujitsu Limited, *Japan*

Private networks are increasingly used to meet company telecom requirements. Using the example of a large Japanese insurance company, the speaker details the construction and implementation of a private network using Network Planning Guidelines (NPG).

3.3.5.3 Broadband Node Control Architecture for Multimedia Services

Hisashi Manabe, Planning Manager and **Tatsuhiko Yamazaki**, NEC Corporation, *Japan*

The speaker looks at call processing capabilities for a wide range of varying loads on an ATM-based broadband network. The focus is not on bandwidth but on the number of calls carried over the broadband network. The speaker provides technical analysis and background.

3.3.6 CULTURE AND COMMUNICATION

3.3.6.1 Art and Technology: Bridges to a Multicultural Society

Joyce M. Gattas, Dean, College of Professional Studies and Fine Arts and **John M. Eger**, Director, International Center for Communications, San Diego State University, *USA*

The speaker describes the current use of multimedia technology in the field of arts education; explores the potential for using art and technology to increase multicultural understanding; and suggests new uses of telecommunications to provide distance learning as well as a new context for art appreciation in the Pacific.

3.3.6.2 Social Impact of Cellular Telephone Usage in Hawaii

Dineh M. Davis, Assistant Professor, Department of Communication, University of Hawaii at Manoa, *USA*

A unique situation in a unique place, concludes the speaker in her survey of the social impact of cellular telephone use in Honolulu. Many parts of the world have introduced legislation to limit the use of cellular telephones in motor vehicles. Honolulu's traffic environment, characterized by congestion, high volumes and slow speeds, suggests that the situation might differ from the accepted norm. Nevertheless, over a quarter of cellular phone users surveyed in this study think that cellular phone use while driving is unsafe.

3.3.6.3 **Imparja Television Pty Ltd - Australia's Aboriginal Owned Commercial Television Company**

Lorraine Liddle, Solicitor, Aboriginal Legal Aid Service and **Jim Wilkinson**, Representative of the Aboriginal and Torres Strait Islander Commission, *Australia*

The speaker describes the hisotry, ownership and structure of the Imparja Television company, an Aboriginal-owned private satellite TV service to Australia's "central zone". Imparja's first four years are assessed, as are its future planse to add enhanced communications services to the television service. From a technical as well as a cultural perspective, Imparja is a unique and innovative broadcaster.

3.3.6.4 **Telecommunications Applications for Education and Rural Development: A Comparison of the Australian Outback and the Canadian North**

Heather E. Hudson, Director, Telecommunications Management and Policy Program, University of San Francisco, *USA*

The presenter examines the use of telecommunications technology for education and development in the Australian Outback and in Arctic and Subarctic Canada. Comparisons of the two regions are based upon the shared sparse population, difficult terrain, and significant aboriginal populations. The study is based on research carried out at Australia's CIRCIT during 1992.

3.3.7 MOBILE SATELLITE SERVICES

3.3.7.1 **The Role of Globalstar, A Satellite-Based Personal Communications System in the Wireless Revolution**

Robert Wiedeman, Vice President Engineering; Loral Qualcomm Satellite Systems, *USA*

The speaker describes the space segment implementation and other aspects of the Globalstar system. Globalstar is not a bypass network but rather a system meant to fulfill currently unmet telecoms needs, complementing the existing network. Globalstar utilizes two low-earth-orbit (LEO) stallites to provide global mobile voice and data services to and from hand-held and mobile user terminals.

3.3.7.2 **Societal Benefits of Global Personal Communications**

Durrell W. Hillis, Corporate Vice President and General Manager, Motorola Inc., Satellite Communications, *USA*

Europe, North America, Japan, and parts of Southeast Asia have been at the forefront of the "wireless revolution" in personal communications. Yet over two-thirds of the planet does not have adequate telecoms of any kind. The speaker shows how the proposed IRIDIUM global personal communications network will address the problem of global connectivity, even in the most remote parts of the world. IRIDIUM will permit many countries to "leapfrog" several stages of telecoms development and harness the benefits of telecoms much earlier than originally envisaged.

3.3.7.3 **TAOS, a New Low-Cost Mobile-User LEO Satellite Network for Positioning and Messaging**

Jean-Jacques Bloch, Business Development Manager, Aerospatiale, *France*

The presenter describes a new worldwide mobile telecommunications satellite system, S80, dedicated to the provision of mobile user position determination and message distribution. The network will be fully operational by the late 1990s and will include five low earth orbit (LEO) satellites. A major featur of the system is its relatively low implementation cost, which will translate into low user fees.

3.3.7.4 Orbcom

Martin Deckett, Vice President International Development, Orbital Communications Corporation, *USA*

The speaker describes the ORBCOMM system, a low cost, satellite-based mobile communications system which provides data messaging, emergency alerting, and position determination and reporting. ORBCOMM services are reviewed, and how this system plans to expand internationally beyond its US base.

4.1.1 SOCIO/CULTURAL/ECONOMIC CONCERNS

4.1.1.1 Telephone Development Project for Valle Del Cauca State, Colombia, S.A.

Fernando Garces Lloreda, General Manager, Empresa Regional de Telecomunicaciones del Valle del Cauca S.A., E.R.T., S.A., Colombia

The speaker provides an overview of telecommunications development in Colombia, from regulatory, technical, and regional perspectives. Colombia's telecoms development has been at the heart of the country's economic development, and the recent liberalization of the country's telecoms structure is seen as a harbinger for future growth.

4.2.1 MARKETS FOR SERVICES

4.2.1.1 Personal Communication Services -- Now That I can Have Them, Why Do I Really Want Them? And Thoughts on the Future of PCS in the Marketplace

Brad Baxter, Project Manager-Business Development, U.S. Intelco Networks, Inc., *USA*

The speaker presents an objective overview of the future of personal communications services (PCS) in the marketplace by describing how the service is viewed by PCS providers, examining how it is being received by PCS customers, and comparing its debut to those of other technological advancements. Will PCS simply fill a niche market, such as cellular and pager users? Will it become the communications mode of the future, or will it be remebered only as a comic-book curiosity?

4.2.1.2 New Telecommunications Services and Network Impacts - Forecasts of Markets and Technologies

Lawrence K. Vanston, Partner, Technology Futures, Inc., *USA*

The impact on the telephone network of new services will be tremendouc and widespread. The speaker depicts how investment patterns that are both economical and responsive to customers must match the adoption of network technology to the market adoption curves for narrow-, wide-, and broadband services. Forecasts of network adoption for key technologies are compared to the market forecasts.

4.2.1.3 Competition for Electronic Superhighways in the Pacific

E. Jean Bishop, Lecturer, University of Queensland, *Australia*

The level of global telecoms activity is now such that we may speak of telecoms "superhighways" spanning the globe. These highways link not just major commercialk centres, but harbour the potential to link the whole world. The speaker provides a broad overview of the evolution of this scenario, and the spread of global networking to the Pacific area.

4.2.1.4 The Market for Multimedia Distance Education for Corporate Training in Japan-US Business & the Management of Information Technology

Larry R. Cross, Vice President for Academic Affairs, Japan-America Institute of Management Science, *USA*

The speaker provides a comprehensive review of literature on international distance education cost-benefit considerations, as well as a consideration of the lessons learned from some of the major unpublished, ongoing distance education experiments. How best to facilitate the transfer of technology, knowledge, attitudes, skills, and information is the main issue to be explored.

4.2.2 FUTURE TRENDS AND PROJECTIONS

4.2.2.1 New Directions in Asian Telecommunications II–Russia's Reach for Global Impact–Integration or Devolution?

Steve Levy, Attorney, Cole Corette & Abrutyn and D. Buell, *USA*

Russia has begun in earnest the task of rationalizing its telecommunications infrastructure and the institutions that sponsor and support that sector. The speaker analyzes the currently complex and changing situation and evaluates the potential of recent developments on Russia's long-term telecoms enviornment. Also discussed in the important role of Russia's Pacific coast and the establishment of Nakhoda, Vladivostok, and Khabarovsk as major gateways and regional corridors.

4.2.2.2 Visions of the Information Age - 2021 AD

Robert M. Janowiak, Executive Director, National Engineering Consortium, USA and Jagdish **Jagdish N. Sheth**, Charles H. Kellstadt Professor of Marketing, Emory Business School, Emory University, *USA*

The US National Engineering Consortium conducted a study of the future of the communications and information industries. The presenter describes the study's 30-year focus and reports on the results of the study. The panel developed 235 scenarios of the future, and base their optimistic forecasts on the maturing of the world's primary regions, the rise of fiscal responsibility in the US, the increased use of telecoms to enhance business competitiveness, and the increased spread of new techonolgies.

4.2.2.3 Developing Strategies for Pacific Communications

John H. Erbetta, Independent Telecommunications Consultant, *United Kingdom*

The presenter takes the view that the Pacific region has specialized requirements in terms of telecommunications development. Success will be aided by planning within a strategy that takes account of all potential users, that facilitates suppliers developing suitable equipment, and that promotes a systems approach at the local and regional level. Furthermore, the strategy must be underpinned by political resolve and appropriate financial backing.

4.2.2.4 Is Multimedia Ready for Primetime? Stumbling Blocks to Multimedia Diffusion

Gwang-Jub Han, Assistant Professor, Howard University and **Jong-Duck Jung**, Assistant Professor, University of Wisconsin, *USA*

Multimedia technology is upon us. The speaker focuses on three different aspects of multimedia growth in the USA: hardware, software, and human resources. The development of the first two will have considerable effects on the latter. The human element is at the heart of the studies speculation and projections of multimedia's future.

4.2.2.5 PECC Triple-T Port (Teleport) for Developing Economies Second Phase Report -- Case Studies

Kenji Saga Professor of International Telecommunications, Asia University, *Japan*

In September 1990, the Triple-T Task Force of the Pacific Economic Cooperation Council (PECC) launched the Triple-T Port (teleport) for Developing Economies project as an action plan. The Batam Island Development Project in Indonesia and the Eastern coast of Thailand have been developed as case study areas for these teleports. The speaker reviews recent meetings and other steps taken to realize this important project.

4.2.3 CONVERGING TECHNOLOGIES IMPACT REGULATORY STRUCTURES

4.2.3.1 Video Dialtone Access to Multimedia

A.C. Harrison-Surgeon, Network Project Manager, Marsh & McLennan, Inc, *USA*

The speaker discusses the current status of video dialtone policy in the USA. Discussion focuses on some of the issues represented by the cable TV industry, telephone inudstry, and information services industry. The concept of video dialtone and its deployment are discussed as they relate to US infrastructure concerns. The focus is on interactive program accessibility.

4.2.3.2 Telecommunications and Computer Industries Collaboration

Carol Burke, Manager, Global Telecom Account Development, Digital Equipment Corporation and **Joan Kelly**, Managing Partner, Sheppard Moscow, *USA*

This presentation focuses on the communications and collaboration issues between the telecommunications and computer industries. For all the change in techonologies, linkages between the industriers are the critical determining factors for success, not only for the corporations involved directly, but also for the overall benefits of a global communications infrastructure.

4.2.3.3 Converging Telecommunications Technologies: Challenges Facing Government and Regulators in Australia and New Zealand

Richard A. Joseph, Lecturer, Faculty of Informatics, University of Wollongong, *Australia*

The speaker reviews the massive changes to the Australian telecommunications environment, looking at issues arising from convergence of technologies which affect the major regulatory bodies in Australia. Also identified are the advantages and disadvantages of the regulatory approaches adopted in Australia, and where improvements can be made.

4.2.3.4 Harnessing Convergence for Development: Industrial Policy and IT Development in Australia

John Houghton, Senior Research Fellow, CIRCIT, *Australia*

Australia is seeking to harness convergence and exploit synergies at the industrial and policy levels in order to develop a player or players of global size in both the communications and computing industries. The goal, according to the speaker, is to position Australia among the "world-class" players. The mechanics and details of achieving this goal are examined, and the likelihood of its success assessed.

4.2.4 BROADBAND APPLICATIONS

4.2.4.1 High Definition Television: The Key To Multimedia and Broadband Networks

Dennis W. Elliott, President, Elliott Communications Co., *USA*

HDTV is not just about television. The potential of HDTV may change forever the way we communicate. The speaker outlines some of the lesser-known applications of this technology beyond the delivery of broadcast television. It is seen as part of an overall movement to image-based communications, and away from textual-based media.

4.2.4.2 The Current Status and Future Prospects of KDD's International ISDN Service with the Focus on Typical Application Examples

Syuji Kanazawa, Senior Manager, Marketing and Sales Headquarters, Kokusai Denshin Denwa Co., Ltd., *Japan*

The speaker introduces the current status and future prospects of international ISDN applications, focusing on recent ISDN applications at the 1992 Albertville Winter Olympic Games, the Munich Summit, and the Barcelona Summer Olympic Games. ISDN use is growing, and the speaker looks at the expansion of Japan's INS-Net, current linkages between countries and expansion of this and other services to a variety of countries.

4.2.4.3 Telco Vision: Delivering Distance Education

Paul Kuhar, Director-Federal Regulatory and Industry Relations and EDWIN J. SHIMIZU, Manager-Federal Regulatory Relations, GTE Telephone Operations, *USA*

The speaker discusses what the power of telecommunications in the 21st century can mean for education. The goal is a national US public switched broadband network. The question is not whether telephone companies will achieve this, but when. In the US, telephone companies are prohibited by the 1984 Cable Act from offering video programming services. At present, Japan's deployment of such a system may be 20 years ahead of that in the USA. The challenge is for US policymakers to take action.

4.2.4.4 High Reliability Type LAN which has New RAS Function and Application System

Takaaki Suga, System Engineer, Fujitsu Limited, *Japan*

LANs have become increasingly powerful and commonplace. The author provides technical details of a multimedia LAN system operating in Japan, and forecasts that super high-speed fibre optic LANs will appear in the near future. The focus of such systems is "RAS" - reliability, availability, and service.

4.2.5 FIBER OPTIC SUBMARINE SYSTEMS - REPEATERED & NON-REPEATERED

4.2.5.3 High-Capacity Undersea Fiberoptic Cable Links

Neil Tagare, Director Business Development, NYNEX, *USA*

The speaker describes the fibre optic "Fibre Link Around the Globe (FLAG)" and its potential impact on the industry around the world. Also addressed are the technical, operational, marketing, and industrial aspects of the system. FLAG is a high capacity undersea fibre optic link connecting Europe and the Far East via the Indian Ocean Region. To beign operation in 1996, it will be the longest fibre optic system in the world.

4.2.5.5 **The Customer in Product Development: A Marketing Perspective**
Noella Gordon, Asst. Product Manager, AT&T Submarine Systems, Inc., *USA*

The presenter reviews the research and development resources of AT&T Submarine Services Inc (SSI). SSI's market research and product development efforts are reviewed, as is the general market for fibre optic undersea cable services.

4.2.6 SOCIAL IMPACTS OF TELECOM CHANGES

4.2.6.1 The Technology-Human Factor Relationship

Donald M. Lamberton, Visiting Fellow, Australian National University, *Australia*

Are advances in telecommunications "technology-driven" or "demand-driven"? The speaker investigates the power of demand in determining the progress of telecommunications. Among the aspects explored are the nature of demand for information as opposed to information technology, the complementarity between new technology and human resources; and the need to combine the "technology push" supply-side aspects with demand considerations.

4.2.6.2 Computers and Human Communications: A Psychosocial Perspective of Individual and Society in Change

Gunilla Bradley, Professor and **Gorel Strommqvist**, Research Associate, Institute of International Education, *Sweden*

The presenter reports on a study focusing on the interrelationship of computer/telecommunications technologies and the individual. What is the impact? This cross-disciplinary study seeks to contribute to our knowledge about how combinations of computer technology and telematics and societal factors may benefit society overall.

4.2.6.3 The Human Impact of Converging Communication Technologies: Entertainmentisation, Social Change and Saturation

Greg Hearn, Assistant Director, The Communication Centre, Queensland University of Technology, *Australia*

The speaker reports on a study of attitudes to the human implications of convergence - basic and fundamental shifts in how we percieve information and how institution and systems deliver information. The study looks at the effects on major stake-holders within Australia, and pays particular attention to the relative importance of entertainment versus other services in funding the convergence process.

4.2.6.4 The Impact of the New Services of Telecommunications in Developing Countries

Miguel C. De La Sotta, Electrical Engineer, Entel-Chile, *Chile*

It is more important than ever to analyze closely the impact of telecommunications development on developing countries. The speaker reviews how new services are expanding at a rapid pace. Cellular technologies are helping countries bridge gaps in their terrestrial networks, permitting such networks time to install advanced fibre systems. Likewise, societies are becoming less paper-intensive. There are potential cultural and sovereignty "costs", however, and these are also explored.

4.2.6.5 **The Telephone in Daily Life: A Study of Personal Telephone Use in the United States**

Robert Larose, Department of Telecommunications, Michigan State University and **Herbert Dordick**, Department of Radio-TV-Film, Temple University, *USA*

The presenter summarizes a national survey of personal telephone use in the USA. The presentation will provide an overview of this exhaustive study of basic statistics of personal telephone use, and analyze consumer interest in new telephone services such as videophones, videotext, and ISDN. Marketing and policy implications of the findings will be discussed. The presentation will conculde will a call for participation from Pacific Rim countries.

4.2.7 MOBILE SERVICES VIA INMARSAT

4.2.7.1 **Is the World Ready for the Go-Anywhere Telephone?**

Alan Brunstrom, Business Planning Manager, Inmarsat

The speaker reviews Inmarsat's introduction of the first telephone system that is truly mobile and offers seamless global coverage. The introduction of this system, known as Inmarsat-M, coincides with high-profile publicity for hand-held satellite telephone systems that are planned for the late 1990s. In services and function, there is little difference between what Inmarsat-M offers today and what is being proposed for systems that will not be introduced until the end of the decade.

4.2.7.2 **INMARSAT-M Portable Terminal**

Ram Subramaniam, Inmarsat, United Kingdom; **Akihiro Ishide**, Manager, Engineering; **Nobuhiro Endo**, Manager, Engineering; **Hizuru Nawata**, Assistant Manager, NEC Corporation, *Japan*

The presenter focuses on technical aspects and specification of the Inmarsat-M portable terminal equipment under development by NEC Corporation. This portable terminal is designed for areas where telecommunications facilities are neither readily available nor reliable.

4.2.7.3 **Bridging The Gap**

J.C. Bell, Manager, Regional Business Development, INMARSAT

The land-mobile use of mobile satellite communications is a high-growth business area. The speaker looks at steps taken by Inmarsat to harness this market. Inmarsat-A is increasingly used for thin route telephony to remote regions; Inmardat-C has found applications in supervisory control and data supervision; and Inmarsat-M is poised to be a breakthrough for small island locations in bringing them into the telecommunications world.

4.2.7.4 **Dial M for Service**

Edward R. Slack, Director of Land Mobile & Special Services, COMSAT, *USA*

The speaker describes various uses and applications well-suited to the new Inmarsat-M system. Described as "almost too good to be true", Inmarsat-M should satisfy most Pacific Rim user requirements, pariticularly for remote applications such as in the Pacific Islands.

4.2.8 COUNTRY STUDIES - ASIA

4.2.8.1 Telecommunications Infrastructure - Is it a Catalyst for Growth in Malaysia?

Omar Charles Abdullah, Asia Manager, Network Services, International Computers, *Malaysia*

Malaysia has a declared policy of moving its economy from a primary commodity base to a manufacturing base. The speaker examines to extent to which provision of telecommunications infrastructure is a requirement for achieving this economic growth and transition; and what the Malaysian telecoms sector has done to assist this endeavour.

4.2.8.2 Communications in the Russian Far East

Chuck Schumann, Executive Vice President, Pacific Rim Telecommunications, Inc., *USA* and **George Sapov**, *Russia*

The presenter summarizes the present telecommunications infrastructure in the Russian Far East and Siberia. The focus is on the present development and needs for the future. Examples of new network construction will be presented along with an analysis of current technical and regulatory hurdles. The authors share their insights as to the technical, cultural, and regulatory obstacles of working in the Russian Republic.

4.2.8.3 Utilization of Developing Country Resources for Research and Development Related to Telecommunication Products and Systems

ADVN Kularatna, Principal Research Engineer, Arthur C. Clarke Centre for Modern Technologies, *Sri Lanka*; **Shantha Fernando**, Senior Design Engineer, Exicom Australia Pty. Limited, *Australia*; **M. Kalyanapala**, Research Engineer, Arthur C. Clarke Centre for Modern Technologies, *Sri Lanka*; and **Parkum Fernando**, Design Engineer, Stanilite Electronics Pty Ltd, *Australia*

A group from the Arthur C Clarke Centre for Modern Technologies (ACCMT) highlights some useful experiences gained in carying out design and development tasks utilizing state-of-the-art components, systems, and instrumentation. The focus is on supplying domestic R&D resources within developing countries so they may develop indegenous, low-cost, independent solutions to telecoms problems.

4.2.8.4 The Political Economy of Deregulating Telecommunications in Hong Kong

Paul Siu-Nam Lee, Lecturer, Department of Journalism & Communication, Chinese University of Hong Kong, *Hong Kong*

The speaker discusses the political-economic factors behind the Hong Kong Government's intention to open up the local telecoms market for competition in 1995. China's attitude toward a second telecom netowrk in Hong Kong is not clear. The juxtaposition of Chinese, British, and commercial interests is examined against the background of sovereignty change in Hong Kong.

4.3.1 PERSPECTIVES ON THE FUTURE

4.3.1.1 New 'Have-Nots's' and the Old Problems? How the East European Countries and the Republics of the Former Soviet Union Integrate into the World Communication Order

Wolfgang Kleinwachter, Professor, University of Tampere, Department of Communication, *Finland*

The speaker analyzes in detail the process of change in the communications media systems of the East

European countries and the republics of the former Soviet Union. A frank look is provided of the problems faced, such as finincial and mateial crises, overstaffed bureaucracies, underdeveloped telecommunications infrastructures, and outdated technologies. The speaker also looks at the regulatory challenges for these nascent democracies.

4.3.1.2 Multinational Scientific and Technological Information Networks for the Mercosur Common Market

Lidia R. Scratti, Director, Undersecretary of Informatics and Development, *Argentina*

The objective of this presentation is to promote the development of multinational scientific and technolgical information networks in Latin America and the Pan American region, and to begin that development in the MERCOSUR common market. The goal is to develop common telecoms and information technology policies between the MERCOSUR states.

4.3.1.3 Creating Tomorrow's Telecommunications Infrastructures: Cultural Needs and Economic Realities

Joe Arden Flickinger, Assistant Professor of Communication, Radford University, *USA*

Focusing on new digital technologies and their diverse delivery systems, this political-economic study examines the tensions which exist in today's regulatory environment, where new technologies and standards are used as competitive tools. Suggestions for achieving long-term cultural goals by separating infrastructure requirements from competitive objectives are presented.

4.3.1.4 Converging Telecommunications Technologies, Economy, and Business Efficiency

Ronald P. Uhlig, Director, Strategic Marketing and **Bill Joll**, Director, Meridian 1 PLM, Asia/Pacific, Northern Telecom Asia/Pacific, *USA*

There are a multitude of ways in which converging technologies will greatly expand the impact of telecommunications. The speaker looks at several new applications, how they have spread through the Asia-Pacific region, and the extent to which markets may be anaylzed by looking at "GNP per phone", an uncommon measuring device which verifies the linkages between telecoms and economic strength.

4.3.1.5 The Telcos Move Toward a Global Market: Economic and Cultural Implications for the Pacific Islands Nations

Ronnie Bankston, Assistant Professor, University of Northern Iowa, *USA*

This study examines the changing nature of telecom operators in the USA from an economic and regulatory perspective, and identifies possibilities and problems with its application in the Pacific Island nations. Particular emphasis is placed on the transfer and application of video distribution capabilities to the Pacific Island nations.

4.3.2 TECHNOLOGY TRANSFER STRATEGIES AND EXPERIENCE

4.3.2.1 Convergence and the Role of Telecommunications Regulation in Developing Countries

Johannes M. Bauer, Assistant Professor, Michigan State University, *USA*

The speaker studies the regulatory problems confronting telecommunications development in developing countries. In addition, the possible benefits of telecoms development differ between groups of telecom users.

Therefore, a conceptual framework is put forward to help analyze the potential benefits derived. A variety of "instruments" for change are also analyzed in the context of this framework.

4.3.2.2 Institutional Strengthening: Models for Sustainable Development

A. Rubio, Engineer, Philippine Department of Transportation and Communications; **J. Bernardo**, Deputy Commissioner, Philippines National Telecommunications Commission; and **S.C. Macpherson**, Director, Policy & Regulatory Matters, Teleconsult Ltd., *Philippines*

The presenter covers the different types of institutional transitions being experienced in developing countries today, with special emphasis on the Philippines, where the authors of the study are collaborating as a part of a major multilaterally-sponsored program. The traditional "training" and "technology transfer" programs for the developing world will no longer suffice. The prime goal of this new, innovative apporach is the development of sustainable management and policy analysis skills in the personnel of key decision-making ministries and agencies.

4.3.2.3 R & D Efforts; A Case of Japan Key Technology Center

Kobo Inamura, Director, Capital Investment, Japan Key Technology Center, *Japan*

The speaker discusses the financial side of privatization policies. A new mechanism recently introduced in Japan is reviewed, and its effects on research and development processes analyzed. This analysis is studied in the context of the Japan Key Technology Centre (JKTC), which is co-administered by the Ministry of International Trade and Industry (MITI) and the Ministry of Posts and Telecommunications (MPT).

4.3.2.4 The Challenge of Transferring a State of the Art Telecommunication System Manufacturing Technology

Georges Krebs, Vice President, ALCATEL Submaracom, *Australia*

The presenter tells the story of the successful transfer from Europe to Australia and New Zealand of the technologies required to manufacture and install a complete state of the art submarine cable system. The background of the project is reviewed, as are its implications for future challenges.

4.3.3 PROPERTY RIGHTS, PRIVACY AND RELATED CONCERNS

4.3.3.1 Caller ID and Privacy: New Options

Peter B. White, Senior Lecturer, Media Centre, La Trobe University, *Australia*

Caller ID has been a controversial telecoms offering since its inception. New service options and a growing awareness of the potential abuses of Caller ID have led a number of regulatory agencies to oblige carriers to offer subscribers a range of Caller ID "blocking" options. The speaker looks at proposed solutions to this problematic issue, assessing proposed telecoms privacy regimes and other options.

4.3.3.2 Software Patents, Ownership And Infringement Crimes: New Developments

Stephen C. Glazier, Counsel, Attorney, Reid & Priest, *USA*

In the US, software protection by patents and copyrights is a rapidly changing legal area. This is causing rapid changes in business practices. The speaker reviews how these developments interface with recent changes in international patent law, and require changes in international business norms wherever computers, software, and IC chips are applied.

4.3.3.3 **Managing the Privacy Implications of New Technology**
Brian G. Milton, National Director - Social Policy, Stentor Telecom Policy Inc., *Canada*

The speaker describes the escalating concern regarding telecoms privacy in political, regulatory, and consumer advocacy and business groups in Canada. These trends are analyzed in terms of their effects on Canada's major telecommunications companies. Various initiatives to address these privacy concerns are reviewed.

4.3.3.4 **The Personal Data Protection Regime in Korea**
Jisuk Woo, Ph.D. Candidate, Annenberg School for Communication, University of Pennsylvania, *USA*

Is the increased use of telecommunications technology by governments and private organizations to collect personal information a threat to privacy? The speaker addresses the inherent conflict between the right to privacy and the right to information, and looks at Korea's efforts to introduce a personal data protection regime.

4.3.4 DISTANCE EDUCATION NETWORKS

4.3.4.1. **Distance Learning and Northern Telecom**
John Mahoney, Vice President, External Affairs, Northern Telecom Inc., *USA*

The speaker looks at several distance education case studies in the USA to show how telecoms technology serves the interest of education. This is accomplished through a coalition of interests - educators, students, parents, equipment and service providers, and governments - to guide the process, set priorities, pursue funding, and keep things moving.

4.3.4.2 **Creating an ISDN Distance Education Network**
Betty Mitchell, Manager, Telecommunications Applications, Open Learning Agency and **Deb Reidlinger**, ISDN Service Development Manager, B.C. Telephone Company, *Canada*

The Open Learning Agency (OLA) of British Columbia, Canada, in cooperation with MPR Teltech, BC Tel, and provincial and federal government departments is conducting a major project to test the ability of basic rate ISDN for distance education applications. The speaker rports on the results of this project and makes recommendations on network configuration, set-up, instructor preparation, and suitable instructional applications.

4.3.4.3 **Pacific Regional Education Network: Options for the Future**
Malinda S. Matson, Director of Learning Resources, Northern Marianas College and **Robert F. Kelley, Jr.**, Consultant, Management Communications Services, *USA*

The speaker reviews a major project designed to upgrade the US Western Pacific region's abilities to serve higher education objectives and promote high-quality distance education. The history of such prjects is summarized, limitations of the current system assessed, and the goals and objectives of the new project outlined.

4.3.4.4 **Multi-cultural Issues in the Delivery of Distance Education**
Barry Willis, Statewide Director of Distance Education, University of Alaska System, *USA*

Delivery of distance education services to a multicultural audience poses a huge challenge to distance education providers. The speaker reflects on the experiences encountered when designing, developing, delivering and evaluating distance instruction to a multicultural audience.

4.3.4.5 Distance Learning and Northern Telecom

John Mahoney, Vice President, External Affairs, Northern Telecom Inc., *USA*

The speaker looks at several distance education case studies in the USA to show how telecoms technology serves the interest of education. This is accomplished through a coalition of interests - educators, students, parents, equipment and service providers, and governments - to guide the process, set priorities, pursue funding, and keep things moving.

4.3.5 MAKING IT WORK

4.3.5.1 Academic Internetworking in Mexico -- The world at the reach of a keyboard

Mario M. Arreola-Santander, Sales Director, Consorcio Red Uno S.A., *Mexico*

There is a new imperative in Mexico for a full upgrading of enterprise networks, in an effort to increase productivty and remain competitive. Several factors are oulined by the speaker as catalysts for change, including the privatization of government-owned entities, increasing capacities of Mexican telecom infrastructure, the lifting of trade barriers through the GATT, the North American Free Trade Agreement (NAFTA), and the need to comply with international standards.

4.3.5.2 The HI-NEST Model: An International Computer Network for Support of Program Implementation

Donald B. Young, Co-Director, FAST Program; **Mary Gullickson-Morfitt**, FAST Science Program Field Services Specialist and **John H. Southworth**, Educational Associate, Curriculum Research and Development Group, University of Hawaii, *USA*

The Hawaii Network for Education in Science and Technology (HI-NEST) is an international computer network designed to support the implementation and use of the Foundational Approaches in Science Teaching (FAST) program. The presenter reviews the progress of this system, and predicts that by 1995 it will be used by over 8,000 teachers and 600,000 students. The network already extends to nine countries.

4.3.5.3 A System Architecture for Ideographic Language Support

Andrew Pan, Technical Advisor, American Express, TRS Advanced Technology Group and **Roen Hogg**, ADIA Information Technologies, *USA*

The speaker looks at the Idoegraphic Language Support Project, the goal of which is to support indeographic language capability (eg, Japanese and Chinese characters) in input, database, processing, and output. Japanese, Korean, and two forms of Chinese are encompassed in the project, covering one-fourth of the world's population. The challenges and rewards of this project are enormous.

4.3.5.4 Architectural Consideration in the Design of Network Based Educational Systems (NBES)

S.V. Ahamed, Professor of Computer Science, City University of New York and **V.B. Lawrence**, Head, Data Communications Resources, AT&T Bell Laboratories, *USA*

The architectures of both telecommunications networks and intelligence networks may be enhanced to incorporate a substantial component of "knowlege processing" for educational system applications. The speaker provide a technical review of how this might be accomplished, and the applications such a network could incorporate.

4.3.5.5 Open Learning Centres: Making the Best Use of Technology to Enhance Decentralised Education and Training

Anne Gooley, Director, Opening Learning Network and **Steve Towers**, Assistant Director, Opening Learning Centre Network, *Australia*

The speaker presents the background to the Queensland Open Learning Project, the establishment of the Queensland Open Learning Network (OLN), and the learning programs that are based upon the OLN for delivery of educational products and services. Issues that will be addressed include the role of the OLN and open learning centres; problems associated with the development of the network and strategies developed for successful management and future planning.

4.3.6 SOCIAL IMPACT STUDIES

4.3.6.1 Anticipating and Estimating Adoption and Resistance of Interactive Instructional Technology: A Look at Multimedia in Higher Education

Louis Leung, Assistant Professor, University of Hawaii at Manoa, *USA*

Adoption of instructional communications technologies meets with resistance and even opposition in higher education. This study examines the awareness, interest, evaluation, and perception of multimedia instructional technology; factors in multimedia instructional tecnology adoption and integration; and negative factors and hindrances to the adoption of multimedia instructional technology.

4.3.6.2 Development and Telecommunications Technology in Pacific Island Microstates

Michael R. Ogden, Instructor/Research Associate, Center for Pacific Islands Studies, University of Hawaii, USA

The presenter summarizes the results of a PTC-sponsored comparative research study of the role and impact of telecommunications technology on development planning and aspirations conducted in the Republic of the Marshall Islands and the Cook Islands. Examined are aspects of recent telecoms developments in both countries; the broader social, economic and politcal impact of such developments; and several 30-year scenario projections are put forward regarding these small countries' telecoms development.

4.3.6.3 Assessing Videotex Diffusion and Usage Patterns in a Manufacturing Organization: A Case Study

Michael G. Elasmar, Instructor, Department of Telecommunication, Michigan State University, *USA*

The speaker outlines a case study of a large multinational manufacturing organization which utilizes the service of a US nationwide network that provides private company videotex services over its host computers. A survey was conducted to assess user satisfaction with the videotext system and the services it offers. The problems and positive factors encountered are evaluated and analyzed in the context of future videotex applications.

4.3.6.4 An Empirical Investigation of Telex Data as a Useful Predictor of Socioeconomic Development Among Less Developed Countries

Meredith S. Glenn, Assistant Professor, Barry University, *USA*

The speaker considers the relationship between converging telecommunications technologies and socioeconomic development in developing countries. Examined is the effect of telecoms on the social and economic activities of developing countries and the understanding of the contribution the telecommunications infrastructure provide to socioeconomic growth.

4.3.6.5 Framing Our Common Future: Strategies for Promoting Cooperation Among Stakeholders

Angelina T. Wong, Professor of Extension, The University of Saskatchewan, *Canada*

The successful incoporation of telecommunications technologies in higher education requires the orchestration of different types of expertise and reflective dialogue among the stakeholders. The speaker highlights some of the lessons she and her colleagues have learned duirng six years of development and delivery of province-wide televised courses.

4.3.7 VSATS

4.3.7.1 VSAT Solutions for Innovative International and Domestic Services

B.K. Syngal, Chairman, Videsh Sanchar Nigam, *India*

The speaker describes applications of VSAT networks for the realization of innovative and cost effective networks. VSATs may be a particularly effective solution for developing countries, and may even be used as overlay networks for advanced services such as ISDN.

4.3.7.2 VSAT's - An Efficient Option for Voice and Data Networking

Carol A. Politi, Senior Marketing Specialist, Hughes Network Systems, *USA*

With over 5000 VSATs installed and ordered to date, the Pacific rim is one of the most rapidly growing markets for VSATs today. The speaker looks at how VSATs are enabling businesses to operate effectively in regions where it was previously difficult to obtain reliable, high quality telephone service.

4.3.7.6 VSAT in Local Administration Communication Network

Hideki Noda, **Yutaku Onda**, and **Toru Kikuta**, Japan Radio Company, *Japan*

The Japanese market for VSATs (Very Small Aperture Terminals) is gradually expanding after the infrastructure for satellite communications was established by the launches of JASAT-1 and JASAT-2 in 1989. The speaker introduces Japan's nationwide satellite communications system for local administration and disaster prevention and outlines the technical features of the multimedia VSATs.

4.3.8 COUNTRY STUDIES - DEVELOPING ECONOMIES

4.3.8.1 Television in Papua New Guinea: Policies and Practice

Amos Owenares Thomas, Lecturer, University of Tasmania, *Australia*

The introduction of television in Papua New Guinea (PNG) was preceded by considerable debate by civil leaders spanning decades. The speaker traces the development of PNG broadcasting policy and compares what the policy initiatives envisages against current broadcasting reality. Content analysis of TV programming will be reported, with a focus on fireign-to-local programme origin ratios.

4.4.1 REGIONAL ORGANIZATIONS AND TELECOM DEVELOPMENT

4.4.1.1 Global Telecommunications Development - Market Forces or Multi-Lateral Planning?

Chris C. Vonwiller, Director of Corporate Affairs, AOTC, *Australia*

The Maitland Commission in 1984 formulated recommendations for the development of global telecommunications, including multilateral initiatives. The speaker reviews progress since the Commission's report and contrasts some of the planning assumptions for telecommunications services in developed countries against those more appropriate in developing nations.

4.4.1.2 Technology Transfer in the Asia Pacific Region

Setyanto Santosa, CEO, PT Telekom and former CEO of PT INTI, Indonesia

The presenter reviews the basic US regulatory scheme for export controls and technology transfer. Export controls can affect the ability to export technology and the ability to enter into joint ventures with foregin partners. In addition, they can restrict re-exports of such items once abroad. They are likewise an issue for non-US companies seeking to invest in the US. The US regulatory scheme has changed in redent years, and the speaker reviews this vital component in international telecoms trade.

4.4.1.3. Cooperation Tasks of Telecommunications in the Asia-Pacific Region

Yun-Sik Shin, Ph.D, President & CEO, DACOM, Korea

The speaker addresses the important area of cooperative activities for telecommunications development within the Asia-Pacific region. This overview of the regions telecoms advancement and current telecoms needs also looks at the role of multilateral organizations such as PECC, the role of organizations such as PTC, how data communications networks are evolving in the region, and the pressing need for human resource development programs.

DISCUSSION GROUPS

NOTES

FORECASTING SATELLITE DEMAND

Jack Albert, Vice President of Broadcast Services
PaAmSat, L.P.
Greenwich, Connecticut U.S.A.

Satellite life is now 15 years. Costs have skyrocketed and classical leading indicators have disappeared with changes in technology, de-regulation, fiber-optic cable and separate satellite systems. So, why are so many new satellite launches being planned? The risk takers may be the new experts at Forecasting Satellite Demand.

INDUSTRIALIZED NATIONS

A Telecommunications infrastructure emerged in the late 19th century with the telegraph technology forming the backbone of routes between and within the populated areas. The routes follow the same paths of wagons, trains and ships. Telegraph technology spread with the increased demand for communication networks. Commerce grew and communications systems expanded along with it. An interdependent relationship was formed between commerce and communications, which would continue to prosper throughout the future.

TECHNOLOGY CHANGES

Land-based communications were augmented by air-based technologies. The first air-based system were carrier pigeons. These birds flew air routes where land services did not exist.

Radio followed, greatly expanding the reach and direction of communications. Radio, Telegraph (and Voice) brought a revolution to commerce with the new ability to expand globally.

Capacity, quality and security plus transmission technology spread the wire-based systems to and within all commercial areas.

- Radio Technology

Reliance on radio technology met an obstacle; demand surpassed frequency capacity and radio communications remained an open channel with little privacy.

- Microwave Technology

Point-to-point high traffic (capacity) spread trunk routes between centers. For decades this was, and still is, the main technology used in many areas. Distance became a costly and time-consuming problem. Since microwave is a "line of sight" system, a repeater is needed every 20 - 40 miles -- with the horizon as its boundary.

- Cable and Fiber Optics

Early cable (wire) supported one signal per wire; multiplexing allowed hundreds of signals per wire.

Fiber Optic Technology introduced a faster, more secure cable system with greatly increased capacity. Capacity jumped to thousands of signals and equipment size was greatly reduced. Cost and time to build still remain negative factors in this point-to-point system.

The capacity and security of fiber makes it an ideal solution to high capacity trunk routes and terrestrial connections to global/domestic satellite systems, unlike microwave, it does not use radio frequencies that may a problem with interconnection or co-existence with satellite transmissions.

SATELLITE TECHNOLOGY

In the 1960s satellite technology emerged, providing the combination of land and air. The services provided by land technologies could now be utilized on satellites but with less of the disadvantages of these technologies.

The satellites provided a single microwave repeater approximately 22,700 miles above the earth. Such a repeater is in "line of sight" from about 1/3 of the earth's surface on the horizon from outspace.

EARLY SATELLITE DEMAND

It took 10 years for the USA Television broadcasters to switch from the tried and proven terrestrial microwave to satellite technology. It took only one year for the new cable television industry to link cable systems and to supply large amounts of new television programming to geographically diverse areas. It took the major television broadcasters a decade to copy the cable systems use of satellite technology. There was now competition to the broadcaster's monopoly dominance in supplying T.V.

INDUSTRIAL NATIONS AND SATELLITES

All technologies flourish in industrialized nations. Traffic forecasting of telephone service became a science. Erlang calculations are still used to project expansions. High traffic routes followed the "build it and it well be filled" concept.

Satellites for international and domestic services launched around the globe in the 60's, 70's and early 80's followed that same concept and were deemed successful in both financial and utilization terms.

INTERNATIONAL SATELLITES

The International Telecommunications Satellite Organization (Intelsat) was formed in August 1964. Intelsat, jointly owned by about 120 nations, became the back-bone transmission system on a global basis. It became both a natural and treaty monopoly in providing such services. Similar natural and legal monopolies such as Post Telegraph and Telephone (PTT) organizations became the national representatives or "signatory" to the intelsat organization. The signatory/PTT was the single source of international satellite service in each member nation. Each PTT charges what ever it wants for capacity it resold on Intelsat satellites.

ROOM FOR ALL BUT NOT ALL FOR ONE

Domestic Communications satellite systems, like Intelsat, also use a geostationary orbital location. Domestic systems became regional systems, covering more than one nation.

The emerging satellite industry looked at a new, unexplored market. Satellites are used for more than just telephone traffic, so the scientific approach to forecasting became difficult to use. Increased traffic volume and complexity as well as rapid advancements in technology further confused the forecasting dilemma.

Satellite systems growth over the last 10 years could not be and were not scientifically forecasted.

The spacing between satellites had to be reduced from 4 degrees to 2 degrees to provide room for the satellites crowding over the industrialized land mass. The problem of a lack of room over the oceans has now arisen. This is where international satellites are located.

> Mr. Xavier Picard of Arianespace summed up the situation as follows:
>
> > "500 years ago Christopher Columbus was seeing 'new stars appearing in the sky.' New nations were formed and gold, yesterday's wealth, has been replaced by innovation, technology, research . . . At the same time, the sea was useful; today, it is space."

LOOKING AHEAD 5 YEARS

Looking too far into the future reduces the accuracy of a forecast. There are too many variables and unknown events that can drastically change a long term forecast. By taking only the major issues into consideration and perhaps putting a little history into the mix, only a short term or near term forecast of satellite demand can be achieved with any practical accuracy.

SATELLITE CAPACITY AND THE GLOBAL MARKET

The standard capacity is measured in terms of 36 mHz transponders. There are in fact 36, 54 and 72 mHz, C-band and Ku-band transponders.

The following **table** in Figure 1 is from Euroconsult's "World Space Industry Survey -- 10 Year Outlook" depicts the 1985-1995 transponder capacity. In 1965, it was virtually zero. By 1985, it had grown to 1,788. By 1995, it is expected to be 3,140.

This is a relatively accurate short term forecast, for both failures and drop-outs will be quickly replaced. In addition to this capacity, PanAmSat will be launching 3 new satellites by 1995. Although they will have 54 mHz transponders, the equivalent 36 mHz transponders will total 144. Moreover, Low Orbit Satellites should now be accounted for in the near term forecasts. One system of Low Orbit Satellites personal communications system requires about 66 satellites to be in orbit at one time.

In May 1992, Arianespace made known that it has 101 launch contracts pending. PanAmsat's new Global satellite system will bring that number to 104.

How big is the global market? Can it support the projected launches? By the year 2002, Euroconsult predicts a US$ 80 billion global space market. **Figure 2** breaks down the forecasts by Market Segment. The optimistic size could be as much as US$ 100 billion.

In order to continue developing a short term forecast one must understand some intricacies of both the satellite distribution system and intense political elements of the market. This understanding, combined with realizing the importance of the growth (or potential growth) of the newly emerging industrialized nations is essential.

NEW SATELLITE COVERAGE AREAS

Satellite communications are particularly well-suited to the newly industrializing nations. Communication demands can be satisfied almost overnight . . . anywhere. Small, inexpensive VSATs offering data and voice capabilities are available virtually immediately. Satellites offer a variety of services from television to telephone, as well as many other standard and unique telecommunication services for large and small users.

Flexibility is the key to the success of satellite systems. Services can be established in a very large pre-defined area. Newly industrializing countries are expanding at rates which render long-term planning for the communications infrastructure very difficult. This expansion encourages over-centralization of established population centers, attracting the many social, economic and technical problems typical of an urban society while weakening rural societies. Satellite communications can treat all areas equally and enable those living in remote areas to communicate with the metropolitan areas of the world thus negating the tendency to over-centralization.

The interest of the new generation of providers of satellite communication services is to see new operators of communication systems develop in new countries.

An example of the new generation of satellite operators is PanAmSat PAS-1. The first privately owned international satellite was launch on June 15, 1988 located at 45° west longitude. It offers services to Latin America that were not available before. This Separate Satellite System (separate from the Intelsat monopoly) was at the leading edge of today's waves of deregulation, free market and open competition that is sweeping the world. Now, only 3 year later, serving over 70 countries in Europe, North America and South America its 36 X 36 mHz (equivalent) transponder are near full capacity.

The PAS-1 footprint shown in **Figure 3** is not very unique aside from a rather large North American coverage area. What makes the real difference is the company directive to provide high quality, reasonably priced and very flexible services that meet customers' needs. The

Breakdown of International Space Telecommunications Capacity

1985-1990 projections for 1995

Number of transponders in-orbit(36MHz equivalent), minus those at the end of design lifetime

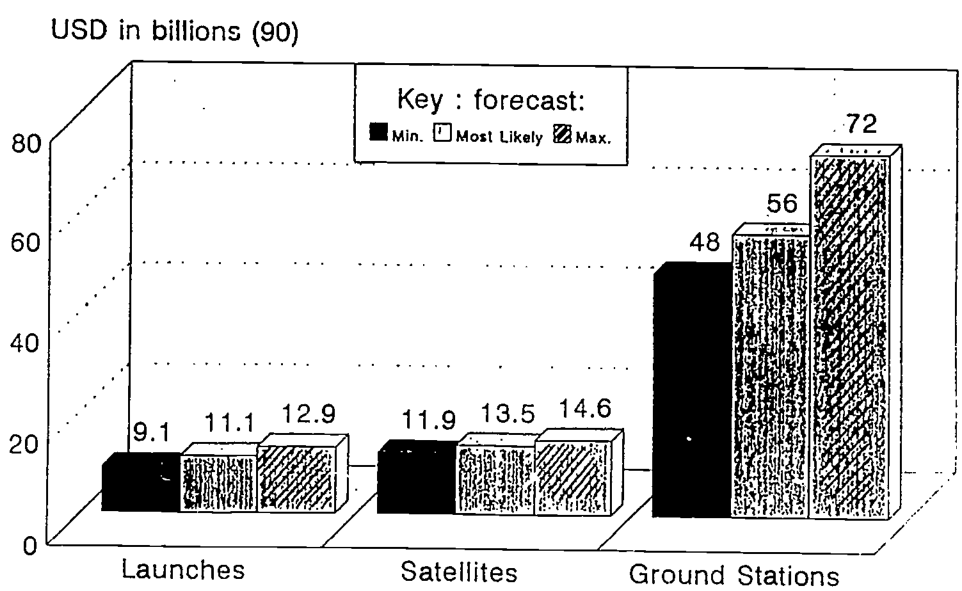
Regions	1985	1990	1995 Estimate
Intelsat	664	776	1010
Private Systems	0	36	156
USA	624	706	720
Canada	144	120	134
Europe	64	157	436
Japan	64	171	218
Rest of World	228	343	466
TOTAL	1788	2309	3140

Source: Euroconsult
"World Space Industry Survey
- 10 Year Outlook"

Figure 1

The World Market for Civilian Telecommunications

Satellite Systems - Forecast by Market Segment :1991-2002



Source: Euroconsult

Figure 2

BEST COPY AVAILABLE

customer was, and still is, considered first and foremost.

A few interesting facts have been exposed in the 4 year history of PanAmSat. These are shown in the **Figure 4**. PamAmSat has satisfied a pent-up demand and created a new market or at the least succeeded in expanding existing markets in its coverage area.

By combining a flexible satellite delivery system with user demands creates a new way to do business. The Old Way of establishing a transmission path is illustrated in **Figure 5**. Rules and regulations necessitate a complex set of providers, or middle men, each at an incremental cost for the user to pay.

The new way is to eliminate the complexities. This is demonstrated in Figure 6. Simplicity yields the benefits of speed to establish the service at lower costs, higher reliability and flexibilities to meet user needs plus the ease of one-stop shopping.

THE 5 PS: POLITICS, PTTS, PRIVATIZATION, AND POSTURING FOR PROFIT

The 1990's will see the five P's swimming in the sea's of the new free markets.

WORLD POLITICS

The World Administration Radio Conference (WARC) met early in 1992. For nearly 5 weeks, 1400 delegates from 127 country-members of the International Telecommunications Union (ITU) met in Spain to discuss frequency allocations for new technologies. New or growing technologies are important to the rapidly growing Asian-Pacific market.

WARC-92 was the first major frequency allocation conference to be held since 1979. The political priorities of each nation and region were of importance since the ITU operates on a one-vote-per-country basis. Despite alliances and formation of regional voting bloc's allocations satisfying the various proposals and recommendations were reached as well as time tables and technical constraints to permit the introduction of new services. An important conclusion that affects developing countries was made clear. In order to assist developing countries to take part in the new telecommunications revolution, the conference adopted resolutions providing all types of assistance including financial. Unless otherwise indicated, the decision approved at the WARC will take effect on October 12, 1993.

PTTs are Privatizing and Posturing themselves to compete in an open market for their share of profits. The days of monopolies are numbered. A PTT may, in some nations, remain part of the government either totally owned by the state or partially owned by the private sector. Privatization has been one of the main forces behind deregulation. Many PTTs are now being privatized in part or altogether.

While governments were prepared to tolerate state-run monopolies, they have been less willing to give their blessings to private monopolies.

Oeregulation and privatization is a double-edged sword. De-regulation allows competition but also and allows PTTs to enter new markets in other countries. The **chart in Figure 7** show the privatization status of a few giant PTTs and cross-border activities as the sleeping giants awaken. As reported in the Financial Times. The relative values of cross-border telecommunication acquisitions since 1988 shown in **Figure 8**. In 3 years the growth has been 1420%.

France Telecom, the world's fifth largest telecommunications operator, has in the past year made more foreign alliances than ever before since its creation in the 19th century, when in was a telegraph service for King Louis Phillippe.

Asia and Pacific Region Markets - Why More Satellites

The Pacific Rim is preparing for an explosion in demand for satellite-based communications. Trade between the US, Europe, and Asian countries is burgeoning. One study shows no less than three satellites are needed to serve the region. De-regulation will fuel major growth even more.

As of February 1992, Star TV's 1.8 million subscribers were viewing a new television service. That 's three times the original projection just two months after the launch of its 5 TV channel service.

Analysts agree that the advent of satellite systems such as Asiasat, Aussat, and PanAmSat are indicative of increasing interests among satellite players in the **hows, whys and whens** of tapping the demand for space segment in the region. The escalating pace of developments in the Pacific Rim justifies the optimism.

One study by **Communications System Ltd.** of the UK indicates most capacity will be for video and data. The Pacific satellite demand, by application, is shown in the **next Figure 9**.

TOO LITTLE OR TOO MUCH

One of the rarest commodities in Asia Pacific region at this moment is a space satellite transponder with cross-border coverage. A number of new satellite systems are in the planning or construction stage or, as in the case of Intelsat, the moving stage. At present, the demand for transponders exceeds the supply.

Although new capacity will soon come to the rescue of Japan's satellite communications market, some analysts feel that, if all the satellites planned/owned by Japan's Space Communications Corp (JC-Sat), Satellite Japan Corp., and NTT were actually in operation by 1995, there will be more than 200 transponders available - and demand will fall short of the supply of available capacity.

In the short term, it will be two to five years before existing demand can be satisfied. There seems to be an immediate (in the next 5 years) demand for 30 to 100 transponders. Arianespace's study shows that the number of transponders needed to meet demands will increase from the present 200 transponders to approximately 700 transponders by the beginning of the next century.

The uncertain future only increases the number of variables involved in predicting future demands for transponders. So-

PAS-1 Coverage

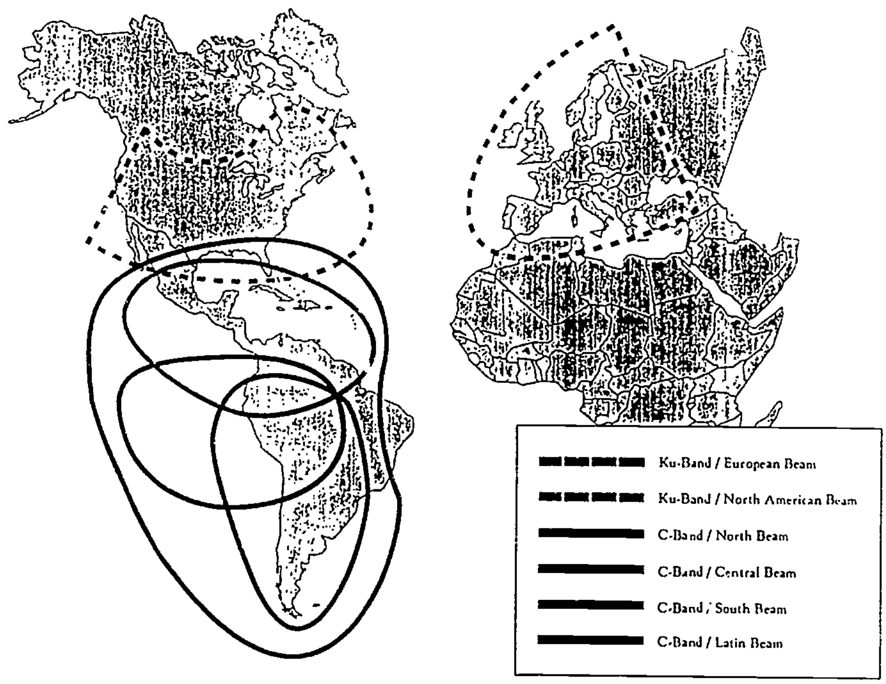


Figure 3

1988 - 1992 PanAmSat

95% of traffic is new

85% of traffic is video

98% of traffic is private enterprise

0% of traffic is telephone

Figure 4

THE OLD WAY OF DOING INTERNATIONAL COMMUNICATIONS

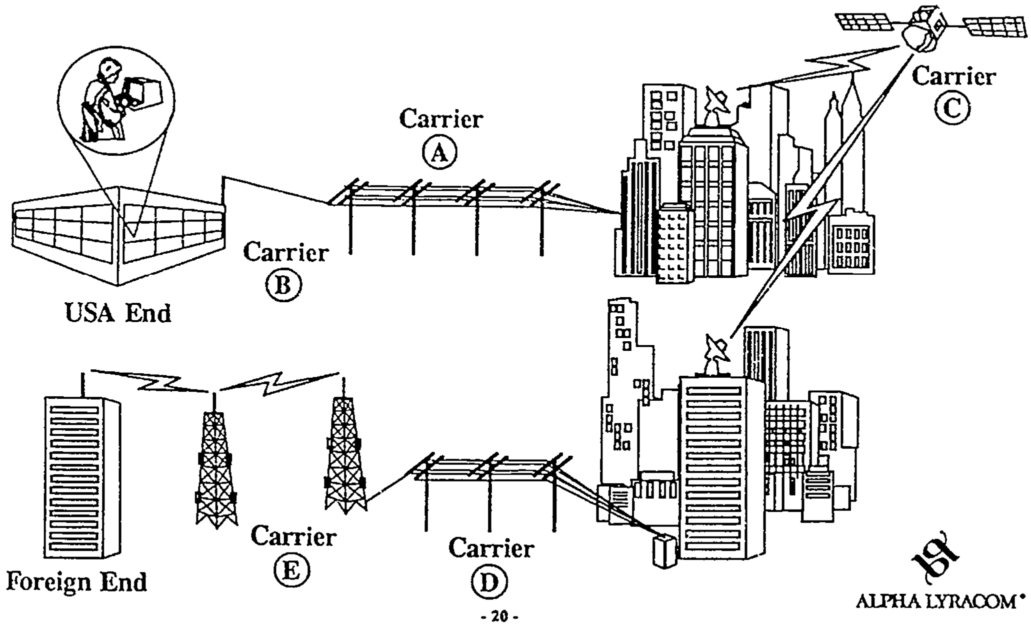


Figure 5

THE NEW WAY OF DOING INTERNATIONAL COMMUNICATIONS THE ALSC SOLUTION

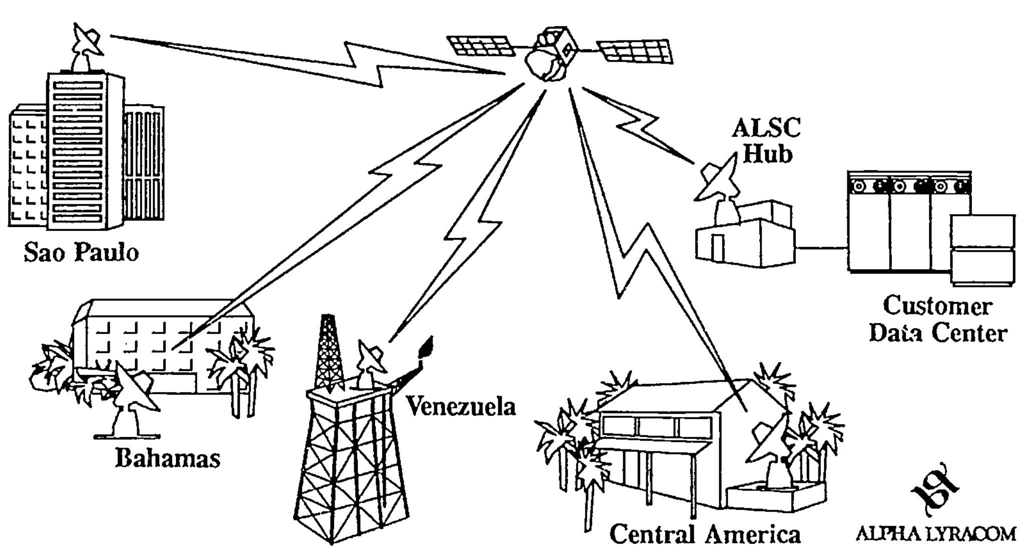


Figure 6

Major PTT Privatization

U.K - The remaining 22% may be privatized in the next year.

Germany - DBP Telekom could be privatized as eary as next July.

Japan - NTT privatized

France - Maybe by the end of the decade.

USA - Privatized and fragmented.

Figure 7

The Sleeping Giants Awaken

Cross-border Telecommunication Acquisitions

1988 - 11 deals worth $116 million (USD)
1989 - 50 deals worth $2.7 billion (USD)
1990 - 67 deals worth $16.5 billion (USD)

PTTs have strategies for global expansion. Instead of being insular monopolies sleeping in their backyards the giants will invade each others' turf.

Figure 8

called "experts" are only able to give us a "best guess" on the most current requirements for transponders and the manner in which the demand is most likely to grow.

Entrepreneurs who had previously been excluded from the telecommunications business by tight regulatory controls as well as already established telecommunications companies seeking to expand in the region are now preparing to risk money to provide the infrastructure necessary to meet needs.

The services with the highest immediate demand will probably be similar to those of the presently existing regional satellite systems. Television leads.

The demand list: Rapid development of Cable Television, SMATV, MDS, Compressed TV and HDTV are in the forefront of development and implementation.

Television is not, by any means, the only service in demand. Well-developed countries need to expand. Both densely-populated, urban areas and new industrial zones will need expand their telecommunications infrastructures by adding teleports and VSATs. There still are areas in this region's younger, still-developing nations where such basic services such as telephone service are in short supply or non-existent. Satellite transponder loading technology is expected to enable 2000 telephone circuits per transponder in a year or two. This capacity is similar to that of undersea fiber-optic cables. Satellites have the ability to bring telecommunications services rapidly and at a reasonable price to all areas, however remote.

The present lack of transponders is slowing expansion. The demand for service being greater than supply is known as "pent-up demand." Exclusively domestic satellites can not offer the solution. Regional satellites can serve several neighboring ccuntries. International satellites are best for the long distance services. The optimum solution is a combination of regional (domestic) satellites and international satellites.

SEPARATE SATELLITE SYSTEMS TO THE RESCUE!

The term "separate satellite system" refers to a non government, non treaty, open market, commercial satellite system. The combination of spacecraft capacity and service is the solution to fulfill the pent-up demand. Easy, open access by customers is also a fundamental element of success. The emergence of such new "separate satellite systems" offers hope to entrepreneurs as well.

The foremost separate satellite system already in existence is PanAmSat. Presently PanAmSat has one satellite over the Atlantic Ocean which has enjoyed much success. Recently PanAmSat announced the addition of three more satellites, which will cover the Pacific and Indian Ocean regions by 1995. This expansion will create the first global separate satellite system.

Video First - Television
First of all the TV is visible, exciting and in the lead position of "pent-up demand." Second, TV is the easiest and fastest service to supply. Third, TV provides the quickest revenue to support the investment and life cycle of a satellite.

The Television market is vast. From program development to TV sets, it encompasses entertainment, business and educational services.

There is a downside.
Regulations still exist in many high population areas that restrict dish installations. Although deregulation is slow in some parts of the world, the eventual deregulation, and the inability to control TVROs will overcome this restriction to growth.

Censorship is also an issue. Many countries still support strict censorship of political and religious programming. Entrepreneurs may be discouraged from distributing programs to these countries On the other hand advertising-supported programs need not be overly concerned with collecting revenues.

Signal piracy and effective subscriber management system in the collection of fees will be a major challenges for developing countries. Signal encryption may be a solution, but a standard may first have to be established. The local industries' ability to manufacture earth stations and work with the associated electronics (under license) can resolve many of these issues in due time. Indeed involved industries will flourish with the introduction of services.

What do projections look like today? By the year 2000, Direct To Home dish installations ("DTH") could reach almost 17 million plus a mere 180,000 for CATV/SMATV. This represents only a 5% penetration of TV homes. The value of these systems is, however, almost US $3.4 billion.

The good news
Television programming on the Palapa Satellite seems to already have penetrated over 41 million TV homes with 1.7 million DTH/CATV/SMATV systems.

In Japan, only 1% of homes have cable TV compared to 60% of US homes. However, more than 5 million homes have subscribed to satellite TV. That represents roughly 10% of the country since the service began two years ago. Popularity is expected to double by 1995.

CATV AND MMDS

Initially, cable television (or CATV) provided remote areas with TV. Homes were wired to one point. At that point, a head-end was built to obtain TV programs from the airwaves, microwave and eventually satellites. Small systems confined to one building or a few buildings are called Satellite Master Antenna Television or SMATV.

Channel capacity grew from a just a handful of channels to 100 channels. Improved picture quality, increased program variety and pay-per-view for exclusive programming caused an explosion in CATV in the US during the 80s. The concentration of population that would pay for service provided an economic base for the new industry. It is, however, a costly project and time consuming to build. CATV competes with multi-channel multi-point distribution service (MMDS) or wireless CATV and over-the-air broadcast. With the advent of high-power satellites on separate frequencies it is now possible to obtain television using very small dishes. Direct Broadcast Satellites (DBS) cover small areas in order to concentrate power into 60-90 cm dishes. Satellite fed MMDS and DTH offer the lowest cost and fastest delivery in the largest market areas.

DTH dishes as small as 90 cm present a challenge to DBS, CATV, MMDS, and over-the-air broadcast services. In Europe, the DTH penetration is expected to reach 15% (22 million homes. By the year 2000, CATV is expected to reach 39% (55 million homes). The breakdown: 24 million in Germany, 12 million split between The Netherlands and the United Kingdom. The vast majority of programming will be satellite-delivered, either directly to viewers or via alternate systems.

MMDS began in 1986 on specially dedicated frequencies. The cost is 1/3 of the cost of CATV. Compression provides up to 30 channels of high quality premium programming to any subscriber in the broadcasting area. A small, inexpensive roof antenna and TV converter is all that is needed at the subscriber location. Transmission does, however, require line-of-sight to a master or repeater transmit antenna.

In many developing countries, no regulations exist governing the MMDS frequencies. On a global basis, MMDS systems outnumber traditional CATV systems.

VIDEO COMPRESSION

Video Compression squeezes signals into a smaller bandwidth. Digital compression is the leading technology to provide the best quality in the smallest space. Compression schemes take essential picture-by-picture information and condense it using spectrum-efficient digital coding. The data is then sent in a fraction of the spectrum formerly needed.

It is interesting to note that NHK, Japan's Broadcasting organization in cooperation with NEC Corp. has developed a new lightweight, digital satellite TV news-gathering unit (SNG). The significantly smaller fly-away can more easily be transported to news events. The transmit power is reduced to 20 watts using a small 1.2 meter dish. Overall weight is 1/2 of existing systems.

Increase in Capacity, Not In Cost

The equipment costs are minimal when compared to the costs of actual transmission. With several channels to share the cost of the entire delivery system, the individual share is therefore significantly lower. There is, however, no such a thing as a free lunch. There will be a limited number of satellite channels that will be designated for compression because of the scarcity of capacity. Popular channels will command a premium.

High Definition Television (HDTV) will be utilized, and, indeed, requires some compression technology since HDTV requires a much larger bandwidth or digital output . . approximately twice that of standard television formats.

BUSINESS AND EDUCATIONAL TV

A small but growing market is the market known as Business TV. It was one of the first market niches to take advantage of the lower transmission costs using compressed video. It does not demand the same full-motion, high-quality of broadcast television.

Private **Networks** represent more than half of all Business Television. Educational or informational networks comprise the balance. Applications drive the US $610 million dollar world market. Already, the Asia market is almost equal to the near $300 million US market. About 46% of the world market is used by manufacturing companies.

The growth of private networks is indicated in **Figure 10**. There are a total of 132. The location of downlinks is dramatically different than the location of the network. This is shown in the **Figure 11**. The US has 2 1/2 times as many downlinks as Asia.

Live applications drive the business. The European networks comprise the smallest segment since most usage is tape.

Once Business Television is integrated into desktop computers, a significant expansion in the market is expected. The technology is available already, so the expansion is imminent.

TELEPORTS AND VSATS

Teleports are significant installations of satellite earth stations, terrestrial transmission interconnections and real estate developments.

Satellite C-band frequencies share the same frequencies as terrestrial microwave. Radio Frequency Interference (RFI) is a major problem in locating C-band earth stations in urban areas.

Teleports were the only solution. Such communications centers, which could be shared by many users in a centrally-located or metropolitan area were established. Besides providing communications services, a teleport also serves as a magnet for real estate development. Strategically located, such real estate development could relieve urban congestion while providing economic growth.

VSATS

A Very Small Aperture Terminal ("VSAT") network consists of a satellite, a central hub, and anywhere between 10 - 1,000 VSAT terminals (antennas). Terminal sizes range from .4 meters to 2 meters. C-band antennas are slightly larger than Ku-band. In the US, VSAT operators use Ku-band. In other parts of the world, the situation is the opposite. Developing nations, particularly those near the equator, use C-band.

VSATs offer a flexible, low cost, quick solution to data and voice service needs. The major impediment to VSATs is monopolies and regulations. The needs of the economic development and social goals of the population clearly favors VSATs.

In North America, there are an estimated 100,000 VSATs. By 1997, it is estimated that there will be over 200,000. At the same time, European VSATs will reach 20,000. The potential is much greater if deregulation were to continue.

Pacific Satellite Demand

Forecast Market Share Breakdown by Application

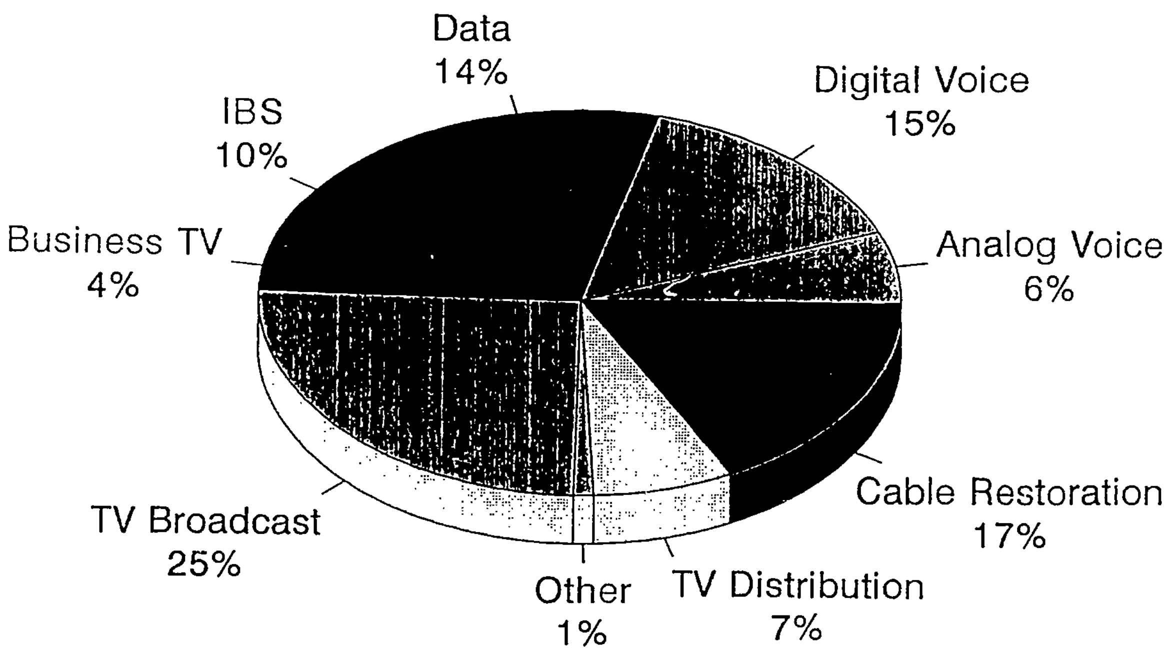
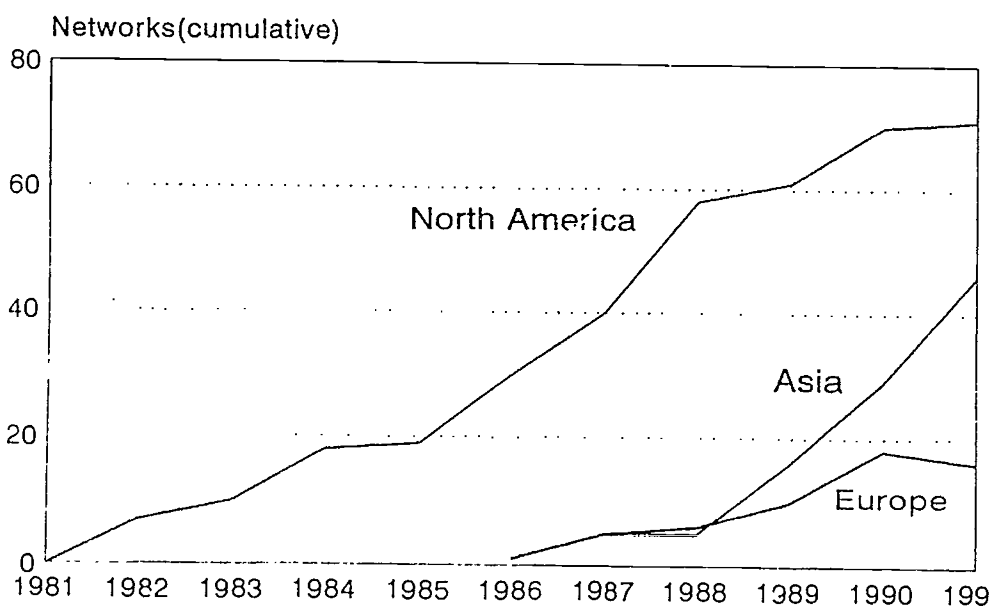


Figure 9

OPERATIONAL PRIVATE NETWORKS

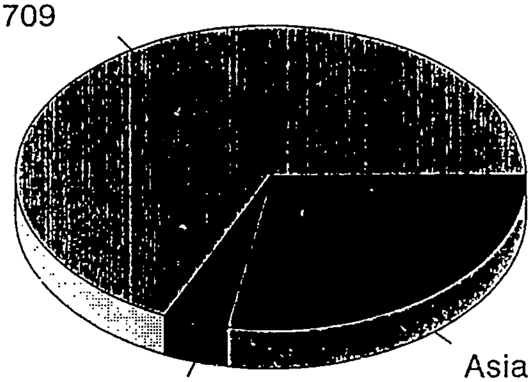


KJH Communications

Figure 10

PRIVATE NETWORK

DOWNLINKS BY REGION



132 NETWORKS

Source: KJH Communications **Figure 11**

I have covered the entire satellite market from the beginning to the present. I even added a bit of the future. As presented there is a huge multifaceted problem in forecasting Satellite Demand.

Is there an easy way to forecast satellite demand? The answer is no! Let the entrepreneurs build the satellite systems at their own risk. Supply and demand will reach equilibrium eventually. Remember, satellites have a limited life and, therefore, only the question of replacement remains.

Al Bond
President
Satellite Management International, Inc.

BUSINESS TELEVISION IMPACTING THE CORPORATE BOTTOM LINE

As the cost of doing business continues to escalate, the need for cost-effective solutions becomes more demanding. A trend which began in the United States over ten years ago is now bringing the power of television into businesses around the world. Satellite delivered business television is having a major impact on the way businesses do business.

Business television has long been an effective communications tool in the United States. The first satellite business networks began operation as early as nineteen eighty. Today there are nearly one hundred such networks in operation in the United States. Europe is just beginning it's growth cycle. Plans are being developed to begin similar networks in the Asia Pacific and Australia.

The visual and verbal impact of television brings an unprecedented opportunity to reach the intended audience in a manner to which they are most accustomed. Today's work force has hardly known a world where they did not receive information and education from the television screen: a new baby is placed in a cradle where it is rocked and given a chance to observe the motions on the television screen. Then on to school, where more and more information is delivered via television. So,it is natural to receive video and audio information in the work place.

Dramatic new technological changes are taking place which are allowing the expansion of business television networks throughout the world. There are three basic types of business television networks, each has a very specific purpose: Corporate Networks, Subscription Networks, and Special Purpose, Advertiser Supported, Networks. The following will outline their purposes and explain their impact on the areas in which they serve.

In the early 1980's, corporations began to develop business television networks to take advantage of the power provided by satellite technology. The need to communicate with large numbers of people in widely dispersed locations provided the incentive to take advantage of this communications innovation. Businessmen and women needed timely information. Now there is little chance that the information distributed before in memos would be lost due to non-readership by staff members. Regular staff and sales meetings have evolved as a normal part of business television network services. Managers talk with their staff wherever they are located, interchanging time sensitive information. Additionally, the staff has the capability of questioning those presenting the information on the television screen using return audio over a normal telephone line.

Corporate business television networks are not common to one product line. These networks support anything from hardware to software, clothing to stocks, controls to computers, insurance to electronics. The list goes on and on. Among the numerous applications are: new product announcements, development of marketing campaigns, product reviews, customer seminars, employee benefit programs, annual stockholders meetings, employee enrichment and motivational programming, fund drives, etc.

Looking closer at some of these programs we find:

New Product Announcements--- a regular part of corporate satellite network activity which can be an integral part of an organization's sales training program, used to educate employees, or included in a planned focus group directed toward customers.

Customer Seminars--- a popular way to attract attention and focus information of interest to certain customer groups. Entire networks are designed and set up with the idea being to bring potential customers into the network owner's place of business. Manufacturers readily invest promotional funds in satellite communications to increase sales and reduce the cost of doing business.

Training --- an effective method and a cost saving event for the company using satellite delivered instruction. Larger numbers of employees are able to receive instruction at the same time, which results in quicker implementation of their new knowledge with working teams also trained via the satellite network. Training via satellite frees employees to spend more time on the job and reduces travel expense.

Traditional, costly multiple national sales meetings are no longer necessary as corporations with satellite networks now have national and international meetings weekly, monthly or quarterly. Instructional programs are produced and released to the employees via satellite, ensuring that all receive the same information at the same time. In many business circumstances this timely information can save the originating company many millions of dollars and result in increased product sales. Employee time on the job is increased, resulting in greater productivity. A happy employee is one who is no longer required to make endless business trips, thanks to live interactive television presentations on the corporate satellite television network.

It should be noted that throughout the world training needs of an organization receive a great deal of discussion by upper management, but only in a few selected locations is action really taken to support training. It is, however, the customer that generates the most interest in the mind of management. Training via satellite is done more effectively in most cases. Travel is reduced for the employee. The staff is freed to spend more time on the job. Traditional training done via satellite reduces extended trips on the road. These trips are becoming cost prohibitive reducing the amount of time being allocated to valuable training. The training is most likely to be an addition to the network rather than a primary reason.

Subscription networks are relatively new in the business television world, having their inception in the latter part of the eighties. With these networks, viewers pay for the right to receive programming designed to meet specific needs. Networks which address the financial community, automotive manufacturers and retailers, civil servants, such as police and fire departments as well as emergency teams, all find it cost effective and educationally beneficial to participate in subscription networks. These networks are becoming an integral part of business television as the power of numbers brings reduced costs for the individual subscriber. An example is found in the Law Enforcement Network available throughout the United States. For a minimal fee, subscribers receive twenty-four hour per day training and information important to the law enforcement industry. Top quality instruction and timely information is now available to law enforcement officers no matter how small their departments may be.

These networks develop quickly, with thousands of subscribers, because of the need for services provided. To date, the subscription network concept has yet to find an application outside North America, but the concept and techniques are being studied in many of the developing nations of the world. We can expect to see a dramatic increase in this type of network within the next few years. One of the driving forces which will facilitate this explosion is the heart of the latter part of this paper.

The newest entry into the business television arena is Special Purpose, Sponsor Driven, Satellite Networks. In this type of network very special groups are targeted for the delivery of industry specific information and those companies which produce products for each industry find it very attractive to advertise to the special audience groups.

A current example of a Special Purpose Network is the American Transportation Television Network. This network is designed to support the American truck driver in providing him with industry news, government plans and regulations, weather conditions, safety tips, lifestyle clips, and a great deal more, all designed to improve his quality of life.

Advertisers are aware of the enormous buying power of the trucking industry and are excited about spending their advertising dollars which are guaranteed to reach their target audience. Before the introduction of this network concept, target audiences were addressed as a part of mass media advertising campaigns or little read publications for the industry. This new type of business television network and it's ultimate success depends on the advertisers' perception of the impact generated by their specialty sales dollars.

Driving the growth of the subscription and the advertiser supported networks, in particular, is the new video compression technology. Electronic technology is now making it possible to use only a small portion of the television signal and still reproduce the same quality picture. Using this new technique it is possible to produce multiple broadcast signals on a single satellite transponder. Video compression makes it possible to increase the number of channels providing for more programming space, reduce the cost for satellite space segment, and open new horizons for potential programmers.

In today's satellite market, getting occasional transponder time when you want it has been a problem for the business television network manager. Digital compression increases transponder availability and eliminates this stumbling block. Full implementation of this technology will only be realized when PTT's offer the digital service necessary for full broadcast quality service using occasional and fulltime transponder service.

Compressed full-motion technology is destined for the desks of businessmen and women and will provide unique business applications in the future. This new technology must not be confused with the point-to-point digital compressed technology used on a limited basis to carry low quality pictures on data lines. Compressed full-motion technology is today's state of the art method of delivering a television picture of noticeably better quality than the analog systems presently in use throughout the world.

At this time, there are several competing technologies attempting to get the business television world's attention. Already in the marketplace is the technology of Compression Lab Inc. In development and yet to be introduced are technologies by Scientific Atlanta, General Instruments, and several others. None of these technologies support the new universal standard being developed by the motion picture experts group who are striving for a compatible standard to be implemented around the world.

Early users of this pre-MPEG II technology will have to be satisfied with their decision and take advantage of the current technology rather than waiting for the extended decision-making processes necessary for a universal standard. Because the technology is new it is difficult to forecast who will win. It is reasonable to assume that the technology which is already in the marketplace will clearly have the lead. If the new MPEG II introductions are so significant that they make the existing systems obsolete, the early users may find themselves with a difficult compatibility problem.

Problem free broadcast and reception service is what the business television community demands. Responding to their needs are network management service companies. These companies are dedicated to handling every step in the transmission and reception chain. This leaves the message development to the user. Satellite management companies support the activity of business television networks in their country of origin. A few are equipped to support business television around the world. Such service companies have the necessary contacts with satellite owners, hardware suppliers and service technicians throughout the world to install and operate an international network.

The digital revolution is here and business television is poised to take full advantage of this technology. Integration of full-motion video with computer generated data is and will continue to push the communications skills of the business community. No part of our world will be left out. As in the past, the business community is providing the demand and technologies are providing the solutions to the communications needs of our world.

ZAP, CRACKLE AND POP: Health Concerns in the U.S. as to Radio Frequency Electric and Magnetic Fields Emitted from Telecommunications Facilities

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An issue of increasing importance to telecommunications companies is rising public concern about the safety of non-ionizing radio frequency electric and magnetic fields which emit from telecommunications facilities or devices. Litigation is growing as plaintiffs file suits against telecommunications companies and claim their serious illnesses are caused by radiofrequency EMF.

1. Introduction

More and more attention is being placed on the issue of potential adverse health effects from non-ionizing electric and magnetic fields ("EMF"). Although most concern about so-called "electromagnetic pollution" has been focussed on extremely low frequency ("ELF") EMF emitted by power lines, the public debate has encompassed whether non-ionizing radio frequency ("RF") EMF associated with cellular and microwave transmission facilities, cellular telephones, broadcast towers and video data terminals may be harmful to human health.

This concern is rising despite the fact that most scientists agree that the biological effects of exposure to EMF are frequency dependent. Thus, although most scientists agree that health effects relating to *extremely low frequency* EMF cannot be generalized to *radio frequency* EMF, this point has tended to be lost in the public debate. Typically, sensationalistic press reports that cancer may be linked to living near high voltage power lines have alarmed citizens and local agencies, who often jump to the conclusion that radio frequency EMF has the same physical effects as the extremely low frequency EMF emitted from power lines.

This article reports on the status of the controversial debate in the U.S. as to whether non-ionizing RF EMF associated with telecommunications facilities may be linked to adverse health effects in humans. A brief explanation of radio frequency EMF is first provided, along with how the ELF EMF issue gained national attention. Activity by some of the most influential public agencies--the federal Environmental Protection Agency and the California Public Utilities Commission, is then explained. A currently pending Florida lawsuit is then described as an example of potential RF EMF lawsuits that can be expected to be filed against telecommunications companies. Finally, the author suggests steps that a telecommunications company may take to prepare and deal with this volatile issue, ranging from doing nothing, establishing educational programs, considering low cost "prudent avoidance" techniques, funding of research, monitoring EMF-related legislation, and strategizing for potential litigation claims against a telecommunications company.

2. What is Non-Ionizing Radio Frequency EMF?

All around and within humans are fields of electrical and magnetic energy emitted from natural sources such as human cells and the earth itself, as well as from manmade sources, such as household appliances, power lines, microwave ovens, and radio and television broadcast transmitters. This kind of non-ionizing radiation has been long regarded by scientists to be harmless to human health. In layman's terms, non-ionizing EMF is electrical energy in a form that passes through matter without dislodging electrons from atoms. The failure to dislodge electrons from atoms is why it is called "non-ionizing." When power to the source of the non-ionizing radiation is turned off, the emissions of non-ionizing EMF stop completely.[1]

Two forms of electromagnetic energy that humans are able to sense are heat and light. Much of the spectrum of electromagnetic energy is invisible to humans, however. The electromagnetic "spectrum" begins at the extremely low frequencies with long wavelengths, such as 60 hertz EMF emitted by power lines, and continues up to X-rays and gamma rays which have very high frequencies and short wavelengths. In between those extremes lie radio waves, such as amplitude-modulated ("AM") and frequency-modulated ("FM") radio waves, microwaves, infrared radiation, visible light and ultraviolet radiation. The latter are generally referred to as "radio frequency radiation" or "RF radiation."[2]

Prior to 1940, there was very little non-ionizing EMF in the ambient levels of the U.S. environment. In the last five decades, however, the levels of exposure have risen dramatically due to increased output of non-ionizing EMF by power lines, satellite microwave communications, telecommunications facilities and radar. Many typical

American homes also contain additional sources of non-ionizing EMF, such as electric appliances, video display terminals, televisions, radios, and cellular telephones. In short, the modern American is bombarded by non-ionizing EMF on a daily basis.

3. Sparking the Controversy

A 1979 Denver epidemiological study that linked childhood cancer to high voltage power lines was the first scientific study to cause much attention to be focussed on the extremely low frequency EMF issue related to power lines. Two researchers, Drs. Nancy Wertheimer and Ed Leeper, found a connection between living next to certain types of electric power lines and childhood leukemia. A 1982 study by the same scientists found a similar link between living near electric power lines and adult cancer.[3]

Although scientists generally agree that short exposures to non-ionizing EMF is harmless to human health, a minority of scientists have sounded alarms that chronic exposures, even at low levels, may be dangerous. Other scientists have performed studies which found no association between the development of cancer and exposure to non-ionizing EMFs.[4] Still in progress are other scientific studies focussing on the issue of whether non-ionizing EMFs cause cancer.

In sum, a careful review of the EMF issue reveals that the clear consensus among knowledgeable scientists is that the evidence is inconclusive as to whether non-ionizing EMFs cause cancer in humans. Until further studies are done, the connection between non-ionizing EMFs and cancer remains only a possibility. Notably, these highly publicized studies have focussed on non-ionizing EMF produced *by high voltage 60 Hertz power lines, which is the extremely low frequency portion of the spectrum*. As noted previously, radio frequency EMF is located much higher on the EMF spectrum, and scientists agree that no generalizations can be made about radio frequency EMF based on the relatively recent studies of the effects of extremely low frequency EMF related to power lines. Nevertheless, the extremely low frequency EMF studies are important because they prompted widespread public concern.

A popular writer named Paul Brodeur further ignited public controversy by publishing a book, ominously entitled, "Currents of Death: Power Lines, Computer Terminals and the Attempt to Cover up Their Threat to Your Health" in the late 1980s. Brodeur is a New Yorker magazine environmental reporter who has previously alerted his readers to environmental hazards posed by ozone depletion and asbestos. Told like a riveting medical detective story, Brodeur's book can be characterized as a dramatic argument that a few honest scientists have discovered that exposure to extremely low-frequency EMF (especially from high voltage power lines) poses a grave danger to public health, but their efforts to inform the public are blocked by a massive conspiracy of silence, denial and obfuscation ranging from the Environmental Protection Agency, the National Institute for Occupational Safety and Health, the Occupational Safety and Health Administration, the Food and Drug Administration, the Office of Management and Budget, various branches of the military, several of the Department of Energy's national laboratories, professional groups such as the American Medical Association, state agencies, most of the North American power companies, IBM, and Bell Laboratories.

Brodeur's book primarily treated the topic of extremely low frequency EMF emitted by power lines, but he also implicated EMF emitted by video data terminals as having potential adverse health effects on humans. The Brodeur book has been highly criticized by knowledgeable scientists who argue strenuously that Brodeur deliberately oversimplified and misrepresented the complexity of the scientific process and the evidence that it has produced. These scientists argue that, thus far, there is insufficient data to establish any link between extremely low frequency EMF and adverse health effects. While some studies have shown a link, other studies have not. Nevertheless, the book has been very successful in increasing the public's awareness of the EMF issue and shaping the way many concerned decisionmakers and citizens frame and think about the EMF issues.[5]

4. The Draft EPA Report

In October 1990, the federal Environmental Protection Agency ("EPA"), released in draft form a report, entitled "Evaluating the Potential Carcinogenicity of Electromagnetic Fields." The report reviews and evaluates published information pertaining to the potential carcinogenicity of electromagnetic fields, including both extremely low frequency EMF and radio frequency EMF. The information includes epidemiology studies, chronic lifetime animal tests and laboratory studies of biological phenomena related to carcinogenesis. It opined that, while there are epidemiological studies that indicate an association between electromagnetic fields or their surrogates and certain types of cancer, other epidemiological studies do not substantiate this association. It tentatively concluded that EMF is a "possible" carcinogen, but found that there is insufficient data to determine whether or not a cause and effect relationship exists, and further research seems warranted.

The draft report, which was stamped "DRAFT - DO NOT QUOTE OR CITE," was immediately quoted in the press and became a matter of public controversy. The controversy centered around news reports that some of the EPA's staff had recommended that EMF be rated as a "probable" (as opposed to a "possible") human carcinogen. News accounts reported that due to alleged concerns by the EPA and White House as to the public policy implications of such a pronouncement, the EMF cancer risk was downgraded to "possible" by order of an EPA official after consulting with White House officials.[6]

The Science Advisory Board of EPA reviewed the draft and concluded it needed substantial revision, because it failed to consider critical research published since 1989, it contained insufficient data to conclude that EMFs are carcinogens at all, and there were insufficient information to designate specific values of magnetic fields strength that may be hazardous to human health. Due to these comments, it may be early to mid-1993 before the final EPA report is issued.[7]

In reviewing the EPA draft report from the point of view of telecommunications companies, the draft report apparently failed to differentiate adequately enough between extremely low frequency EMF and radio frequency EMF. Many reviewers who filed comments on the EPA draft report have made the point that exposures to extremely low frequency EMF may not support evidence of the same effects following observations from exposures to radio frequency EMF and microwaves. The main reason given is that electric and magnetic fields' mechanisms of interaction with, and effects on, biological systems are entirely different for lower versus higher frequencies, and thus, reported findings of health or biological effects should be presented in a manner that recognizes such a difference.[8]

The importance of the final EPA report will be great. At last, there will be a report based on a comprehensive federal governmental study that can be used as evidence in court, before state regulatory agencies, and in crafting legislation.

5. <u>The California Public Utilities Commission Investigation</u>

Stepping into the fray have been some state agencies. For example, the California Public Utilities Commission ("CPUC") is the state agency that regulates utilities, including electric and gas companies, landline telephone companies, cellular telephone companies, and radio telephone utilities. In January 1991, the CPUC opened its first comprehensive EMF investigation "to explore the scientific evidence relating to possible health effects, if any, of utility employees' and consumers' exposure to electric and magnetic fields created by electric utility power systems," and to examine "the range of regulatory responses which might be appropriate." It indicated it would examine four possible alternatives of regulatory responses: (1) no action because there is not enough evidence to warrant action; (2) restrict any increase in exposure but leave the present levels of acceptable exposure as they are; (3) adopt a new policy of "prudent avoidance" which limits exposures where they can be avoided with relatively small amounts of time and money; and (4) if the evidence suggests a serious health problem, commit substantial time and money to an aggressive program of limiting EMF exposure.

In its order instituting the investigation, the CPUC named both electric utilities and cellular radiotelephone utilities ("cellular carriers") as respondents. The CPUC specifically included within the scope of its investigation cellular telephone facilities over which the CPUC has environmental review authority.

The cellular carriers were dismayed at being lumped into a proceeding with the electric utilities into what they foresaw as a major investigation on the extremely low frequency EMF issues relating to power lines. The cellular carriers feared that the CPUC may be confusing the power line EMF issues with issues related to the low level radio frequency EMF produced by cellular transmission facilities. The cellular carriers then adopted a strategy that other telecommunications companies may find helpful when faced with similar agency investigations.

First, the significant first step was that the cellular carriers got together and hired one counsel and experts to represent their common interests. Second, they filed a motion to have the investigation split into two phases, one phase for the electric utilities and the ELF issues related to 60 Hertz power lines, and the second phase to address issues related to radio frequency EMF released by cellular transmission facilities. The cellular carriers' motion was granted.

Finally, the Cellular Carriers Association of California and the national Cellular Telecommunications Industry Association filed joint comments in the CPUC investigation in April 1991. These comments contended that the scientific community's consensus was that the very low level emissions from cellular transmission facilities are safe and do not in any way pose a danger to the health of the general public. This conclusion was supported by expert testimony from two experts in the field.[9] The expert testimony argued that the power density levels of emissions from cellular transmissions to which the public is exposed are well below permissible exposure standards set by numerous independent scientific bodies to ensure the health and safety of the public.[10] Their conclusions were supported by actual measurements taken in and around cellular transmission facilities operating at maximum power. These measurements demonstrated that the power density levels in the vicinity of such cellular facilities are significantly lower than the permissible exposure levels that have been scientifically determined to be safe.[11]

The cellular carriers also explained in layman's terms where cellular operated in the radio frequency spectrum, and distinguished the ultra high frequency ("UHF") radio wave transmissions of cellular carriers from the fields associated with electric power lines. The experts emphasized that, unlike the scientific research conducted in the ELF EMF area, there are over 10,000 scientific papers and references relating to studies of biological effects associated with radio frequency exposure. These papers and references have served as a database for the setting of permissible exposure levels to ensure public protection from adverse health effects from radio waves. Testimony was offered showing that, as indicated by the scientific data, and the actual field measurements, power densities from cellular facilities are substantially lower than the levels reported in the scientific literature as causing any biological effects, and well below both National Council on Radiation Protection and Measurements and American National Standards Institute permissible exposure standards. Consequently, the carriers argued that the probability that any member of the general public could be exposed to hazardous levels of RF radiation from a cellular facilities is "essentially zero." Thus, the carriers argued that no active regulatory response was warranted at this time to protect the public from cellular transmissions.

At this time, the CPUC has formed a consensus group to recommend to the Commission the issues to be addressed in the cellular phase of the EMF investigation. No hearing or decision has issued to date.

6. Radio Frequency EMF Issues Relating to Cellular Telephones

A. Florida Lawsuit

Lawsuits involving radiofrequency EMF issues are beginning to be filed more frequently in the United States. On April 11, 1992, a complaint was filed in the Circuit Court for Pinellas County, Florida by a woman, Susan Ellen Reynard, and H. David Reynard, Jr., her husband, against the following defendants: (1) NEC America, Inc. ("NEC"), the manufacturer of Mrs. Reynard's cellular telephone; (2) Coastal Radiotelephone, Inc. ("Coastal"), the entity which sold the cellular telephone to Mrs. Reynard; and (3) GTE Mobilnet of Tampa, Inc. ("GTEM"), Mrs. Reynard's cellular service provider.

The complaint alleges that in May of 1990, Mrs. Reynard was diagnosed with a brain tumor which resulted in cancer. The complaint alleges that the tumor was a result of radiation emitted by a cellular telephone used by Mrs. Reynard, or if not caused by such radiation, the tumor was aggravated by the cellular telephone's emissions. It further claims that emissions from the cellular telephone were so positioned "as to cause exposure to microwave radiation in an excessive and unsafe amount to the portion of the brain where the tumor was found to exist."[12] The cellular telephone is alleged by plaintiffs to be "unreasonably" dangerous for use because it exposed the brain of users to dangerous, hazardous and excessive microwave radiation, it was not equipped with shielding devices which could have been provided by the manufacturer, the product was not marketed with warnings as to the hazard or instructions on how to avoid the hazard, the telephone failed to meet accepted standards setting maximum levels of exposure to microwave radiation, and no information was provided at the time of purchase or later which provided precautions as to lessen the risk of injury from the hazardous condition.

The plaintiffs requested relief as follows: (1) against NEC for negligence in the design or manufacture or sale of the cellular telephone and for strict tort liability in the sale or distribution of the cellular telephone; (2) against Coastal for negligence and strict tort liability as to the sale of the telephone; and (3) against GTEM for negligence and strict tort liability in the operation of its microwave system so as to cause excessive microwave exposure to Mrs. Reynard. The plaintiffs requested unspecified punitive damages and a trial by jury. After filing the suit, Mrs. Reynard died on May 24, 1992.

All the defendants have filed motions to dismiss the case, and the suit is currently in discovery. Cellular carriers, equipment manufacturers, and retail outlets of telecommunications equipment may desire to monitor this case to see what the Florida state court decides.

Other examples of lawsuits that have been filed against telecommunications companies include:

- Settlement of a case brought by a husband and wife whose summer home is located near an FM broadcasting tower. The plaintiffs claimed the exposure caused the husband to develop terminal Hodgkin's lymphoma and the wife to have increased susceptibility to cancer.[13] They alleged that certain non-ionizing EMF "hot spots" measured on their property exceeded both the Federal Communications Commission ("FCC") and the American National Standards Institute standards by a factor of 10, although most levels in the house were significantly below the most stringent U.S. exposure standards.

- A Washington widower received compensation in a wrongful death action based on his wife's alleged exposure to non-ionizing EMF emitted from an AM radio tower.[14]

B. Brits Initiate Survey on Safety of Cellular Telephones

In Britain, a $1.5 million dollar survey backed by the government has been launched in June 1992 to look into the potential radiation risks of the mobile telephone. The survey is a collaboration between three British universities and eight telecommunication companies, including Cellnet, Vodafone of Britain, and Motorola of the United States. News reports state that although risks are thought to be minimal, the three-year study will look at any health dangers from high-frequency EMF emitted by the mobile telephones. One theory that is being investigated is whether the mobile phones can damage the user's health by heating up parts of the brain. Also being studied is the interaction between radio waves and brain tissue.

7. Preparing to Deal with EMF Issues

Given the raising of the public's consciousness about EMF, what should a prudent telecommunications company do to prepare for EMF issues? Here are some practical suggestions:

Do nothing.

A company can always do nothing. But what risk do it take via inaction? What will happen if a lawsuit is filed against the company? How will it defend its actions?

First, what would these suits likely allege? Traditional toxic tort legal theories can be asserted in a radio-frequency EMF exposure case. A plaintiff could allege negligence and strict liability on grounds that the defendant telecommunications company failed to use the highest degree of care in protecting its employees or the public from exposure to radio frequency EMF. Strict liability could be used if the plaintiff can show that the radio frequency EMF was produced or used under circumstances that constitute abnormally dangerous activity. For example, the Florida lawsuit discussed above alleged both negligence and strict liability against the cellular telephone manufacturer, the seller of the telephone, and the cellular carrier.

Recently, EMF cases have even alleged traditional legal theories of nuisance, trespass and battery. Nuisance and trespass are possible depending on the case facts. Battery may be available if it can be shown that the producer of EMF knew it was causing the contact with plaintiff, and the producer of EMF knew the contract was regarded by the plaintiff as offensive. Other less traditional theories are always available too; for example, it has been asserted in EMF cases that a plaintiff should recover for increased risk of adverse health effects and for fear of cancer. On the other hand, courts traditionally have insisted that a plaintiff prove present physical injury in order to recover on such theories. Thus, a plaintiff would likely use expert testimony to show that exposure to RF EMF has either caused cancer, or has caused adverse biological effects at the cellular level even if not yet observable.

Finally, the issue of whether RF EMF can be harmful to human health has been discussed for many years. A plaintiff could request punitive damages on grounds that the defendants knew or should have known that radio frequency EMF is harmful to human health, and that defendants failed to take affirmative steps to prevent exposure that was at harmful levels. Thus, the potential liability for doing nothing can be very high.

Establish an educational program on radio frequency EMF for customers and employees.

Another recommended option that is relatively easy to effectuate is to establish an educational program for customers and employees. Designate an EMF officer at your company, and make it this person's responsibility to monitor EMF issues, and be available to discuss the issue knowledgeably with your employees and the public.

Consider putting together an informational brochure discussing what radio frequency EMF is, how it differs from extremely low frequency EMF related to power lines, and summarizing the scientific body of knowledge to date. A number of the large cellular carriers, such as McCaw Cellular Communications Inc. and PacTel Cellular, have such brochures available and distribute them to land use agencies, concerned neighbors, and the press.

Another recommendation is to hire an independent expert to measure radio frequency EMF levels at a typical telecommunications transmission facility and have the expert opine under penalty of perjury in a report that the measured levels fall significantly below the most stringent current national exposure standards. Have this report ready to distribute to interested persons.

Undertake limited "prudent avoidance" measures.

A company could also undertake some limited "prudent avoidance" measures, which means a policy of voluntarily limiting EMF exposures when they can be avoided with relatively small investments of money and effort. This is one option being considered by various states and the EPA.

To effectuate this, one could simply take some low cost precautions, for example, placing EMF-emitting devices away from populated areas, adding fencing or safety zones around such devices, or adding shielding to EMF emitting devices during manufacture. For example, in Florida and New York, there are rules which require electric utilities to have magnetic field strengths for their transmission line right-of-ways no higher than 200 milligauss at the edge of the right-of-way. Similarly, in Colorado, the PUC found that, despite the absence of certain data, "prudent avoidance" dictated that a transmission line upgrade be conditioned on the use of some EMF reduction mechanisms and on the submission of a plan by the utility for further EMF research.[15]

Fund research on radio frequency EMF and the portion of the radio spectrum in which your company operates.

Another option is to assist in funding research on the radio frequency EMF issue in the portion of the radio spectrum in which your company operates. This will add to the body of scientific knowledge on the issue and help dispel unfounded fears.

Monitor and promote legislation related to radio frequency EMF.

Telecommunications companies also may wish to monitor, draft, or promote legislation regarding RF EMF. The monitoring could be performed by your RF monitoring officer, or through your industry's association to save costs. Clearly, EMF legislation is increasing, as interest in this area becomes more widespread.

Develop strategies for the defense of potential litigation claims.

One may also begin strategizing as to potential defenses for possible litigation claims as to radio frequency EMF. Retention of knowledgeable counsel and experts is recommended. They can assist you in strategizing to form your defenses, including traditional defenses such as contributory negligence, comparative negligence, or assumption of the risk. Naturally, a defendant will likely argue that exposure to radio frequency EMF is not harmful and could not be the cause of the plaintiff's injury. Hiring an expert would be invaluable in order to prepare a summary of the scientific body of knowledge to make the point that so far, there is no scientific "proof" that radio frequency EMF causes cancer.

A defendant can also explore whether there are any so-called "confounders" which refers to some other occupational, environmental or lifestyle risk factor which could be the cause of plaintiff's injury. For example, the defendant could allege that it was plaintiff's five-pack a day smoking habit which caused the lung cancer, not the plaintiff's proximity to a radio tower.

Also, a defendant can attack the plaintiff's expert with the usual strategies. For example, the following arguments can be employed: the plaintiff's expert is not qualified to opine on this specialized area or is expressing opinions that lack adequate scientific support; the expert's measurement of the radiation dosage was erroneously performed; or the expert's reliance on scientific studies showing EMF harm do not pertain to the part of the EMF spectrum at which the defendant's radio frequency operates.

8. Conclusion

The implications of the EMF issue will touch on a far-reaching variety of industries due to modern society's economic infrastructure which is dependent upon the availability of wireless communications and availability of electricity. Industries and public entities that are likely to be affected include telecommunications and electrical equipment manufacturers, retailers of telecommunications equipment, telecommunications companies with systems in densely-populated areas, local governments planning land use, developers who may be required to set aside land as buffer zones, school or park districts and other public agencies that require open space, designers of office buildings and structures equipped with generators, and medical diagnostic equipment manufacturers. A prudent telecommunications company should become familiar with the issue and monitor recent events, in order to be well prepared to deal with the EMF issue or the possibility of a lawsuit.

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ENDNOTES

1. Compare "ionizing radiation," which is commonly called "nuclear radiation," which is used in medical X-rays, nuclear power plants, nuclear weapons, and which can dislodge electrons and other atomic particles as it passes through matter. The radioactive materials that emit may continue to produce potentially harmful energy for a few seconds or for hundreds of years, depending on the material.

2. The radio frequency part of the electromagnetic spectrum is generally defined as electromagnetic radiation with frequencies in the range from about 3 kilohertz to 300 gigahertz. Federal Communications Commission OET Bulletin No. 56, Questions and Answers About Biological Effects and Potential Hazards of Radiofrequency Radiation, at 1-2 (3rd ed. January 1989).

3. Wertheimer & Leeper, Electrical Wiring Configurations and Childhood Cancer, 109 AM. J. EPIDEMIOLOGY 273-84 (1979); Wertheimer & Leeper, Adult Cancer Related to Electrical Wires Near the Home, 11 INT'L J. EPIDEMIOLOGY 345-55 (1982).

4. Creasey, Extremely Low Frequency Electric and Magnetic Fields and Cancer: A Literature Review, 1-8 (Electric Power Research Institute December 1989).

5. In December, 1992, Brodeur published a lengthy article in the New Yorker magazine about a group of California teachers who have alleged an official runaround after spending two years trying to find out if high-voltage power lines are responsible for 14 cancer cases at Louis N. Slater Elementary School in Fresno, California. This article will surely continue to increase attention to the issue.

6. Strauss and Bernard, EMF and the States: Time for a New Perspective, The Electricity Journal, Jan./Feb. 92, at note 1.

7. Id.

8. See, for example, Comments of Committee on Interagency Radiation Research and Policy Coordination, dated Aug. 5, 1991, at 2. See also Comments of Electromagnetic Research of the Department of Energy, dated May 23, 1991, at 2 ("A major problem and weakness of the Executive Summary is generalizing across RF and ELF radiation. . . It is a mistake to attempt to cover both RF and ELF in the same document as it as led to unjustifiable generalizations.").

9. The experts were Dr. Arthur W. Guy, Professor and Director of the Bioelectromagnetics Research Laboratory, Center for Bioengineering at the University of Washington, and Dr. Donald Justesen, Professor of Psychiatry at the University of Kansas School of Medicine.

10. The permissible exposure standards cited by the respondent cellular carriers were the National Council on Radiation Protection and Measurements ("NCRP") and the American National Standards Institute ("ANSI").

11. Actual measurements of cell sites operating under maximal operating conditions with all channels broadcasting simultaneously demonstrated, that, even under these conditions, the power density reading represented only 1% of the current ANSI permissible exposure standard. Typical energy levels associated with cellular transmissions are several hundred times below the NCRP permissible exposure standard for cellular radio frequencies (800-900 MHz).

12. Complaint, Susan Ellen Reynard, et al. v. NEC America, Inc. et al., Circuit Court for Pinellas County, Florida, Case No. 92-1750-CI-011, filed Apr. 11, 1992, at 2.

13. Main v. Jefferson-Pilot Broadcasting Co., No 88-B.1461 (D. Colorado., April 9, 1990).

14. Diluzio v. KGA Radio, Inc., No. 86-2-03790-4 (Wash. Spokane Cty., Super. Ct., filed Jul. 30, 1986).

15. In the Matter of Public Service of Colorado to Have Upgrades in Douglas County, Docket No. 89A-028E (Dec. 20, 1989), note 1, at 21-22; Elec. Util. Week, Jan. 22, 1990, at 1 and 10.

Risk, Security, and Policy Considerations in the Use of Computer and Communications Technology in Financial Management

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ABSTRACT

With today's advancing technologies, electronic transactions have created new risks, security problems, policy issues, and service performance issues. This paper describes the current status of the risk and security issues involved in the electronic transmittal of financial transactions. The research further considers the tradeoffs among security, costs, convenience, and risk.

1. Introduction

The financial management system in the corporate environment has changed dramatically due to the rapid advancements in computer and telecommunications technology. With the use of the information technology, financial transactions occur more frequently and more rapidly while the relative cost of information processing decreases. Technology affects the future price and mix of financial services offered, and plays a vital role in day to day operations of financial business functions. For example, electronic funds transfer (EFT), automatic teller machines, and cash management techniques are just a few of the new applications being offered.

However, as changes in information and communications technology revolutionize the financial services, significant issues have come to light with regard to the present public policy regulating the financial services and transactions. Partly because many premises of current policies in most countries were based on an industry that was not automated, the regulations are being questioned as to their relevance and appropriateness in the new technology dependent applications. Although fundamental policy objectives, such as fostering institutional stability and integrity or protecting consumers, remain the same as in the past, the focus of current regulation needs to involve access to services, system security, privacy, and effects of changes in telecommunications industry.

For example, there appears to be a compromise between system access security and control versus convenient customer access and service price in some of the major electronic funds transfer networks which amounts to approximately $1.29 trillion every banking day. A human mistake in the New York Stock Exchange caused the Dow Jones Industrial Average to fall nearly 12 points, which resulted in a 1.57 point loss for the day. Financial managements are vulnerable to computer and communication technologies (Neumann, 1992; Chung and McGowan, 1992).

The use of computer and communications technology creates a dramatic need for new regulations. New policies on the problems related to excessive daylight overdrafts and wire transfer liabilities are to be established. In fact, there has been a tradeoff between reducing payments system risk and promoting payments system liquidity. With today's advancing technologies, electronic transactions have created new risks, security problems, policy issues, and service performance issues.

We need to understand the current status of the risk and security issues involved in the electronic delivery of financial transactions. Furthermore, it is necessary to evaluate the tradeoffs among security, costs, convenience, and risk and the policy considerations. The following sections describe the risks inherent to participant in electronic payment systems and security measures as well as policy alternatives.

2. Risk

Four general categories of risk relating to payment systems have been identified: operational risk, credit/settlement risk, fraud risk, and money laundering risk. The main risks associated with funds transfer include the latter three items:

Settlement Risk

One issue of concern to the Federal Reserve is the creation of daylight overdrafts, which can be directly attributed to the electronic payment systems. The Federal Reserve requires all depository institutions to have a positive balance in their reserve account at the close of the business day. Daylight overdrafts are the deficient amounts or negative balances that reserve accounts may have prior to final settlement at the end of the day. Daylight overdrafts can be the results of intentional or unintentional mismatching of payments and receipts. Unintentional overdrafts often result from poor planning, inadequate communication, or computer problems. On the other hand, intentional overdrafts might involve borrowing federal funds from another institution as an overnight loan in order to maintain a positive end-of-day balance (VanHoose and Sellon, 1989).

The biggest risk associate with daylight overdraft is that of default. Since these overdrafts are viewed as unsecured loans, they expose the Federal Reserve and other financial institutions to potentially serious financial loss.

Fraud Risk

Another risk to the large-dollar funds transfer networks is fraudulent transfers. Because most payment orders are transmitted electronically, a bank may not know whether a funds transfer has been authorized by its customer. Internal collusion is also a big threat for financial institutions (Ahwesh, 1991).

Money Laundering Risk

Money laundering is a risk associated with the use of electronic payment systems to move the proceeds of illegal activities.

3. Security

Most safeguards may be grouped into four categories: physical security, access controls, encryption, and administrative controls: Physical security measures refer to the limited access to terminals and computer operations areas to only those individuals who require access to perform their duties. The use of guards, surveillance equipment, and card key access devices are the most commonly used tools for physical security. Access controls refer to both software and code words that are used to prevent unauthorized access to sensitive data and programs. Next, encryption involves the scrambling of a message sent from one party to another to protect the confidentiality and integrity of electronic transactions. Lastly, administrative controls refer to the employment practices, separation of duties, and software development standards in place by an organization. Such security measure as password, callbacks, algorithms, encryption, authentication, and smart card are possible controls that can be in place when transfers are initiated (Brandon,1991; Cocheo, 1991; Fischer, 1988).

4. Policies

Important policies focus on the problems related to excessive daylight overdrafts and wire transfer liabilities.

Daylight Overdraft Regulations

In order to slow the growth of overdrafts on Fedwire and reduce payment system risk, the Federal Reserve has implemented a policy highlighting two features: overdraft caps and the pricing of daylight overdrafts. The first method of reducing daylight overdrafts places a limit on the amount of intraday credit available in individual institutions. Those who exceeding their overdraft caps are penalized by limiting their ability to conduct additional transfers on the wire systems (VanHoose and Sellon, 1989). Along with these caps, the Federal Reserve has established a pricing scheme to charge institutions for daylight overdrafts. Under the pricing scenario, institutions would be charged for the average intraday overdraft that exceeds a deductible equivalent to a certain percentage of capital (Ahwesh, 1991).

Wire Transfer Liabilities

The Uniform Commercial Code requires that the use of security procedures be established by agreement between a customer and a bank for the purpose of verifying a payment order or any communication amending or canceling a payment order (Brandon, 1991). The other issues addressed by the Code deals with erroneous payment orders in which a customer and a bank have agreed on a security device to detect erroneous payment orders.

5. Tradeoffs

The increased use of electronic payments has clearly improved the efficiency of financial markets by lowering the costs and increasing the speed of transactions. However, there has been a clear tradeoff between reducing the risk of payment system and promoting payment system liability. Overdraft policies and security devices are the two main factors that can affect the performance of payment systems. Without regulated overdrafts, the obvious advantage is the resulting increase in speed at which payments can be sent or received. With the implementation of overdraft caps and pricing of overdrafts, payment processing will be slower because institutions will need to synchronize electronic funds flow to avoid unnecessary expenses. As a result, the gains from reducing the risk of payment system against the costs of reduced payments system liquidity need to be balanced (VanHoose and Gordon, 1989).

As far as the security measures are concerned, the more secure the transfer system is, the more delay in transaction processing will occur. Often customers may adopt less secure procedures because of the costs associated with the actual security devices, such as authentication devices, and the costs associated with the transfer delays resulting from the higher level of security. Tradeoff must be considered among security, costs, convenience, and risk.

6. Conclusion

Trends in financial institutions—decentralized operations, network, and open systems—will promote the electronic utility of delivering enhanced services to customers. With the globalization of the banking networks, financial services market face the events of 24-hour trading, payments over the electronic funds transfer systems in different countries made in different currencies, and difficulties in establishing global network regulations. In this paper, risk , security, and legal issues affecting international EFTs have been recognized: Issues associated with the payment process, electronic recordkeeping, and the institutional structure within which an EFT system operates have been addressed. There is a compelling need to address these concerns in the electronic financial transactions as the technology advances rapidly and becomes available economically.

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Low Cost Information Gateways

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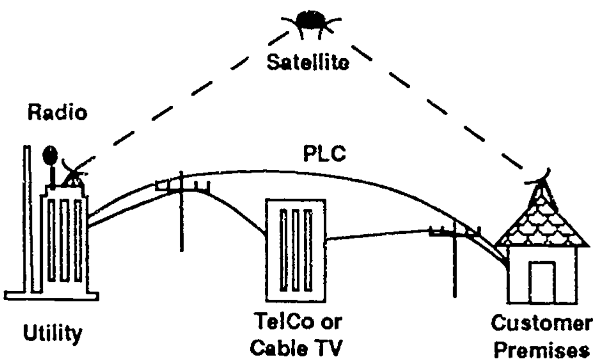
Abstract

Information Gateways that provide energy management, information services, and building automation have been developed and are undergoing trials in the field. Gateways are available for interconnecting various Wide and Local Area Networks (WANs and LANs). Depending on specific applications, each gateway is configured with appropriate WAN and LAN interfaces and operating software. Both current and future generation gateways integrate previously separate data conversations and thus 1) reduce communications costs and 2) expand communications applications.

Communications Today

Today, communications users typically have access to more than one WAN in their home and workplace. The most common WAN is the telephone network, and almost everyone has ready access to telephone service. Another common WAN is cable TV, which passes in front of 90% and is actually wired into over 60% of U.S. homes. Satellite service is another WAN, cellular telephone is another, and so forth. Various WAN connections to a customer premises are shown in Figure 1.

Figure 1.
WAN connections to a Home



Today, users wishing access to these WANs must provide individual interfaces to get "hooked up" to a particular WAN. If more than one device will use the WAN, or if multiple WANs are used, many costly interfaces that don't interoperate must be provided by users.

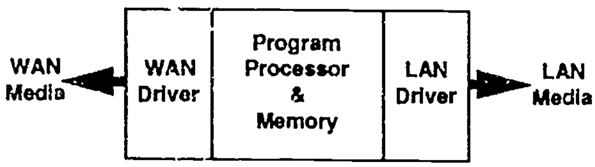
Consider the proliferation of facsimile (Fax) machines and data modems for personal computers; each has a dedicated telephone interface, and each operates without knowledge of the other (often to the user's disservice). Many newer phone answering machines hang up when a user picks up an incoming call after the "machine" has answered it—but for years this was not so. Further, Fax machines and personal computer data modems may never yield the phone line for someone wishing to call in or out. These types of problems have led to the proliferation of multiple phone lines to homes, and to a much greater extent, commercial spaces. It is very rare today to find a business with only one phone line. Even the smallest business may have three or four lines (at a monthly cost of approximately $50.00 per line), with one usually dedicated to Fax service.

It has been said that we "live in the Information Age," and many predict a proliferation of connectivity—but this means more interfaces and costly specialized connections unless gateways are used.

What is a Gateway?

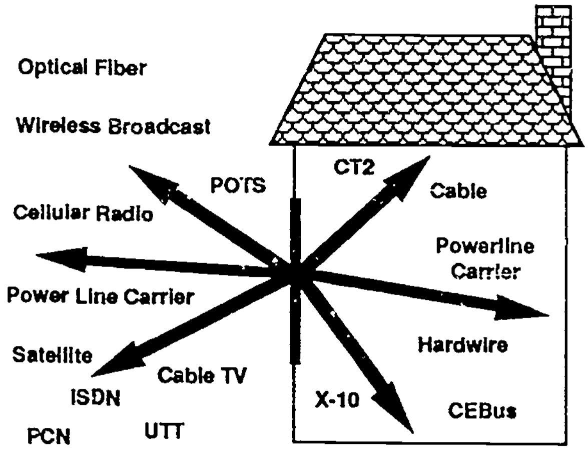
An information gateway is a communications controller or "data switch" between dissimilar networks. It has a microprocessor and memory and is programmable to "talk" in the native language of each WAN and/or LAN to which it is connected. A functional block diagram of a simple gateway with a single WAN and single LAN connection is shown in Figure 2.

Figure 2.
Information Gateway with single LAN and single WAN



A gateway may connect to one or more WANs and LANs. It is able to transfer information across these connections (interfaces). A gateway with many possible connections for various WANs and LANs is shown in Figure 3 (the vertical line along the wall of the building represents the gateway).

Figure 3.
Information Gateway with many LANs and WANs



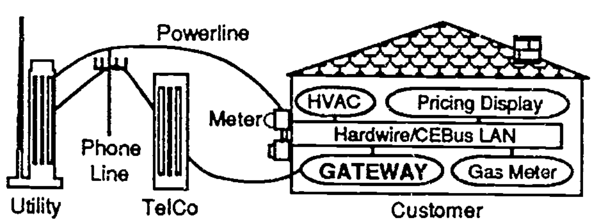
Applications

The Information Gateway may be installed in two possible locations: either on the customer's premises or in a location which is able to serve several customer premises at once.

One Gateway Per Building

A gateway may be mounted on or inside a building. Communications between local hardwired or powerline devices (meters, load control devices, information terminals, etc.) and remote hosts is provided. A hardwire or Consumer Electronic Bus[1] (CEBus) powerline LAN and telephone WAN are shown in Figure 4 (other options are available).

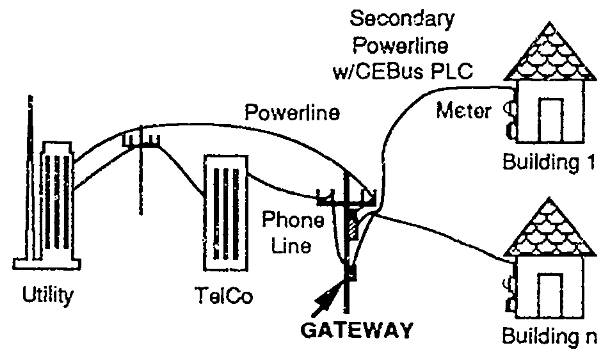
Figure 4.
Customer Premises Gateway



One Pole Mounted Gateway Serving Several Buildings

Alternatively, a gateway may be mounted on a utility pole or pedestal. Communications between local powerline devices (meters, load control devices, information terminals, etc.) and remote hosts is provided. A CEBus powerline LAN and telephone WAN are shown in Figure 5 (other options are available).

Figure 5.
Pole Mounted Gateway Serving Several Premises



There are a plethora of applications ranging from energy management[2], to data acquisition/process control, to information services, depending on where a gateway is installed and the needs of the customer(s). Some of the many possible applications are listed in Table 1.

Table 1.
Information Gateway Applications

Energy Management
- Utilize digital output ports:
  - Individually control AC or DC loads
- Utilize digital input ports:
  - Read pulse utility meters
  - Read serial utility meters
  - Monitor loads or consumption
- Utilize analog input ports:
  - Read voltage, current, temperature, etc.
- Utilize RS-232 port:
  - Send realtime or time of use pricing
  - Send usage and billing information
  - Allow customer access to usage and billing info.

Information Services
- Utilize RS-232 port for enhanced network and other information services such as:
  - Caller ID
  - Electronic Yellow and White Pages
  - Home Shopping
  - Home Banking

Building and Other Automation
- Utilize RS-232 and Input/output ports:
  - Security
  - Lighting control
  - Heating and air conditioning control
  - Process monitoring and control
  - Substation Supervisory Control and Data Acquisition (SCADA)

High Speed Data Concentrator
- Utilize several RS-232 ports:
  - Transaction processing (cash registers)
  - Credit card verifiers
  - Integrated voice/data

Markets

There are at least three major markets for information gateways: 1) mass residential/commercial, 2) small business, 3) work at home. By far the most attractive is the combined residential and commercial "intelligent network interface" market. With 100 million homes in the U.S. and tens of millions of commercial buildings, the volume of products and services that could be moved in this market is incredible. However, in the event that it is too early for mass deployment of gateways for Energy Management, Information Services and Automation—the small business and work at home markets should be considered (please see High Speed Data Concentrator application in Table 1). Because of the high cost of maintaining several phone lines, these markets would support a higher (entry) priced gateway and could be a starting point for deployment until gateway prices drop—making mass deployment in the residential and/or commercial market(s) feasible.

Configuration Options

Applications drive the configuration of a gateway[3]. If a gateway is to be an intelligent network interface, then it will likely be installed at the network-to-customer point of demarcation (i.e., network termination). Depending on which communication company is providing service, one or more WANs may be used. Depending on local area applications to be supported, one or more LANs may be used. Various WAN and LAN options are shown in Table 2.

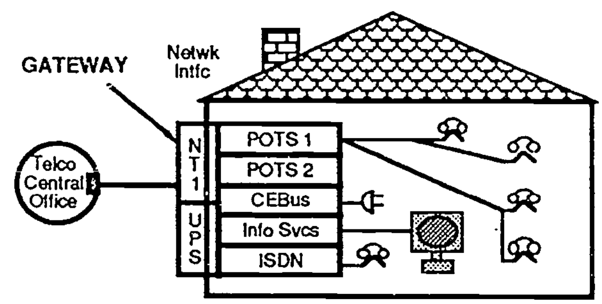
Table 2.
WAN and LAN Options

Wide Area Networks
- Plain Old Telephone Service (POTS)
- Integrated Services Digital Network (ISDN)
- Utility Telemetry Trunk (UTT/UTS)
- Cellular Telephone
- Personal Communications Network (PCN/PCS)
- Cable TV/ Satellite
- Packet Radio
- Broadcast radio

Local Area Networks
- Plain Old Telephone Service (POTS)
- Integrated Services Digital Network (ISDN)
- Cable TV
- Hardwire Digital Outputs
- Hardwire Analog & Digital Inputs
- RS-232
- X-10
  - Powerline Carrier
  - Radio Frequency
- Consumer Electronic Bus (CEBus™)
  - Powerline Carrier
  - Radio Frequency
  - Twisted Pair
  - Cable TV
  - Infra-red
- Echelon LON™
  - Powerline Carrier
  - Radio Frequency
  - Twisted Pair
- Adaptive Networks Powerline Carrier

As an example, a configuration for a telephone company that wants to provide energy management (for a local energy utility) and information services (for customers) might initially be installed with a Plain Old Telephone Service or Utility Telemetry Service WAN, and one day upgraded to Integrated Services Digital Network. When the upgrade occurs, the old WAN interface(s) would be swapped for or supplemented with an ISDN interface. The new configuration might look like that shown in Figure 7.

Figure 7.
Gateway Upgraded to ISDN

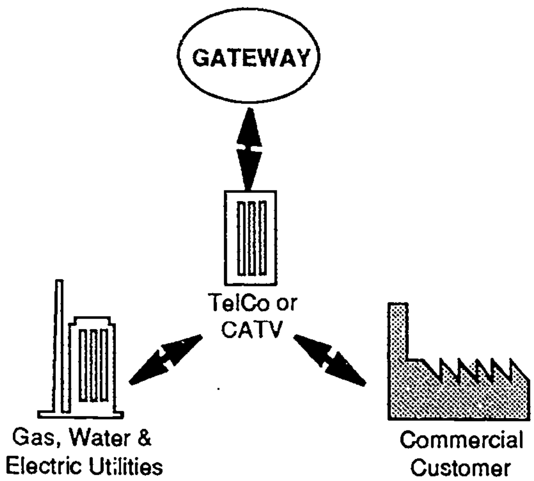


Who uses a Gateway?

Gateways may and should be used by more than one individual or entity. In the previous example, the gateway was installed by a telephone company, and was used to provide energy management for one or more utilities and information services for building occupants. Thus, there is more than one customer for the gateway.

The gateway can be thought of as an electronic (on-premises) information "mailbox". Within an energy utility, the metering department may "call" the gateway to gain access to meter readings; the load management department may access the gateway for load control; the customer planning department may access the gateway for end use (i.e. customer) surveys, etc. On the other hand, a utility's commercial or industrial customer may also access the gateway, though for different reasons. S/he may wish daily, weekly or monthly energy usage information (which the utility billing system does not likely provide) and retrieves this information by accessing the gateway[4]; or, perhaps remote process monitoring and/or control is a customer need. These too are accomplished by accessing the gateway. This type of joint access to a gateway is shown in Figure 8.

Figure 8.
Joint Access to a Gateway



Field Trials

CyberLYNX gateways are undergoing trials in the field by a telephone company and an energy utility. Additional trials with other service providers are planned.

Telephone Company Trial

Twenty CyberLYNX SEM470s are being installed by a Regional Bell Operating Company (RBOC) for the purposes of energy management (for a local energy utility) and information services (for customers). The gateways are installed on customers' premises and access the Integrated Services Digital Network and the X.25 packet switching network. Hardwire LANs are used, one for the customer information display/terminal and one or more for load management and monitoring. The overall system is astonishingly fast. The total elapsed time to call a gateway and pass a message, read a meter, monitor loads, and/or perform load management is well under a half a second. With a host computer supporting 128 logical X.25 channels, the system is expected to reach over 500,000 gateways per hour.

Duke Power Company Trial

CyberLYNX SEM470s are being installed by Duke Power Company. Three units are being configured as pole mounted gateways and access a Plain Old Telephone Service WAN. Each gateway is capable of communicating to meters on several homes via a CEBus Powerline Carrier LAN. Additional units are being used in each home and are configured as CEBus Powerline Carrier Modems so that appliances may be remotely monitored and controlled.

Available Products

CyberLYNX provides SEM470s on a general availability basis. They may be configured as Information Gateways or as remote CEBus powerline data acquisition and process controllers. ISDN and POTS WAN interfaces are available with future plans calling for Cable TV, Radio and various other media. Many hardwire LANs are available.

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About the Authors

Robert F. Cruickshank joined CyberLYNX Computer Products as Vice President of Energy Management in June of 1991. Mr. Cruickshank came to CyberLYNX from AT&T Bell Laboratories in Denver. In addition he is pursuing a Ph.D. in adaptive learning systems for energy management and environmental control at the University of Colorado at Boulder involving a unique interdisciplinary graduate program between the Telecommunications Program, the Joint Center for Energy Management and the Computer Science Department.

Timothy D. Schoechle is President of CyberLYNX Gateway Corporation. Mr. Schoechle has a B.S. in Administrative and Computer Science from Pepperdine University and attended Virginia Polytechnic Institute, UCLA, UC Irvine, and the University of Colorado Graduate School. He has worked in the field of embedded microcomputers and communications since 1973 and was co-founder of BI Inc., a successful international electronics firm. Mr. Schoechle has been deeply involved in the development of the CEBus standard and is chairman of the EIA committee on powerline communications as well as U.S. representative to several international standards committees concerned with communications and home electronic systems.

About CyberLYNX Gateway Corporation

Founded in 1992, CyberLYNX Gateway Corporation is involved in the development and manufacturing of the information "Gateway." Prior to this time, the company's principals were engaged at CyberLYNX Computer Products, Inc., an electronic engineering firm which developed products, tools and technologies focused in the fields of communication and home automation. That company provided electronic and software engineering services utilizing specialized local area networks and embedded microcontroller software and, particularly, implementations of the Electronic Industry Association's newly adopted CEBus (Consumer Electronic Bus) standard. Past accomplishments include product design, development and prototype construction of new products for Mitsubishi Electric, Texas Instruments, Samsung Electronics, and Maxon Electronics; and engineering projects for Southern California Edison, NEC, BellSouth, Florida Power Corporation and Pioneer Electronics.

CyberLYNX Gateway Corporation was founded to focus on a specific market niche and to commercialize certain specific products and technologies that were developed by CyberLYNX Computer Products, Inc. Currently, CyberLYNX Gateway Corporation is engaged in developing prototype systems for US West and Duke Power Company.

Questions?

If you have any questions, please write or call Bob Cruickshank or Tim Schoechle at CyberLYNX Gateway Corporation, 2885 East Aurora Avenue, Suite 13, Boulder, Colorado 80303, Voice 303-444-7733, Fax 303-444-9062.

RE-ENGINEERING TRAVEL INFORMATION: OPPORTUNITIES FOR TELECOM PROVIDERS

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Abstract. The biggest global consumer of telecom services is the travel industry. Propelled by regulatory developments in the US and the EC, the business of preparing and distributing travel information is now undergoing fundamental change. These regulatory changes, coupled with the ubiquity and power of microcomputers and the advent of VSAT in the greater Asia/Pacific region, represent a major opportunity for telecom providers to expand services for the travel industry. These same conditions may also induce the "mega-CRSs", e.g., SABRE, Apollo, System One, and Worldspan, to develop new value-added network services that will compete with those offered by telecom providers. For both offensive and defensive reasons, therefore, telecom providers may wish to play a role in the re-engineering of travel information services.

Background. After nearly three-years of rule-making preliminaries, the U.S. Department of Transportation issued comprehensive new regulations (57 Fed. Reg. 43780, Sept. 22, 1992) governing Computerized Reservation Services (CRSs) owned by U.S. air carriers or airline holding companies. The new regulations took effect on December 7, 1992. The major features of the new regulations are an "open systems" approach to access by subscribers to CRSs. Under the regulations, CRS vendors cannot impose minimum use requirements, must allow subscribers to use subscriber-owned equipment in accessing the CRS, and cannot interfere with the subscriber's right to access other CRSs if the subscriber owns the necessary equipment. The regulations govern the operations of air carrier-owned CRS vendors in the U.S. The extent to which CRS vendors may choose to offer different services within and outside the U.S. is not yet known. The EC is expected to issue very similar regulations governing CRSs based in EC countries.

U.S. CRS contracts with subscribers were formerly styled as "equipment leases" with "free" access to the CRS database and no lease rent due if the subscriber booked a minimum number of segments of air travel each month using the CRS. As far as travel agents and other travel intermediaries are concerned, the new regulations will essentially drive the CRSs out of the "equipment leasing" business and into the software licensing and fee-based access business. One important ramification of the new "open systems" environment is that airlines that now must pay "booking fees" to the mega-CRSs (which fees are the primary source of CRS revenue) will probably open their internal CRSs for "direct access" by travel intermediaries and thereby avoid payment of booking fees.

The airlines know that direct access by travel agents can work, and work well. Southwest Airlines, a regional carrier in the U.S., is one of the most profitable airlines in the world on a return on sales basis. Since its formation, Southwest Airlines has chosen not to be listed in any of the mega-CRSs; Southwest keeps the roughly US$5.00 to $9.00 booking fee it would otherwise pay to a mega-CRS for each seat booked on a Southwest flight. Southwest has previously accepted only telephone reservations, but is now conducting a pilot program of direct access to its internal CRS by travel agents.

The First Opportunity: "Direct Access" CRS Networks. It is very likely that many airlines will follow Southwest Airlines' example and open direct access to internal inventory databases to large customers and travel intermediaries. Each airline that sets up a direct access CRS network will be a bigger consumer of telecom services. The opportunities for direct access by mega-CRS subscribers apply equally to non-U.S. airlines. Travel agents that have new freedom to access "third party" databases will use a foreign air carrier's reservation service so long as such use does not incur additional expense for the travel agent and provides some specific advantage over a mega-CRS.

If a given airline's direct access CRS is perceived by travel agents as providing greater value, it will attract more use. If travel agents can obtain lower fares, or a higher commission, by using direct access, travel agents will adopt direct access in droves. Airlines that desire the development of innovative value added services in an effort to differentiate their offering may seek to establish joint ventures with telecom providers. The top candidate for such value-added services is broadly called a "destination database."

The Second Opportunity: Destination Databases. The CRS reservation set (res set) is essentially a point of sale terminal through which the activities of "travel document" sales are conducted. These activities are: checking availability, making reservations, obtaining confirmations, and issuing travel documents. Much to the chagrin of travel agents, the res set has heretofore been seriously inadequate as a POS terminal: it only sold the "airline" product. Over the past ten years, partial access to a few non-airline products has been added. First, rental cars, but only five models or so from a given vendor ... not the 40 models the rental car vendor would like to be listed. Then, listings for a few hotel chains. What's missing besides better coverage of hotels and rental cars? Most of the non-airline suppliers in the travel industry, such as, national tourist organization services, scheduled rail and other surface mass transportation, land tours, cruises, events, dining, non-hotel accommodations, meeting services, rental items from PCs to planes to temporary employees, and a broad area known as "destination information." It's no exaggeration to say that travel information services to date have only scratched the surface of what travelers and travel managers would like to have and will pay for. This unmet need can be summarized as the "destination database" void.

Telecom providers are old hands at information publishing in print and electronic media and could expand their publications to address the destination database void. Listings of directory numbers by name and type of business service are the core products of a local exchange carrier's information publishing business. Travelers and travel intermediaries have an ongoing requirement for detailed information about the cities and regions in which business and leisure travel is planned. You need only reflect about the unanswered questions you had before your most recent international trip and multiply those unanswered questions by all international travelers. Most of those questions had answers in a database or a print publication that you could not access either before your trip or during it. What kinds of information beyond reservable services? Maps, business and avocational associations, business leads, recreational and cultural activities, subject matter experts, home stay programs, telephone directories in roman characters, in English or other languages, ... the list is endless. To such a "destination database," a mechanism for making reservations may be added.

Destination databases developed by national tourist organizations often lack a reservations capability, whereas those developed by other enterprises invariably include a reservations capability. Booking fees and commissions on reservation transactions normally generate more revenue than dispensing information (i.e., availability) alone. The uncertain profitability of large destination database providers has usually resulted in governmental tourist organizations, such as the Scottish Highlands and Islands Development Board (the HILINE project), or international associations, such as the International Automobile Federation (the Ulysses project), undertaking them. Telecom providers, however, may be better equipped to demonstrate the viability of such projects.

Swiss PTT has proven that destination databases with reservations capability, as a line of business, are very complementary to the provision of telecom services. Swiss PTT designed and implemented two pilot projects in the Swiss State of Valais. In Saas-Fee, Swiss PTT created a reservations system for local hotels and chalets, and in Zermatt, a "pure" destination database. Both projects were very well received and plans were made to extend the service nationally. Although no one disputes that destination databases and res systems are useful and can generate revenue, disputes arise over who will pay for recruiting suppliers, collecting and loading the data, training users, and promoting the system. The proposed nation-wide Swiss system, called SwissLine, is still awaiting funding. The leadership role that Swiss PTT played in the Valais projects remains, however, as a model of initiative by telecom providers in development of value added network services for the travel industry. Austria and several Eastern European countries are now trying to apply the Valais model to their countries.

The Third Opportunity: Electronic Ticket Delivery Networks. Electronic Ticket Delivery Networks (ETDNs) begin to solve the "last mile" problem in travel document sales: delivery of travel documents to the traveler, either before departure or while traveling. An ETDN comprises a packet network, user access, and automated ticketing machines that dispense air travel tickets, hotel vouchers, and other travel documents ... just as an automated teller machine dispenses cash. ETDNs and automated ticket machines should be to the travel industry what electronic funds transfer networks and automated teller machines are to the banking industry. The analogy is closer than facial, in fact, because the manufacturers of automated teller machines have also begun to manufacture ticket dispensing machines ("TDM"). Instead of using postal services or couriers, travel agencies will arrange for ticket dispensing to travelers at the TDM closest to the traveler, anywhere in the world.

ETDNs represent an important new consumer of telecom services and equipment. Although only one mega-CRS (System One) has agreed to support ETDNs, competitive pressures will force the other megas to join. As of press time, two ETDNs have been formed, have ordered TDMs, and plan to commence operations in 1993.

The Fourth Opportunity: Travel Agency Equipment and Agents in Home Offices. What type of computer equipment vendor will travel agencies seek after agencies are permitted to use "non-CRS" equipment to access the mega-CRSs? Unlike most businesses, travel agencies use data communications all day long. If given a choice between the local clone shop and a vendor affiliated with a major telecom provider, most travel agencies will choose the latter if prices are comparable. Telecom providers marketing PCs and peripherals to travel agencies should (i) emphasize their understanding of data communications, particularly the networks used by the CRSs to which the agency has subscribed, and (ii) plan to make more profit from maintenance and support contracts than from sales of PCs and peripherals.

The experience of most travel agencies in the U.S. that have tried using agents working at home has been positive. Two approaches have been used: standalone PCs, and wide area network (WAN). In the former approach, the "agent at home" uses the commercial version of a mega-CRS' workstation software. The commercial version of CRS workstation software is designed for corporate travel departments and has a character-based user interfaces (as opposed to a graphic user interface, like Microsoft Windows, used in the travel agency version). The "standalone" agent at home may or may not have a voice line configured as an extension on the travel agency PBX. Data communications with the travel agency office use off-the-shelf e-mail software and a commercial packet network.

The WAN approach to supporting agents working at home is used in cities with ISDN service and is a good example of computer integrated telephony. The Houston office of American Express Travel Related Services, for instance, uses Basic Rate circuits to extend local area network and automatic call distributor connectivity to the homes of travel agents around the city. The agents at home have all the PBX, LAN, and CRS features that agents at the main office have, including supervisor monitoring and conferencing. To date, only the System One CRS supports the ISDN/WAN capability.

The inevitability of "open systems" in CRSs has already produced two significant changes in the way CRSs serve travel agents. First, the Amadeus, Worldspan, and Abacus CRSs have agreed to modify their systems to support the sharing of the central ingredient of CRSs, the Passenger Name Record (PNR). Today, only the travel intermediary that entered the PNR, and the airline or other service supplier with which the traveler has a reservation, can access a traveler's PNR. The new agreement puts in place the links that will permit travel intermediaries to share PNRs. With these links in place, travel agencies that agreed to share PNRs could form an international consortium to better serve international travelers.

The establishment of "direct access" CRSs, destination databases, electronic ticket delivery networks, and the personal network built by travel intermediaries sharing PNRs internationally may catalyze the formation of international travel agent consortia. In one scenario, domestic agents would not interact with the mega-CRSs, but with "direct access" CRSs, destination databases, and electronic ticket delivery networks on behalf of their clients and on behalf of foreign travel agencies in their consortium. The mega-CRSs would be bypassed.

The mega-CRSs are well aware that open systems could lower their revenues and are undertaking programs to retain subscribers and develop new sources of revenue. The most comprehensive of these responses is the Sabre Integration Technology Program. Participants in this program can obtain detailed technical specifications for the Sabre CRS network and consultations with Sabre's MIS staff. No other CRS has heretofore offered such assistance to third party developers. Sabre has also now begun a formal program to certify third party products as interoperable with its CRS and to promote such products among its subscribers. Another mega-CRS, Apollo, will soon offer its Focalpoint workstation, previously available only under hardware lease, in a software-only version for PCs. Sabre and Apollo have also developed CD-ROM-based, interactive multimedia services as "point of sale" tools for travel agents.

To distinguish their services from those of "generic consortia" of travel agencies, these mega-CRSs may expand interactive multimedia services to include wide area network connectivity. In ten years, will "travel agency" be synonymous with "videoconference room"? Will you log into the Apollo global videotex network from your hotel room? Or rent a video codec and cellular modem from Sabre when you pick up your rental car?

The Fifth Opportunity: Traveler Services and Travel Substitutes. Destination databases with reservation features may satisfy many information needs, but such databases do not address the messaging needs of travelers. Although increasing numbers of business travelers carry notebook computers with them, "jacking in" to a data network, much less an ISDN Basic Rate circuit, in foreign cities remains a problem.

As telecom providers become more aware of the information services requirements of travelers, new opportunities to rent equipment and sell services will arise. Notebook PCs with inboard video codecs are close at hand. The new CCITT H.320 and subsidiary set of Recommendations for video/audio codec interoperability has been adopted by over 25 codec manufacturers. If a videoconferencing system is as portable as a notebook computer, the system can go to the user, instead of the user going to the system. Portable videoconferencing may become so commonplace that it is perceived as a "more expensive telephone call," but a telephone call nonetheless, and its use adopted by many traveling executives.

Conclusion. The mega-CRSs are very familiar with the criticisms of their systems as being too focused on airline products. Before the new regulations, the mega-CRSs had little reason to change. Now there are powerful reasons. Losing subscribers to third party databases vendors. Losing booking fees. Losing equipment leases. If the mega-CRSs are deprived of these revenue streams, they will respond by expanding their on-line offerings to include "non-airline" products and by pursuing some of the opportunities described above. There will be parallel opportunities for telecom providers to assist in the development of "direct access" CRSs, destination databases, electronic ticket delivery networks, and international networks among travel intermediaries. However, the mega-CRSs are already operating the world's largest videotex and electronic publishing businesses. Existing operators of value added networks may have some sizable competitors or joint venture partners in the very near future.

Discussion Group:
Impact of New User Applications on the Telecommunications Markets in the '90s

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1. ABSTRACT

This discussion group explores how and when major business users will be implementing video conferencing, client/server computing, image processing, and multimedia applications based on interviews with over 250 corporations. The group will discuss the impact of these emerging applications on bandwidth requirements and the demand for new carrier services, including switched wideband, SMDS, frame relay, and ATM, within a new strategic product planning framework.

2.1 BACKGROUND

In the spring of 1992, Technology Management International, Inc. (TMI) completed *Network Markets for the '90s*, a major study designed to support long-range strategic planning in the mainstream North American business communications market. Created for network equipment manufacturers and carriers, the study took an in-depth, multidisciplinary perspective on the future communications requirements of large commercial firms - from the desktop to the carriers.

The impetus behind the study was the need to better understand the customer-driven forces shaping the structure of future network markets, as well as the interrelationship between networking products. Twelve TMI clients, including carriers, major computer vendors, and leading communications equipment suppliers, supported the original research and provided insight on the cost and performance of future technologies.

In the process of researching *Network Markets for the '90s*, TMI developed a new framework for the networking markets, as well as for describing the evolving market structure and the role of integrated, multimedia products in the marketplace. In this framework, technologies are not isolated, but rather considered as part of a total networking solution in a type of zero-sum game.

For example, in a zero-sum game, there are only a finite, albeit growing, number of desktops. As time passes, they will either be connected by SNA or a LAN for data and a PBX/Centrex for voice, or by a new integrated multimedia technology that will replace all of today's technologies.

Utilizing this framework, it is possible to visualize communications products within the context of the continually evolving networking technology and market structure.

In the session at the 1993 Pacific Telecommunications Conference, the group will discuss communications applications and products within this framework.

2.2. New Networking Framework

TMI's networking framework depicts site-to-site communications within a large company. The framework divides networking functions into five categories as shown in figure 1.

A *Applications Classes*. The four classes of applications are shown on the left in shaded area A. They will each connect to a different configuration of premises devices in area B, which, in turn, connect to carrier services in area C. Each application class defines a different level of bandwidth for either data or isochronous (voice and video) traffic.

B1 *Premises Concentration*. This function involves the connection of desktop devices to a single logical node and then the subsequent multiplexing of the resulting communications onto one or more lines. PADs, controllers, LANs and PBXs all perform the concentrating function.

B2 *User Network Switching*. This function allows users to selectively connect to specified resources or locations over a wide area. Packet switches, front-end processors, routers, and PBXs all perform the network switching function.

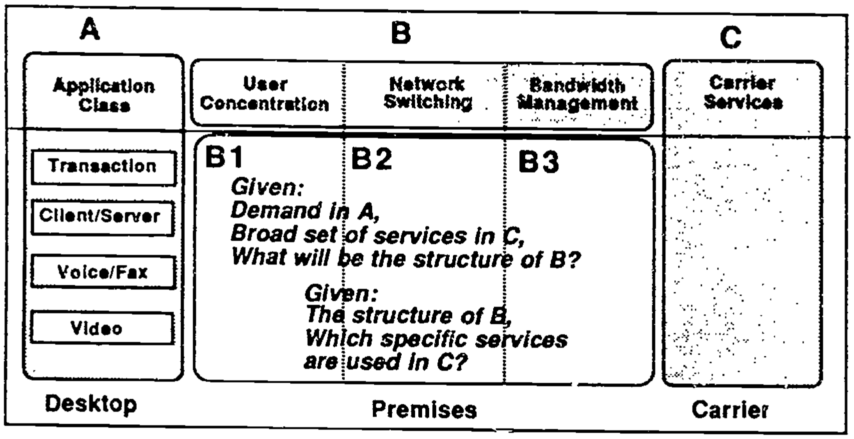

FIGURE 1. NETWORKING FRAMEWORK FRAMEWORK

B3 *Bandwidth Management*. These devices provide a means for multiple, concentrated communications streams to share large bandwidth (T1, T3, and SONET) digital "pipes." Some bandwidth managers, for example T1 multiplexers and digital access cross connects (DACS), have limited switching capability. All of the new fast packet (frame relay and cell relay) technologies perform bandwidth multiplexing and switching.

C *Carrier Services*. These services can include all or none of the functions described in area B. For example, centrex service performs all of the above functions, leaving only the telephone on the user's desk as the customer premises equipment (CPE). On the other hand, a private integrated network requires only private circuits from the carrier, while the user provides his own concentrating, switching and bandwidth management equipment.

Using this framework, TMI investigated the potential for integration to occur across application classes (in the case of multimedia) and across functional categories (in the case of integrated nodal processors [INP] which perform both switch and bandwidth management for LAN internets).

Not shown explicitly in the framework diagrams are the external communications requiring public services. In addition, the diagrams illustrate a configuration at only one site in a network. In order to complete the picture, a comparable configuration is needed at every site.

2.3. Study Overview

At the beginning of the '90s, many large commercial users had installed networks resembling figure 2. Data communications, independent of voice, supported an OLTP, terminal-to-host type of traffic. For large firms, much of the internal voice traffic was carried on private networks comprised of T1 multiplexers and PBXs.

How will this picture change between now and the turn of the century? TMI forecasts three key trends that will transform the networking industry:

- The three-stage migration of data applications from terminal-to-host transactions, to LAN client/server interactions, and then to multimedia communications;
- The growth in bandwidth demand driven by these new applications; and
- The adoption of new public services as replacements for private networks.

An overview of these three major trends follows.

2.31 Migration to LAN and Multimedia

User, technology, and industry conditions are converging to portend the adoption of LAN technology in the early '90s and of multimedia technology in the late '90s.

TMI's interviews with 250 users revealed that users have specific application plans for new technologies. Based on the analysis of this user data, TMI found the following:

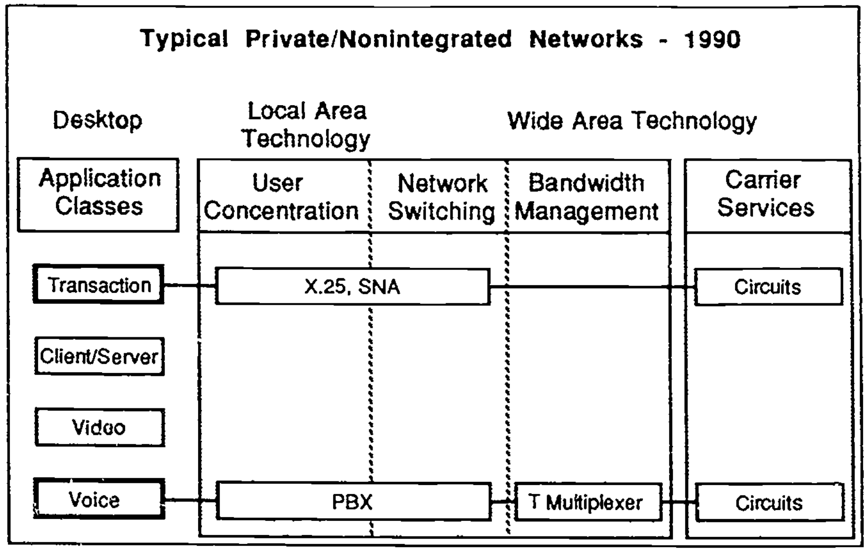

FIGURE 2. TYPICAL PRIVATE/NONINTEGRATED NETWORK IN 1990

- Across almost all industries, users are intent on adopting client/server computing.

- LAN technology is becoming the standard for site concentration of data communications.

- There is a growing trend toward technically integrated organizations in the user firm. Today, more than half of users' voice and data operations organizations are combined. These multidisciplinary organizations are much more likely to accept the new integrated technologies than organizations focusing on a single technology.

- Adoption of hypertext and video applications is projected to increase steadily throughout the decade.

The study projects the dramatic drop in networked devices that perform terminal-to-host OLTP-only in favor of client server and image processing applications. As existing SNA and X.25 technology cannot cost-effectively support the bandwidth required by the new applications, users are turning to LANs to meet these needs. Likewise, the demand for multimedia technology will be driven by hypertext (includes video clips and voice-annotated documents) and video conferencing.

In researching the technology trends, TMI found a number of events coming together to support the move to LANs and multimedia, including:

- A drop in cost that makes LAN technology only slightly more expensive per desktop than current solutions.

- Rapid improvements in LAN management technology that will make it easier for users to implement LAN solutions.

- Cost-effective multimedia premises distribution technology that is expected to be available in the market by the 1995 time frame. (This includes ATM LANs, 802.9, or a similar integrated solution that combines voice, data, video and LAN traffic on a twisted pair media).

In terms of the industry, TMI projects that the combination of a decrease in the cost of bandwidth and the cost of compression will invigorate the demand for wide-area connectivity for client/server and video applications. The cost of bandwidth will continue to drop as copper wire facilities are replaced with fiber and ATM switching technology.

The result is a dramatic shift in user technology preferences to the new technologies. Figure 3 illustrates a typical LAN oriented private networks circa 1995. By the end of the decade, a private multimedia network may resemble the scenario shown in figure 4.

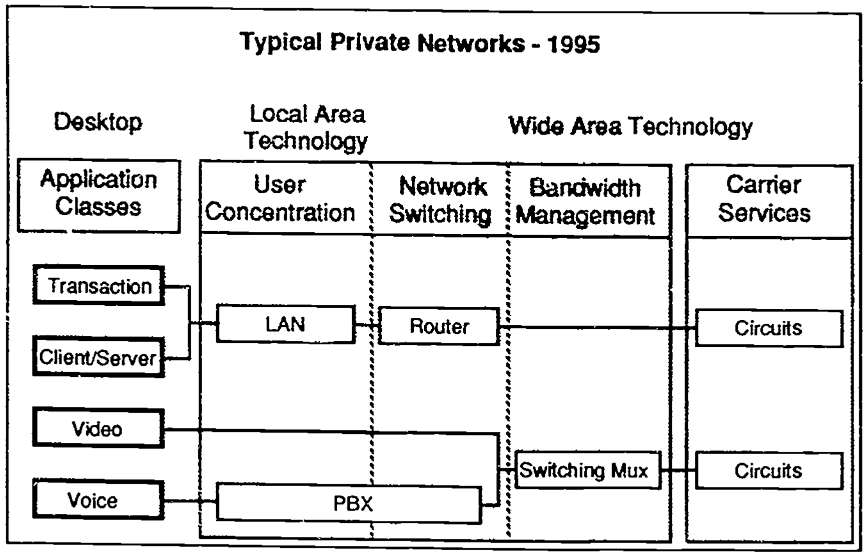

FIGURE 3. TYPICAL PRIVATE NETWORK IN 1995

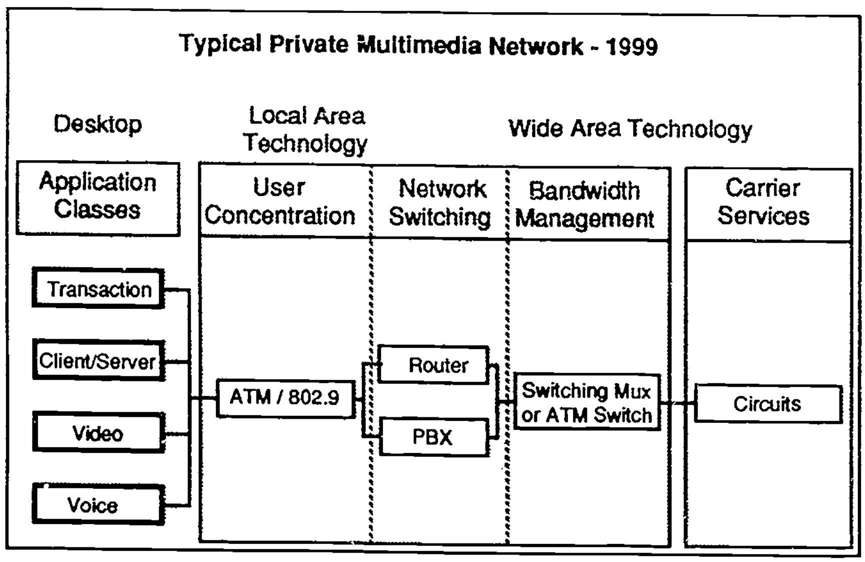

FIGURE 4. TYPICAL PRIVATE MULTIMEDIA NETWORK IN 1999

2.32 Growth in Bandwidth Demand

The second important trend is the growth and shift in bandwidth demand from voice to data and video.

While some analysts are predicting demand for gigabits/sec bandwidth, TMI does not foresee the applications requirements that would drive this demand. In addition, there are forces reducing the demand for bandwidth. Client/server applications are being designed to move data closer to the user, thereby reducing off-site traffic. Bandwidth requirements for video are approaching a single 64 Kbps stream as a result of new video compression technology combined with ever-increasing processing power on the desktop.

2.33 Migration to Public Carrier Services

TMI's analysis of private lines vs. the emerging carrier services indicates that these new services will be very competitive with private network options. TMI sees the migration to the new services supported by a convergence of user, technology, and industry events and conditions.

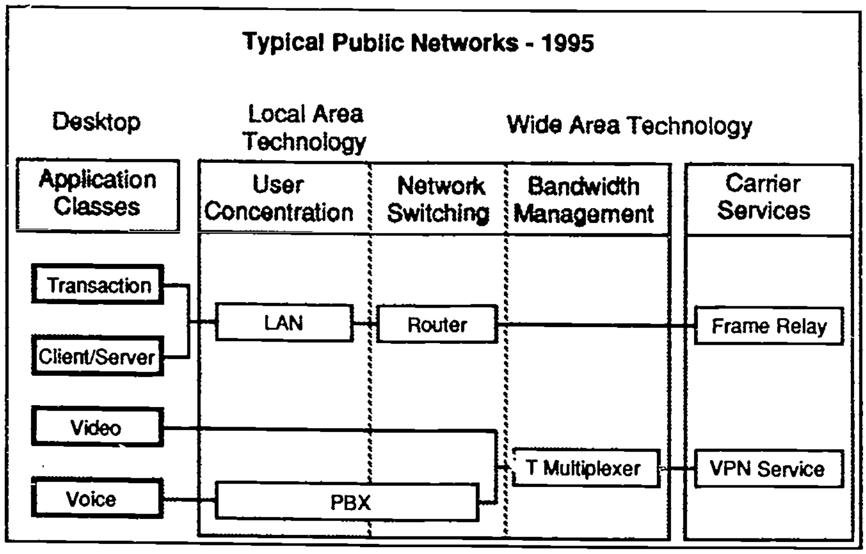

FIGURE 5. TYPICAL PUBLIC NETWORKS IN 1995

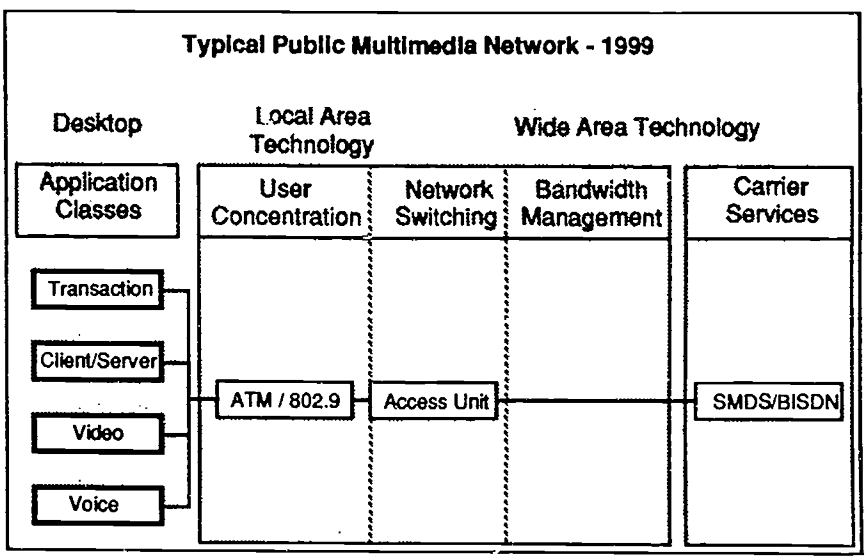

FIGURE 6. TYPICAL PUBLIC MULTIMEDIA NETWORK IN 1999

Users will be facing new networking requirements with the move to client/server and advanced applications. To meet these new requirements, users will be reevaluating their network transmission options. This evaluation phase provides an entree for carriers to introduce these new services.

Technically, frame relay and cell-relay services offer two primary features that are expected to hasten their acceptance in the market. First, they are connectivity services which run under the user network switching protocols (OSI level three), such as SNA and TCP/IP. Thus, unlike X.25 PDNs, these new services are transparent to the communications protocols running on the hosts and workstations. Second, they are designed to meet the bursty nature of LAN traffic. Carriers can offer high bandwidth to each site to reduce delay and share the backbone to reduce costs.

Finally, the industry is pulling together to deliver customer premises equipment (CPE), interfaces and services that makes frame relay service viable today and that will support SMDS in the near future. Carriers seem to understand the data communications market better today than they did in the '80s. Their pricing and marketing efforts appear to be meeting the market's needs.

As a result, TMI forecasts that a significant number of sites, especially the smaller sites, will migrate to public services as they transition to client/server and LAN-based computing starting in 1994.

Thus, the typical smaller site for an early adopter will begin to resemble the scenario shown in figure 5 by 1995. TMI projects that many users will have an independent data network supported by frame relay services and public VPN services for voice.

Medium to large sites, especially those with multimedia LANs are projected to be the early adapters for cell-based carrier services. By the end of the decade, TMI projects that 25% of the bandwidth of large commercial firms will be carried on networks as shown in figure 6.

"Marketing in Japan" for PTC '93 Workshop, Honolulu, Hawaii, January 17 - 20, 1993

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The Japanese market for telecommunications equipment and services, the estimate volume of which is in excess of 80 billion dollars, provides an opportunity to foreign companies to compete not only with domestic Japanese companies but also with well-established foreign companies in Japan. Based upon over 20 years of his experiences helping U.S. companies for their market access in Japan, the telecommunications specialist at the U.S. Embassy, Tokyo, describes how effectively marketing should be done to succeed in Japan.

1. For new-to-market companies: If a firm has not done business previously in the Japanese market, it is suggested that they first find out whether their product has sales potential in the Japanese market.

Specifically, a firm should find out:

a. What companies are selling a comparable product locally;
b. What is the usual sales channel for getting the product into the market;
c. What is the price of comparable products;
d. What is the best way to get sales exposure in the market;
e. Whether products meet NTT (Nippon Telegraph and Telephone) network requirements, if they are for telephone company use;
f. Whether the products are required to obtain JATE (Japan Approvals Institute for Telecommunications Equipment) approval for connecting with PSTN?
g. If the product is a radio terminal, whether it meets MKKK (Musen Kensa Kentei Kyokai) requirements for avoiding interference with other radio stations;
h. Who might be interested and qualified to represent or purchase your product in the market;

2. Key to success:

a. A company that wants to effectively expand its market in Japan should have a presence there!! The Japanese telecom customer is very discriminating. Foreign companies without a presence in Japan are at a significant disadvantage. Japanese customers prefer dealing with suppliers that are close by. Dealing with companies that are not sufficiently represented in Japan is regarded as "risky." They view communicating in another language with a company 6,000 miles away as a major inconvenience.

b. Having "presence" in Japan infers "Japanization or localization" of both customer management and product engineering. That means the foreign company commits its resources to open up a representative office in Japan, or establishes a Japanese subsidiary ("Kabushiki kaisha") in order to support its customers in the same way as the Japanese telecom manufacturers do for their customers.

c. The foreign company's office should be staffed by <u>Japanese speaking</u> engineering staff and <u>Japanese speaking</u> marketing staff that is given sufficient autonomy to make decisions without having to constantly seek approval from corporate headquarters. Similarly, the Japan operation must be given sufficient resources for meeting requirements of customers, and agents/distributors, or OEM partners. Because the typical Japanese customers are "very demanding", their requests must be responded on a timely manner. Successful foreign companies in Japan operates in this fashion.

d. Is there a role for expatriates in the Japan office? Simply stated, yes. The expatriate can be a good communicator between the Japan office and its headquarters, and he could be effective for the home office to better understand the Japanese mentality in doing business in Japan. The expatriate can play an important role for explaining unique Japanese business practices to the home office. On the other hand, the Japanese customers view the role of such an expatriate as a commitment to the Japanese market. However, when the Japan office does not have an expatriate, the reporting on marketing in Japan is often neglected and, consequently, the home office is not informed well of what is happening in Japan.

e. Appointing distributors: Typically, a foreign company comes over to Japan to introduce its product and appoints a distributor either on an exclusive basis or on a non-exclusive basis. Selling imported products through one distributor alone naturally limits the sales level for several reasons. One reason is that the distributor already represents other products and has other priorities, and another factor is the Japanese keiretsu. Often a single distributor is unable to penetrate all corporate groupings.

f. An effective solution to the distribution problem is to define one's market presence by opening one's office, thereby gaining control over distributors and expanding OEM arrangements with Japanese manufacturers.

3. Know Your Competitors:

a. Market entrants will face competition not only with the Japanese companies but also with well established foreign companies in Japan. Remember, Japanese customers prefer dealing with "easy suppliers". "Easy suppliers" mean that they speak Japanese, think like Japanese, and resolve problems like Japanese.

b. "Moshiwake Arimasen" or "I am sorry." Should a product fail at the customer's site upon delivery, the Japanese customer expects the president of the supplier being accompanied by the product design engineers to come over and apologize: "Moshiwake Arimasen, Owabi Moshiagemasu" meaning "No excuse, we are very sorry". These expressions imply that the supplier will take the responsibility for whatever happened to the product delivered and ask the Japanese company to continue long-term business relations, even if there is doubt in the mind of the foreign executives that the failure of the equipment may not be entirely their responsibility.

4. Do's and Dont's of How to Do Business 101:

For foreign companies not familiar with Japanese business practices, the following tips may be helpful:

a. Cold Calls: Many foreign companies make "cold calls." Typically, these companies write to the top executive of the Japanese companies and, sooner or later, start complaining about not hearing from them. The reason for the lack of response is that such letters generally are filed in the wastebasket.

b. Proper introduction: A firm needs a proper introduction to Japanese firms. Remember the one who does an introduction for you bears responsibility for the consequence of your doing business in Japan. If your firm causes any inconvenience to the Japanese company, the individual who introduced you will be blamed for introducing a person/firm that results in contentious business relationships.

c. Avoid sending English brochures: Translating product brochures into Japanese sends an important message: "We are a firm interested in and dedicated to the Japanese market." For personal meetings, hire an interpreter. You may be warmly received over a cup of warm green tea, but this does not necessarily mean that your English presentation of the product was also warmly accepted. A fluent English speaking employee who meets with foreign business persons would be put in a difficult position, because he has to spend a great deal of resources translating your English brochures into Japanese in order to circulate "Ringi" document for approval from each division involved and from the top executive level. Most of the company employees, particularly those responsible for technical evaluation of products, are not proficient in English.

d. Put yourself in the position of the Japanese customer: As a human being the person who has received the English brochures would turn to an "easy" company which has the similar products and speaks Japanese. You can provide English brochures, only when you believe that every customer in the world wants your products and that no one else can make the similar products.

e. Do not expect to cut the deal at the same pace as in your home country. Japanese firms need to feel comfortable with their suppliers to develop a level of trust. An impatient foreign company expects that they can cut the deal "overnight" as in the home country. Even if you are travelling to Japan 12 times a year just because you do not have a presence but only represented by a distributor, your deal with the customer would take almost forever.

5. Regulatory environments: Even if your product meets the FCC Part 68 requirements, the product will not be accepted in Japan. You need to go to JATE for certification for interconnecting with PSTN. If your product is T-I type of data communications equipment, you need to find out what kind of leased lines are available and what kind of interface requirements you need to meet. In this case it is suggested that you consult with NTT.

6. Japan's telecom deregulation: The Japanese Government liberalized the telecom industry in 1985 thereby privatizing NTT and allowing new common carriers to compete with NTT and KDD. As a result, to date there are over 60 "new common carriers" being established in Japan. According to the Telecommunications Business Law, those who own and operate the transmission facilities are called "Type I" and those who lease circuits from Type I for providing valued added communications for others are called "Type II." The definition of "common carriers" in Japan differ from that of the United States where the difference is made whether the one offers "basic services" or not.

7. Conclusion: It is often said that the Japanese market leads to the world market. If you succeed in Japan, you will be succeeding in the world market, and you do not have to worry so much about your home market being eroded by the Japanese. Although there may be other factors for success in Japan, it is critical to establish presence in Japan and Japanize your products and operations for that market.

Suggestions for Forming
Multinational Telecommunications Joint Ventures

by

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The formation and development of agreements for multinational telecommunications joint ventures require creativity and flexibility as well as expertise in telecommunications and transactions. This paper reviews certain issues involving minority shareholder protections and contributions of and constraints on shareholders.

Privatized landline telephone franchises and cellular radio licenses are often awarded to multinational telecommunications joint ventures.

Governments in developed as well as developing countries have encouraged the formation of consortia of experienced foreign telecommunications operators (sometimes from several countries with a range of experience and resources) together with domestic companies which can contribute to the success of the venture and also benefit from associating with the foreign companies. The composition of telecommunications consortia may be an important part of the trade relationships between governments.

Even if not required by the governments' rules for awarding telecommunications franchises and licenses, such multinational joint ventures can emerge from the participating companies' desires to strengthen their credentials reflected in an application, pool resources, lessen political risks, and create the most efficient management team.

Structuring and developing legal agreements for multinational telecommunications joint ventures pose special challenges. Aside from the normal differences in business style present in transborder transactions, the basic goal -- to create a viable telecommunications venture consistent with the diverse interests of the venturers -- is complicated by several factors.

For example, the scope of a telecommunications venture may be uncertain at its inception in light of changing technologies (e.g., wireless or switched video) or business opportunities (e.g., information services, international services and facilities, or telecom equipment manufacturing). Some participants may be unwilling to allow the joint venture to compete against their other interests or otherwise pursue certain lines of business, while other participants may view these lines of business as valuable and synergistic with the joint venture.

As another illustration, certain aspects of the structure or even the entire legal documents may be subject to evaluation by the government, and may affect the consortium's ability to win a franchise or license. Government review can limit the terms of the agreements and require provisions not ordinarily acceptable to some companies or not ordinarily contained in such documents. (On the other hand, some award processes rely on auctions and are blind to most or all aspects of a joint venture's structure.)

Additionally, the multinational telecommunications joint ventures create strange bedfellows. Because of the limited number of world-class telecommunications operators and manufacturers, companies in one joint venture may simultaneously be competing for a license in another country or even for another type of license in the same country as the joint venture. Moreover, these companies may also be engaged in supplier-customer relationships, interconnection disputes, and other joint ventures that are experiencing difficulties. These complex, multifaceted relationships affect the participants' willingness to share information and technology, to rely on each other's management services and procurement decisions, etc.

There is no single magic formula for forming multinational telecommunications joint ventures. Moreover, the legal framework, operating conditions, business plans, and risks of each joint venture are unique. Yet, too often firms approach the process of structuring and developing legal agreements for the joint ventures with unrealistic expectations and inflexible demands. Successfully completing this process requires a special combination of industry and country knowledge, regulatory expertise, transaction experience and adaptability in structuring and documenting a joint venture.

This paper outlines some important issues and alternative mechanisms that may be useful in forming these joint ventures. The issues fall into two categories:
(1) minority shareholder protections; and
(2) contributions of and constraints on shareholders.

1. Minority Shareholder Protections

The development of telecommunications systems pursuant to franchises and licenses requires substantial investments by the participants in a joint venture and represent substantial opportunities for them. Accordingly, minority shareholders or partners seek protections against a wide range of possible adverse conditions derived from decisions by the joint venture, factors controlled by the government, demand and competition in the marketplace, considerations affecting a participant unrelated to the venture, etc.

Yet, telecommunications joint ventures may be limited in the range of feasible minority shareholder protections. The following list describes some options and the possible limitations: (a) exit/sale of interest; (b) supermajority voting;
(c) provisions of services and officers; and
(d) restrictions/requirements in the joint venture agreement.

(a) Exit/Sale of Interest.

As extreme actions to protect a minority shareholder, the shareholder might exit from the joint venture before significant capital investments are required or through sale of its interest. Telecommunications joint ventures may face certain inherent limitations on these actions.

First, the government may want assurance that the participants, or at least certain key participants, will continue to be involved in developing and operating the telecommunications system for at least several years. Next, even without this restriction, the government may require its prior approval for any change in shareholders, and may limit the universe of potential transferees based on nationality, qualifications as a telecommunications operator, etc. Third, the joint venture may be dependent on a shareholder as a supplier of certain services and technologies which would be disrupted by exit of that shareholder from the joint venture.

(b) Supermajority Voting.

Another common minority shareholder protection involves supermajority voting on certain decisions, such as key officers, capital budgets, business plans, new lines of business, major contracts, issuances of stock, changes in by-laws, and changes in articles of incorporation. These protections may apply to board decisions and/or shareholder votes. It is also possible that these voting provisions would kick-in based on some objective performance criteria, such as the joint venture's earnings, revenues, network size, service quality, or market share.

Again, there may be certain sensitivities about these mechanisms in telecommunications joint ventures. While some governments allow foreign-controlled joint ventures, others do not; these mechanisms may be viewed as undue influence by foreign minority shareholders. Moreover, governments may be concerned about deadlocks and unmanageable joint ventures caused by supermajority voting. Similarly, these provisions create the possibility of decisions biased to the interests of one shareholder but contrary to maximizing the performance of the joint venture (such as purchasing equipment manufactured by one shareholder or failing to pursue opportunities which may compete with another shareholder). Finally, the inherent uncertainties facing these operations (including untested telecommunications demand, competition, economic growth and technologies) complicate the use of performance-based criteria for supermajority voting.

(c) Provision of Services and Officers.

Other ways that minority shareholders can influence a joint venture beyond their voting positions are through providing services and officers to the joint venture. Roles in engineering, procurements, construction, marketing, finance, etc. can give certain shareholders substantial influence over the joint venture and, consequently, protection of their investments.

The preceding concerns about undue influence by foreign minority shareholders and bias toward a shareholder's manufacturing and interests also may apply to these mechanisms. Moreover, this method of minority shareholder protection is not simultaneously and equally available to all shareholders; one shareholder's disproportionate influence through the provision of services and officers causes diminished influence of other shareholders.

Generally, all shareholders benefit from an open selection of the most efficient providers of services and the most qualified officers. The government's selection process may be wary of a consortium whose operational and finance decisions are dominated by one minority shareholder.

(d) Restrictions/Requirements in the Joint Venture Agreement.

Finally, the joint venture agreement can specify certain restrictions and requirements which bind the joint venture and require unanimity or a high supermajority approval to amend.

The danger of these limitations is deadlock among the participants as the joint venture itself and each participant individually face uncertain risks and opportunities. The process of amending the joint venture agreement can be burdensome. While these limitations may protect the interests of some participants, they may decrease the value of participating in the joint venture to others.

2. Contributions of and Constraints on Shareholders.

A joint venture is what the shareholders make of it. Some of the key contributions that shareholders can make to a joint venture include use of trained management personnel (engineering, marketing, information systems, construction, operation, procurements, etc.); management of relationships with labor and government; access to proprietary technologies and trade secrets; use of real property for locating telecommunications facilities; use of preferred-customer relationships with equipment vendors; access to networks that will be interconnected; customer base; and financing.

With each potential contribution, two questions arise. First, how will the decision as to the contributor(s) be made? For example, a switch manufacturer might be willing to participate in a joint venture only if it were assured of supplying the switches in the joint venture agreement; it might be unwilling to leave this decision to a majority vote of shareholders at the time of the procurement. If multiple shareholders have overlapping areas of competencies, they may want to have their responsibilities worked out before commencing the joint venture. On the other hand, the other shareholders and the government may want the joint venture to have access to multiple sources of supply, including suppliers who are not shareholders, particularly in light of uncertain technological and marketplace developments.

Second, for shareholders' contributions, how should they be priced to the joint venture? They could be provided "free" (as part of a shareholder's participation in the joint venture), at "cost" (however defined, which may lead to accounting disputes), at a market price (but, some contributions may not be available from the shareholder or third-party suppliers on an unbundled basis in arm's-length transactions), on a most-favored-nation or discounted basis, at a predetermined price, or even based on some performance measure (e.g., management services compensated by a percentage of net income or revenue). Again, the government's rules or review process may be concerned about the joint venture funneling funds to certain shareholders via payments for services and/or equipment.

Regarding possible constraints on shareholders, their basic areas -- non-competition against the joint venture and non-disclosure of confidential information -- are not as simple as may appear for telecommunications joint ventures.

One problem for non-competition constraints involves defining the joint venture's scope of activities. Precise limits on a joint venture's offerings and geographic areas of operation facilitate the specification of non-competition constraints. Even so, the potential for new service offerings created by technological changes makes it difficult to delineate opportunities reserved for the joint venture from opportunities reserved for shareholders or available for both the joint venture and shareholders. Similar problems arise from the bundling and unbundling of service/equipment offerings in response to changes in the marketplace. Moreover, certain time limitations on non-competition constraints may be reasonable.

As for non-disclosure constraints, shareholders are concerned about sharing their trade secrets with the joint venture and other shareholders. Recall that shareholders in one joint venture may compete or have a supplier/customer relationship in other activities. Yet, it is difficult to identify unauthorized users of many trade secrets. Joint venture agreements should also address rights to information developed by the joint venture.

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THE INTRODUCTION OF UNIVERSAL JOINTING AND COUPLER TECHNOLOGY FOR OPTICAL SUBMARINE CABLE SYSTEMS

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1. ABSTRACT

The rapid growth of the optical submarine cable network has resulted in many new cable designs being deployed with totally different jointing technologies. This has serious implications for the efficiency of system maintenance due to the expense and complexity of providing a shipboard jointing service. This paper explains the problem and how it has been overcome with the introduction of a standardised approach to optical submarine cable jointing. It also details the many additional cost saving benefits which are facilitated by this new technology.

2. INTRODUCTION

The world's communications network has expanded rapidly since the successful installations of the first international fibre optic submarine cable across the European North Sea in 1986 and the first transcontinental cable across the Atlantic Ocean in 1988.

This relatively new technology has enabled the provision of high circuit capacities at low cost, precisely the opposite scenario to the analogue co-axial systems which preceded the optical era. As a result the total demise of the analogue submarine cable network is now in sight.

The expiring analogue technology was mature with stable designs and only a few dominant cable manufacturers able to compete in this highly specialised market. This was due to the requirement for expensive submerged amplification (repeater) equipment every 10 km or so to get reasonable circuit capacity onto individual cable systems.

Conversely, the development of optical submarine cable technology is still in its infancy. Factorially higher capacities are now possible with repeater spacing in excess of 100km. This has led to substantial growth of the submarine cable network with many manufacturers entering the submarine cable market for the first time. As a result there is an increasing variety of cable designs, each associated with its respective manufacturer's jointing technology.

This situation is attractive for prospective cable owners at the procurement stage as it widens opportunities for cable system purchase by competitive tender. However, it potentially leads to a complex and expensive maintenance infrastructure. This is due to the number of different jointing technologies which would have to be available on board the world's existing cableship fleet.

BT Marine and AT&T have overcome this problem by forming a consortium with Alcatel and KDD to introduce a standardised approach to optical submarine cable jointing. This new technology is known as UNIVERSAL JOINTING AND COUPLING or "UJ/UC". It is already in service in the Atlantic on TAT 9 and has now been accepted for use on all of the other major optical submarine cable systems to date This includes TASMAN 2, PacRimEast, PacRimWest, APC and TPC-4 in the Pacific region.

This paper explains why a standardised method of jointing is necessary, provides information about the technology used and explains the many benefits which cable owners derive from its introduction.

3. WHY IS A STANDARD JOINTING METHOD NECESSARY?

During the early 1980's the four prime analogue submarine cable manufacturers were investing heavily to develop an optical capability, each taking a unique approach to solving the many diverse technical problems. By 1986 each had a viable product, short-haul systems were being installed and long-haul transoceanic systems were being planned.

The need for a standard jointing method was perceived by prospective long-haul cable owners in the Atlantic and Pacific regions at a very early stage, even before such cables were installed. This was because it was recognised that the new optical systems had to be maintained within the existing zone-based cableship agreement infrastructure.

The ship agreements provide for fully equipped cableships to be available for repairs 24 hours a day, 365 days a year in several maintenance zones around the world. The provision of a jointing service for all types of analogue co-axial cables was easily accommodated within these ship agreements. The jointing equipment was relatively simple and hence low cost, the associated jointer training being equally straightforward.

However, the emerging optical jointing technology was complex and expensive, jointer training requirements more sophisticated. In addition, jointing time was much longer and required the routine shift working of jointers to complete repairs, thus forcing an increase to their numbers and further increasing costs. With four manufacturers offering different but equally expensive jointing solutions, the case for a standard jointing method quickly became apparent.

During these early stages the prospective cable owners tried to persuade manufacturers to co-operate by adopting a common approach to jointing methods, but without much success. In retrospect, the reasons are obvious - cable manufacturers needed to be secretive about their respective cable designs in the hope of obtaining a leading edge in a fiercely competitive market.

Against this background, co-operation by manufacturers to introduce a standardised approach to jointing was an impossible Cable Owner expectation.

As cableship operators, BT Marine and AT&T were very concerned about this situation. The problems were brought sharply into focus in 1988 following the installation of TAT-8. This transatlantic system was supplied by three cable manufacturers - AT&T (Simplex USA), Alcatel Cable (France) and STC (UK). It was entered into the Atlantic Cable Maintenance Agreement (ACMA) for which there were then five maintenance cableships operated by AT&T, FT, Teleglobe, BT and Telefonica.

To get total flexibility the five ships would have to be equipped with three jointing technologies and all jointers trained. In practice this would have been prohibitively expensive and the cable owners opted for a cheaper solution. This unfortunately reduced ship flexibility by restricting the capability of most ships to only one jointing technology.

As a result of this experience BT Marine and AT&T decided to co-operate on the development of a jointing system which would be infinitely adaptable to varying cable designs yet maintain a standard approach for the actual jointing hardware - the basic concept for "UJ/UC".

4. UJ/UC HARDWARE

All jointing systems for deep-sea repeatered optical communication cables require the following:

a. Connection of fibres

b Reinstatement of the tensile strength of the cable

c. Provide pressure resistance for up to 8 km depth of water

d. Maintain conductivity of power transmission path.

e. Maintain insulation of power transmission path

f. Provide adequate mechanical protection from environment (e.g. against fishing activity)

The UJ/UC Jointing hardware consists of Equipment (used to construct the joint) and Piece Parts (the component parts of the joint itself).

4.1 UJ/UC EQUIPMENT

UJ/UC equipment has to be capable of a range of operating parameters. This is necessary to provide the required flexibility to cope with an increasing variety of cable designs. This is particularly true of the moulding system which is required to reinstate cable insulating materials, as different densities of polymer are used, depending on the cable manufacturer.

The equipment currently recommended by the UJ/UC Consortium is comprised of the following items:

- AT&T 'SAMS' Moulding Equipment (reinstatement of insulation)
- BTM Air Hytrel Stripper (required for STC cable)
- AT&T Chemical Hytrel Stripper (required for Simplex cable)
- BTM X-Ray Camera (Radiography of Mouldings)
- State of the Art Fibre Fusion Equipment (connection of fibres)
- A range of ancillary tools

The UJ/UC Consortium have a policy of continuous improvement and equipment upgrades are introduced when commercially available, provided of course that they are cost effective and compatibility with the UJ/UC philosophy is maintained.

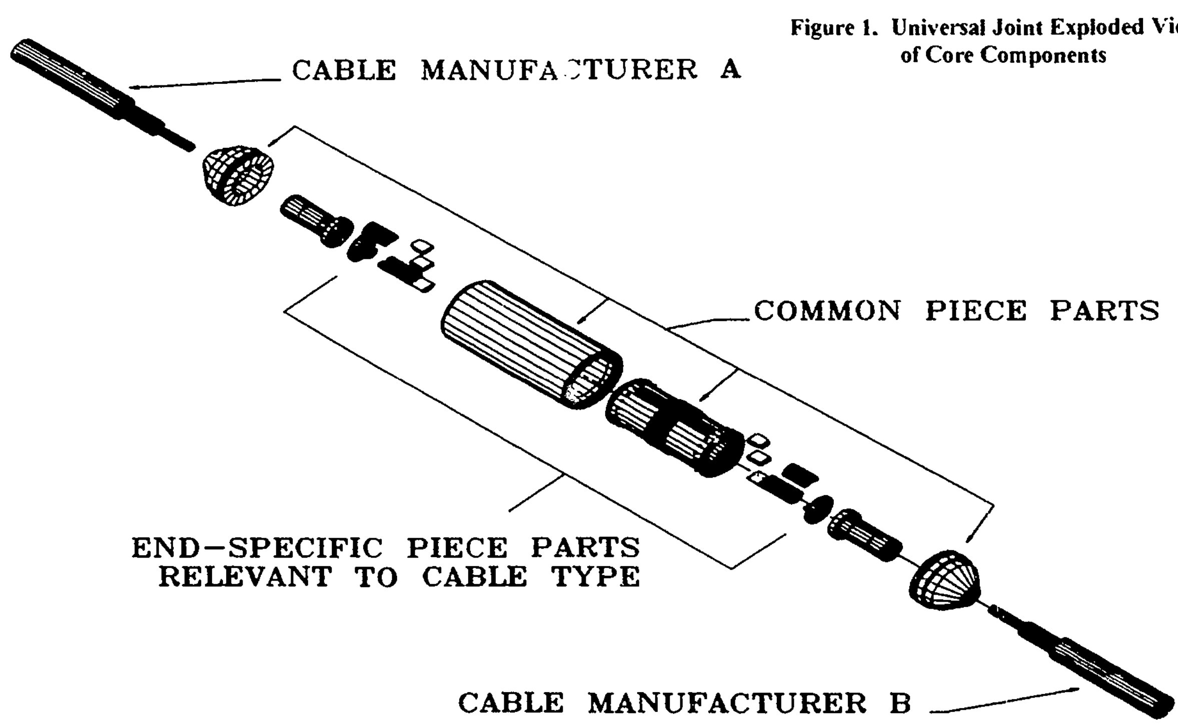


Figure 1. Universal Joint Exploded View of Core Components

4.2 UJ/UC PIECE PARTS

The unique design of the piece parts is at the heart of the UJ/UC philosophy.
A Universal Joint (UJ) consists of end specific piece-parts and common piece-parts, see Figure 1.

The end specific piece-parts are unique to each cable type but all have a common purpose in adapting cable ends to permit connection into the UJ/UC. In order to perform this function effectively it is necessary to clamp all cable elements together to prevent relative movement. This is achieved using a cascaded ferrule - the main component of any end specific piece-parts kit, see Figure 2. This internationally patented device is the only component which has to be specifically designed to suit the core requirements of the various types of cable currently available from the world's suppliers.

A Universal Coupler (UC) is used to connect any repeater housing to any cable using the same common components as the UJ.

Thus it can be seen that UJ/UC technology offers full flexibility in enabling any cable to be connected to any other cable or repeater housing in either line or hybrid combinations. See UJ/UC schematic diagram in Figure 3.

5. UJ/UC BENEFITS

There are many benefits which derive from having a standard approach to jointing techniques on submarine cable

i Common Equipment

ii. Common Piece-Parts

iii. Unified Jointer Training

iv. Spare cable pooling

v. Competitive tender for spare cable

vi. Security of supply for spare cable

vii. Full repair ship flexibility

5.1 COMMON EQUIPMENT

In the North Sea today there are ten optical submarine systems supplied by seven manufacturers If a universal approach had not been adopted by the North Sea cable owners at an early stage there would now be eight different jointing technologies in operation (one of the manufacturers has already changed his jointing system)

Figure 2. Cascaded Ferrule Exploded View

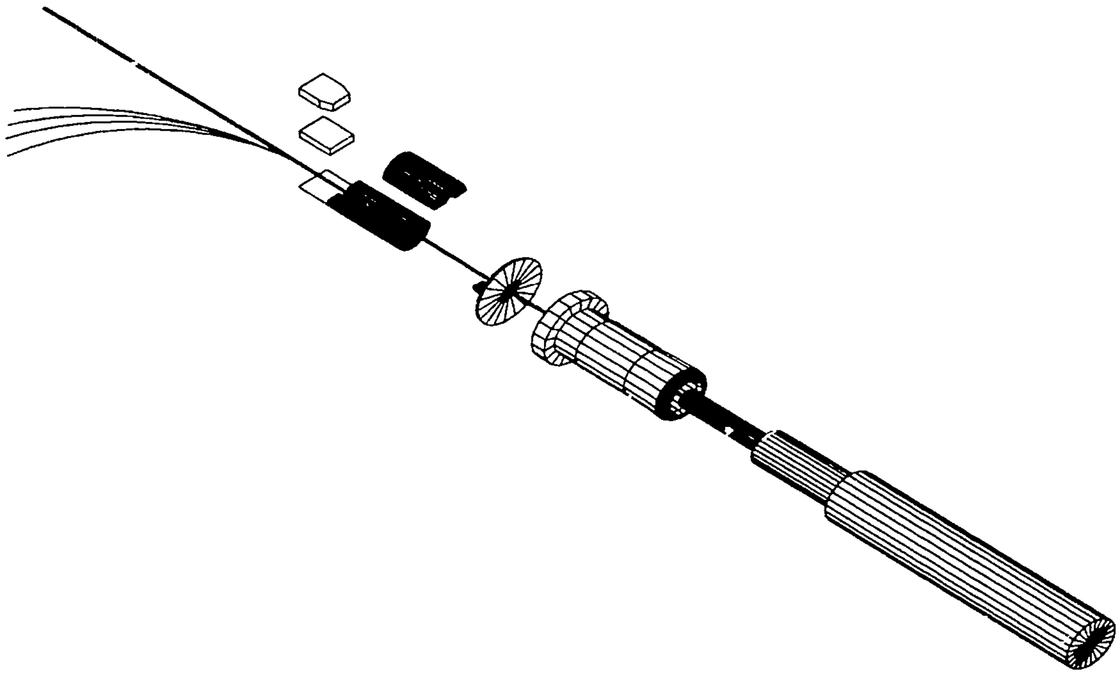
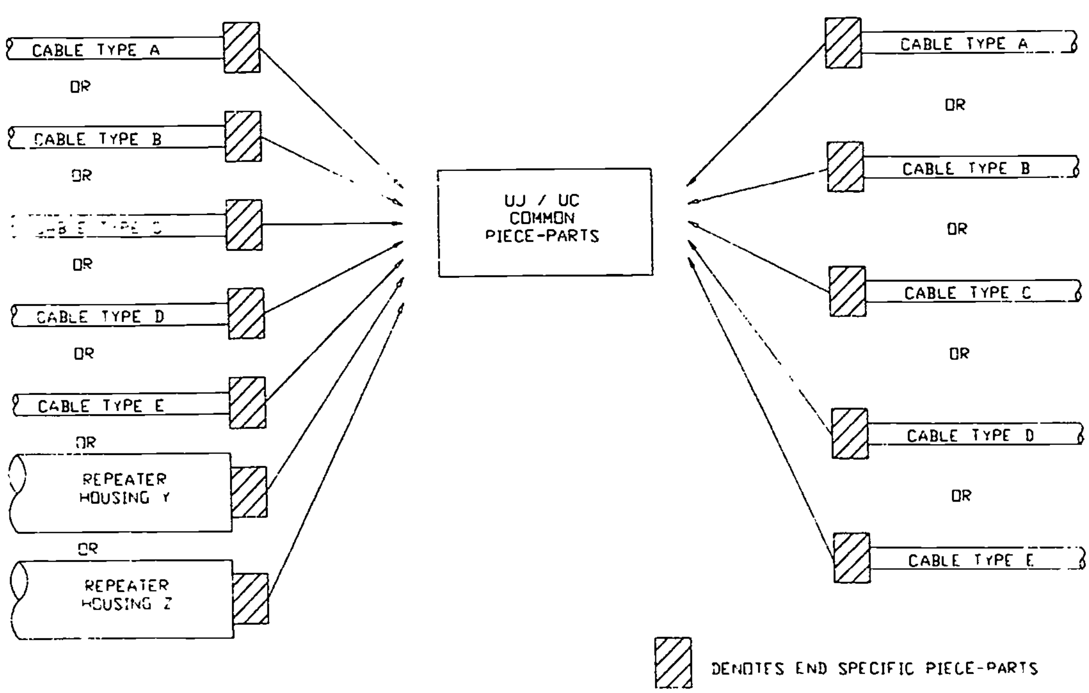


Figure 3. Schematic Showing Flexibility of UJ/UC System



With UJ/UC only one set of equipment has to be purchased for each repair ship to cater for all existing and future cable systems (N.B. Duplication is advisable for critical items due to the remote nature of operations on ships at sea).

5.2 COMMON PIECE-PARTS

UJ/UC offers scope for pooling (sharing) of the common piece-parts referenced in para 4.2 . There is a resultant potential for significant cost savings as large strategic stocks are usually held by individual systems.

5.3 UNIFIED JOINTER TRAINING

Since UJ/UC offers a common approach to jointing techniques and uses the same equipment, the amount of jointer training required is greatly reduced. This is especially of value where several cable types are to be maintained by the same jointing teams as is now the case in the Atlantic and Pacific regions.

5.4 SPARE CABLE POOLING POTENTIAL

One of the side benefits of having a universal jointing system is that spare cable lengths currently held for individual system maintenance can be pooled as common spare stock. The only constraints are that the number and type of fibres is compatible and that the torsional performance of the two cables to be jointed is reasonably matched. With good planning, cable pools could lead to a significant reduction in the amount of cable stored thus achieving considerable maintenance cost savings.

5.5 COMPETITIVE TENDER FOR SPARE CABLE

Another side benefit of UJ/UC is that when additional cable is required for the maintenance of any particular system, it can be procured by competitive tender instead of purchase always being restricted to the original manufacturer. This again should lead to significant maintenance cost reductions.

5.6 SECURITY OF SUPPLY FOR SPARE CABLE

One of the features of the optical era is the number of new cable manufacturers entering the submarine cable market. Many of them will no doubt survive to become enduring suppliers. However, some will inevitably go out of business and the cable designs of others will quickly become obsolete

In these circumstances UJ/UC provides protection because another manufacturer's cable can be used to keep the obsolete system in service for as long as is required.

5.7 FULL REPAIR SHIP FLEXIBILITY

UJ/UC is now becoming the accepted world standard for maintenance jointing of optical submarine cables. One of the most important UJ/UC benefits is the flexibility which will be available when all of the world's maintenance cableship fleet has been equipped. This will lead eventually to any ship having the capability to repair any cable anywhere, optimising opportunities for faster repairs and minimising system downtime

6. UJ/UC AND CABLE MANUFACTURERS

It is interesting to note that all of the benefits listed in paragraph 5 are of significant interest to cable owners but are of little use to cable manufacturers Indeed almost all could be said to be against the interests of cable manufacturers since most will sell less jointing equipment, less piece-parts, less jointer training and even less cable as a result of the introduction of UJ/UC

UJ/UC has been successful because cable owners everywhere recognise the practical benefits which the technology provides and the significant long term savings in maintenance costs which will accrue.

BT Marine and AT&T have represented their respective organisation's cable owning interests by campaigning for the introduction of this technology to increase the efficiency of maintenance ship operations and to give greater security to systems in service. During the early stages of UJ/UC development some manufacturers were concerned about the introduction of UJ/UC and suggested that their system warranties could be affected if UJ/UC were used to repair their cables. This problem has been totally overcome by several enlightened cable owners who have required manufacturers to accept use of UJ/UC for system maintenance as a condition of system purchase. This has been achieved by the inclusion of the following clause at the tender invitation stage of cable system procurement:

"In the event that the Purchasers elect to provide their own alternative maintenance jointing technology for use with the Contractor's cable design(s) the Contractor shall

a) agree that the use of such alternative maintenance jointing technology (including equipment and piece parts) will not invalidate the Contractor's system warranty provided only that sample joints constructed by the Purchaser or its subcontractor shall have passed relevant qualification tests as specified by the Purchaser.

b) provide all relevant cable samples in a timely manner to allow the Purchaser or its subcontractor to perform the engineering and qualification of alternative maintenance jointing technology

It is noteworthy that some Cable Owners are now being even more specific by requiring UJ/UC compatibility to be a condition of Cable system purchase contracts

7. UJ/UC IN THE PACIFIC REGION

Following adoption of this technology by TAT 8 and TAT 9 UJ/UC has now been accepted for use on the following major optical submarine cable systems in the Pacific region:

System	RFS
TPC-3	1989
HAW-4	1989
TASMAN 2	1991
PACRIMEAST	1993
PACRIMWEST	1994
TPC-4	1992
APC	1993
HAW-5	1993

As a result of the above contracts the following existing and future Pacific region cableships will now be equipped with UJ/UC.

Ship	Operator
Global Sentinel	AT&T
CS Long Lines	AT&T
Charles L Brown	AT&T
KDD Ocean Link	KDD
Pacific Guardian	C&W(M)
CS Enterprise	C&W(M)
CS Retriever	ACPL

8. FUTURE DEVELOPMENTS

The success of the UJ/UC concept has already given rise to the possibility of benefits which are additional to the primary purpose An example which has already been referenced is cable pooling which some cable owners are already using to achieve maintenance cost savings. However, as UJ/UC becomes accepted as the industry standard even more benefits become apparent.

8.1 USE BY CABLE MANUFACTURERS FOR MARINE INSTALLATION

Some cable manufacturers now recognise that the introduction of UJ/UC is a fait-accompli and are beginning to use it for marine installation of their systems. This will become progressively more advantageous to them as more cableships are equipped with UJ/UC technology.

8.2 USE BY CABLE MANUFACTURERS FOR FACTORY JOINTING

It was never intended that UJ/UC replaces the manufacturers' own jointing systems However, some manufacturers are known to be considering the possibility of using UJ/UC for factory assembly of their systems

8.3 STANDARD SPARE CABLE

This is one of the most exciting future possibilities. The introduction of UJ/UC gives technical feasibility to the concept of a range of standard spare cables being introduced. As referenced in para 5.4 the only compatibility problems are the type and number of fibres and the torsional characteristics of the cables to be jointed.

For example perhaps any six fibre cable could be maintained with a twelve fibre standard spare having six fibres each of appropriate fibre design.

Co-ordinated introduction of this concept could lead to vast reduction in the stock holdings of maintenance cable throughout the world as the need for system specific spare cable stocks would be eliminated. In addition the logistics of cable storage would be greatly simplified.

9. SUMMARY

UJ/UC is now widely accepted as the industry standard for maintenance jointing of optical fibre submarine cable systems. Almost all systems now entering service, including several in the Pacific Region, are taking advantage of this technology.

The benefits are considerable and will lead to lower maintenance costs as less equipment and less jointer training is required.

As more cables acquire this technology, cable owners will be able to realise the potential for reducing the strategic stock holdings of spare cable. This will in the medium term lead to significant additional savings.

Recent Trends in International Value Added Network Services Agreements in the Pacific Basin

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ABSTRACT

International trade in value added services is a $200 billion per year industry, and one of the most rapidly growing markets in global telecommunications. This marketplace includes such diverse services as videoconferencing, electronic messaging, electronic document interexchange, electronic banking, online databases, telemetry, remote data processing, and network management services. IVANS is also a complex series of commingled trade and regulatory issues which are successfully challenging traditional national telecommunications monopolies and creating innovative government competition policies.

Deregulating access to historically national monopoly networks for foreign private and public providers of value added services, which offer transparent end to end user connectivity, has moved gradually forward in the past five years in the Pacific Basin. It has moved forward in the area of bilateral negotiations, Pacific area wide multilateral talks, at NAFTA, and globally at the General Agreement on Tariffs and Trade negotiations. Progress has been slowest at the GATT, however, where apparently irreconcilable agricultural disputes between the European Community and the United States threaten to collapse this GATT round, including trade in value added telecommunications services discussions.[1]

Progress, however, has been more steady and fruitful in Pacific Basin regional and bilateral negotiations. These include the IVANS negotiations of the Asia Pacific Economic Cooperation group; NAFTA; and the United States-Japan, United States-Hong Kong, and Japan-Korea talks. It is not surprising to find so much progress on IVANS in the Pacific area. Here both innovative government regulatory authorities and user groups have been most active for almost a decade now. The United States, Canada, Japan, Australia, New Zealand, South Korea, Hong Kong and Mexico have all implemented various advanced degrees of privitization of former monoploy states as well as created competition in the provision of value added and even voice telecommunications.

For these countries, growth in trade in value added services is seen as a spur to economic growth generally. This is because competition in the provision of diverse, high quality, cost based value added services stimulates the growth and complexity of international intracorporate networks. And those countries with the most cost effective and advanced telecommunications services are most likely to attract the corporate and regional headquarters of these global companies. Thus jobs, tax receipts and national economic power are very much components of successful IVANS agreements.

IMPLICATIONS OF TRADE IN IVANS FOR INTERNATIONAL VOICE SERVICES

For the United States Federal Communications Commission, competition in IVANS is seen as part of a still larger goal to reduce the accounting rate charges for international voice calling. Under Chairman Alfred Sykes, there has been an aggressive policy of attempting to reduce by half the $7 billion annual cost of international telephone calling from the United States.

Traditionally, high rates for international voice calling were reached through bilateral arrangements with state owned monoploy voice suppliers, the PTTs, who wished to keep the calling ("accounting") rate high in order to generate subsidies for both domestic calling and general revenues for the state owner. The CCITT managed this global system which now benefits higher priced foreign monopolies, which charge more for their originating and terminating calls, than lower priced, highly competitive American carriers. The traditional 50/50 split in revenues also means that those states which receive more than they transmit to the United States obtain an even greater share of the profits of international telecommunications.[2]

Several approaches are being investigated by the F.C.C. to drive down international voice calling costs. These include direct American carrier negotiations with foreign PPTs to lower the accounting rate, possible reduction in the traditional 50/50 split with higher priced foreign carriers, and American pressure in CCITT Study Group III to reduce accounting rates across the board.

Another approach is the licensing of resale of international circuits between two competitive countries in order to attract a larger share of global business traffic, and thereby compel lower prices from recalcitrant monopolies in other states. Resistance to this creative approach has been strong from both higher priced foreign monopoly carriers and even American carriers loathe to lose the higher profits to be earned on incoming traffic from their monopoly correspondents. The drive by IVANS carriers to open up monopoly privilege and drive down the price of international leased line circuits therefore provides a model for increased voice competition and ultimately lower user costs for both IVANS and voice users. The possibility of resale is particularly strong between the United States and the United Kingdom.[3]

Successful future IVANS negotiations are therefore of great importance to both the F.C.C. and the U.S. Trade Representative, as well as for multinational corporate users and competitive value added carriers.

There are many broad similarities in the many bilateral negotiations on the complex issues of user access to competitive international value added network services. These similarities include definitions of value added versus basic services; rights of foreign value added service supplier market access, establishment and investment; and the degree of regulatory control over rate structures for both users and providers of IVANS. More specific points include a search for agreed upon definitions of international interoperability of technical standards; user proprietary data protection; national or most favored nation treatment of foreign value added service providers; and, finally, intellectual property issues.

A common theme of the bilateral negotiations is that the least aggressive position will frame the outcome of the talks. This is to say that specific reserved services of the national carrier (such as basic domestic local and long distance voice and telex services) will not be included in the final agreement. This does not rule out pressure later in the 1990s to deregulate the competitive provision of voice services.

The 1991 United States-Japan IVANS agreement was the first IVANS negotiation successfully completed. This complex arrangement investigated all of the IVANS issues raised above. It also successfully defined intracorporate communications and shared use. A continuing issue still being discussed is the Japanese contention that traffic originating in Japan, processed and routed through the United States, and transmitted to a third country may not fall within the agreement. This sticking point is still under negotiations, and clearly involves a potential challenge to the spirit of the agreement if Japan insists on extending extraterritoriality claims on data originating within Japan to second and third countries.

The complex talks between the United States and Japan revealed the major parameters required to open up the previously restricted Japanese IVANS marketplace. The first parameter was negotiating access to the specific marketplace itself, in place of a general goal of national treatment applied to all goods and services. Previous use of "national treatment" had led to denial of specific marketplace access for some American businesses.

Secondly, deregulation of services access implied changing the customer owned terminal equipment connected to the services. In the case of IVANS, this meant having the Japanese make available to their own corporate users the more sophisticated equipment which their suppliers already were marketing overseas.

The third parameter is the direct connection between the domestic and international telecommunications services markets. These two are seamless for large corporate users, and deregulation of part or all of one of the two markets will lead eventually to the almost complete deregulation of both. Resistance to access to IVANS, therefore, is often prompted by fear of losing control over previously reserved domestic voice and data marketplace by state owned monopolies or quasi-monopolies.

The fourth major parameter required to open up the Japanese IVANS marketplace for American suppliers was acceptance by the Japanese of proprietary technical standards. In this case, rejection of IBM's popular SNA standard in favor of the X.25 international standard for access was an example of the use of technical standards to deny market access. The Japanese negotiators finally accepted both technical standards for access to their corporate user marketplace.[4]

Following the American arrangement, the Japanese completed an IVANS agreement with the United Kingdom. This was more detailed in that it included a list of specified value added services.

The Japanese have since concluded IVANS agreements with Canada, Germany, France, and Switzerland, and is in the final phases of concluding ones with Australia and Hong Kong.[5]

Following its arrangement with Japan, the United States government, with the full support of telecommunications users, is moving forward with other states in the Pacific area in order to secure liberalized trade agreements for its value added services industries. These agreements include Hong Kong and the Republic of Korea, and impending ones with Australia and Taiwan. The form of these agreements can be either a formal list of services opened to free trade, or an exchange of letters similar to the United States-United Kingdom agreement. The latter agreement simply affirms that the domestic competition arrangements of the two powers will be extended to trade in value added services between them.

ASIA PACIFIC ECONOMIC COOPERATION INITIATIVE

The most ambitious multilateral Asian-Pacific IVANS forum is the Asia Pacific Economic Cooperation (APEC) initiative created in 1990 to foster economic cooperation, trade and investment in this area of the world. Its fifteen member states have organized their consultations into ten working groups, one of which is addressing telecommunications issues. These issues include gathering data of the regulatory processes and policymaking among APEC members, rules regarding foreign investment in telecommunications infrastructure (such as IVANS facilities), technical standards setting processes, teleports, electronic data interexchange in the region, and telecommunications training for telecommunications operators and users.

The goal of all the working groups is to identify the region's common interests and present them at the GATT talks, to promote policymaking consistency among APEC members, to create specific programs of economic cooperation, and to support private business interests in a growing free market area in the Asian-Pacific region.[6]

Combining the general goals of APEC with its ambitious telecommunications working group agenda could likely lead to a virtual deregulation of the IVANS marketplace during the next three to five years. The work of all APEC working groups will become of even greater importance if the present GATT negotiations should collapse. This situation will place even greater responsibility on regional multilateral talks to address pressing economic and trade issues.

NORTH AMERICA FREE TRADE AGREEMENT

The most advanced multilateral negotiations in an Asian-Pacific forum are at the current NAFTA talks, and especially at its separate working group on telecommunications. These negotiations are advanced both because of the extensive involvement of users in the talks via their respective governments, and in the proposals for more liberalized trade in value added network services. These proposals for trade among Canada, the United States and Mexico recommend national treatment and nondiscriminatory use of the PSTN for foreign owned value added networks by 1994, although packet switching and managed network services will not become competitive in Mexico until 1996.

Intracorporate networks on a non-commercial shared use basis is permitted, but not resale of services.

Standards issues related to enhanced services equipment are also resolved.

Competition in international value added network services at a more basic level (protocol conversion and electronic mail, for instance) would become competitive immediately, but the more complex and profitable managed networks services and resale would be put off almost until Telefonos de Mexico exhausted its reserved monopoly voice services in 1997.

Basic services are not included in the NAFTA proposals, although American users and even many carriers were in favor of including them. Resistance to full reciprocity (even with an extension of its voice monopoly to 1997 for Telefonos de Mexico) by both Mexico and Canada has restricted liberalization to trade in value added network services for the time being.

If NAFTA can survive governmental approval processes in the three member states in 1993, then the largest competitive marketplace in the world in basic value added network services will have been created.

CONCLUSIONS

Recent trends in international value added network service agreements have been positive in both bilateral and multilateral fora. Approval of the NAFTA proposals, which appear likely, will make it easier for APEC negotiations, which are at an earlier stage, and involve more governments, to move forward. The multiple successes of bilateral agreements, although some of these are more liberal than others, presents another alternative line of approach if multilateral agreements cannot be reached, or are muted due to domestic political pressures.

Many challenges still exist, however, both in opening up closed IVANS marketplaces, and in creating still more liberalized regimes for advanced value added network services where limited or moderate advances have already been made.

FOOTNOTES

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2. Communications Week International, May 21, 1991, p. 1; May 27, 1991, p. 12; September 30-October 7, 1991, p. 4; November 4, 1991, p. 1; December 16, 1991, p. 1; Economist, July 6, 1991, p. 16; London Financial Times, July 13, 1990, p. 1.

3. Ibid.

4. Richard Beaird, presentation on Japanese-American value added network services negotiations at the panel discussion "Telecommunications Value Added Services Issues: Recent Trends in International Value Added Services Issues, GATT and Bilateral Agreements in the Pacific Basin." Pacific Telecommunications Council Fourteenth Annual Conference, January 1992.

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TELECOMMUTING: APPROPRIATE FOR THE ASIAN SETTING OF THE 1990'S?

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1. ABSTRACT

Telecommuting - the practice of having employees working at home or elsewhere away from the traditional office - has become more popular in many Western countries. The authors contend that a combination of factors (technical, cultural, and economic) today make telecommuting increasingly attractive for many Asian countries. The future growth of telecommuting throughout Asia depends on the willingness of private-sector employers to adopt this innovation, along with the need for a proper government policy framework.

2. INTRODUCTION

The Asian region is full of contrasts. Developing countries next to fully developed ones; highly skilled workforces next to barely literate ones; highly advanced communications networks next to ones that barely exist. It is in this region of contrasts that we offer the idea that telecommuting is a work method whose time has come.

"Telecommuting" (also known as "telework") refers to the practice of having employees do some or all of their work away from the traditional office setting. They may work at home, in so-called satellite or neighborhood offices, or even across national borders in so-called offshore offices. Whatever form it takes, we believe that telecommuting is, in fact, fully appropriate for many Asian countries as they continue to develop their businesses, government operations, and telecommunications.

Since the age of the Industrial Revolution, we have been refining the process of bringing the workers to the workplace. This has led to tremendous economies of scale in some cases, and very complex problems in others. Telecommuting, conversely, assumes that we will bring the work to the workers (or at least some of them). This has significant implications for issues as diverse as labor force utilization, regional and rural economic development, urban transportation management, business profitability, and the operating efficiencies of public (and private) sector organizations.

In this paper we will briefly survey the telecommuting situation around the world and then move on to the special case of Asia. We will next discuss the potential advantages of being in the position of a late adopter of this method, and then cover the variety of remote work locations that are available. We conclude with a review of policy development options that exist, and their implications for government agencies from local to international levels.

We approach this paper with three fundamental beliefs:

1. Most, if not all, knowledge-based work is virtually location-independent, and much of it is time-independent. This means we can do most office work at any place or any time.

2. Telecommuting is a proven management method with demonstrable success, not an uncertain experimental concept.

3. There are significant public policy issues surrounding telecommuting that, to date, have not been adequately addressed in most countries where the concept is in use. This is an oversight that needs to be addressed in Asia (and elsewhere) in order to fully take advantage of telecommuting.

3. TELECOMMUTING DEFINITIONS

In this paper we will be discussing three forms of telecommuting; these will be more fully explained in section 6. The basic element of telecommuting is the decentralization of the traditional head office as we know it. While the head office will (and should) continue to exist, we will see three other work locations become more common:

A. HOME-BASED TELECOMMUTING: This is for office workers who will spend several days a week on a routine basis working at home. The time will range from a minimum of one day to four days, and only rarely will the person work at home a full five days a week. This does not include the occasional day spent at home to do paperwork; we are concentrating on the regular, routine substitution of home time for office time.

B. SATELLITE OFFICES: These are hybrids between the traditional head office and the work-at-home situation. Typically these are for small numbers of workers (10-50) and are located in or near suburban areas. Their advantage is to reduce commuting times and to help attract workers who cannot or will not work full-time in the downtown head office. In some cases these satellite offices could be quite a distance from the metropolitan area; these rural work centers offer distinct advantages to be discussed later.

C. OFFSHORE OFFICES: This most extreme form of telecommuting exists where access to advanced telecommunications capabilities and/or lower-cost labor makes it desirable to set up an office at a considerable distance from the head office - sometimes halfway around the world. Most of today's offshore office work is for lower-level tasks such as forms processing or data entry, but an increasing amount involves high-level computer programming skills.

What is common to these definitions is the idea of decentralizing the office as we know it. As the next section will show, telecommuting is often associated with work at home but that is far from the only form it can take.

4. SURVEY OF TELECOMMUTING AROUND THE WORLD

Examples of telecommuting activity in various countries include:

A. UNITED STATES: Telecommuting is becoming rather well established, mostly in home-based work, with growing interest in satellite offices and rural work centers. Current estimates suggest that at least one million salaried workers telecommute on a regular basis. Among the main reasons for this interest are business pressures (need to improve recruiting or retention, need to increase productivity), worker preferences for more flexibility, and the use of telecommuting as one method to help reduce traffic congestion and air pollution.

B. JAPAN: Most telecommuting has been done at satellite offices, with almost two dozen such offices having been piloted or established in the last five years. There is growing interest in satellite sites as one answer to the difficult problems of population concentration in the metropolitan Tokyo area. Also, some employers are starting to look at satellite offices located far from Tokyo to help attract and retain qualified engineers and other professionals who want to leave Tokyo in favor of their home towns.

Home work in Japan has been limited by the small size of many Japanese homes and apartments, although there is some interest growing in this kind of telecommuting particularly for married women who want to re-enter the workforce because of the current labor shortage.

C. EUROPE: Telecommuting has been studied and/or used in countries such as England, Sweden, Ireland, Italy, Germany, the Netherlands, and Finland. Most of this is the work-at-home variety, though there has been considerable interest recently in satellite offices and rural work centers because of their economic development potential.

D. NEW ZEALAND AND AUSTRALIA: Modest interest has been developing in this region, though most of the work done at home has been of the self-employment variety. Interest has been growing recently based on several conferences held to brief the business community, and various government agencies are examining possible policy initiatives. In addition to these countries, interest in and/or use of telecommuting is developing in Canada, Argentina, Singapore, Spain, Belgium, and Norway, to mention a few. It should be clear from this pattern that telecommuting is no longer an experimental or speculative idea; it has been proven to work and to create good results for telecommuters and their employers. In later sections we will suggest some reasons for likely growth in Asia.

5. TELECOMMUTING: A DIFFERENT PHENOMENON IN ASIA

Telecommuting will take different form in each of the nations of the Pacific Rim. In the more "western" Pacific Rim nations (Australia and New Zealand), patterns of adoption are likely to be similar to those of the U.S. and Canada. Most other Asian nations are likely, however, to have unique adoption patterns, which may be somewhat unrecognizable to western observers, and will introduce new variations on the form that could not have taken place in the west.

Here is a review of five of the factors that will help determine what form telecommuting takes around the Pacific Rim:

5.1. Housing Conditions

Housing conditions in the Pacific Rim nations will influence the form that telecommuting takes. Australian and New Zealand homes are the closest to the American suburban model, often with extra room for such activity as telecommuting. Singapore's housing, while quite dense in terms of units per acre, also has relatively high square foot area per person. Japan presents the other extreme, with highly crowded housing in metropolitan areas that very seldom is appropriate for "work at home" telecommuting.

5.2. Telephone Availability

A wide gap separates the telephone "haves" from the "have nots" in Asia and the Pacific Rim. Recent statistics illustrate the wide range of variation:

Nation	Phones per 100 Population
Australia	55
China	1
Hong Kong	41
Indonesia	1
Japan	54
Malaysia	8
New Zealand	64
Philippines	1
Singapore	41
South Korea	17
Taiwan	30
Thailand	2

One must look more closely at these statistics, to learn more about possible implications for telecommuting. For example, telephones in Thailand are predominantly in businesses, rather than homes. Street corner and village phones often suffice for the residential customer. This suggests that adoption of telecommuting will take the form of business center to satellite center, rather than "work at home."

In Singapore, on the other hand, phone installations in the home are commonplace, and the government is encouraging wide use of the "Teleview" home information service. Here, "work at home," in combination with satellite center applications, could appear. Finally, in Hong Kong, many of the telephones in use are mobile phones, used by owners of small businesses to eliminate the need for a fixed office and permanent receptionist. Here, mobile phone use takes place on foot, in a highly urban setting, rather than in cars and on freeways.

5.3. Cultural Factors

In this paper, we can only begin to outline some of the cultural factors that will influence adoption of telecommuting. In Japan, the need for face to face contact between employees is recognized as an important feature of business style. This may limit adoption of telecommuting there, although work is currently underway on videoconferencing software that can accurately communicate facial expressions! In Singapore, cultural issues may help to encourage "work at home" telecommuting. While the nation seeks to educate both me. and women, and to use their talents to the fullest, it also recognizes and encourages the involvement of women in child-rearing.

5.4. Settlement Patterns

Land use planning concerns will shape the character of telecommuting throughout Asia - and in a number of different directions. Japan, Singapore and Taiwan all seek to decentralize population and employment from congested urban centers, and have serious plans for creating dispersed work centers, which could be test-beds for satellite center telecommuting experiments. Indonesia, a nation of over 13,000 islands, stretching over 3000 miles, has faced the challenge of educating a dispersed population. The next challenge is to provide employment to this dispersed population, rather than bear the costs of too-rapid urban growth in a few centers. Telecommuting - dispersed office work - could provide part of the answer. Other nations, like Thailand and Malaysia, are now trying to cope with the effects of congestion in their major cities. Telecommuting solutions there - at least for metropolitan areas · are likely to be somewhat similar to the southern California model.

5.5. Government Policies

A number of different types of government policies can influence the level and character of telecommuting. In most Pacific Rim nations, the policy environment is one of cross-currents, with some policies favoring telecommuting, others working against it. Effects are not always clear, and consequences are not always intended. This list of some of the more significant policies will help to clarify this:

Policies favoring improved telephone service:

Most, perhaps all, nations, have now recognized the important connection between the quality of telecommunications infrastructure and national economic strength.

Policies favoring training for information age employment:

Some nations have recognized the importance, also, of having highly skilled employees available to utilize the telecommunications infrastructure. Singapore, with its comprehensive programs geared to making the nation the "intelligent island," and India, with its vast reservoir of trained software engineers and technicians, are two examples.

Policies favoring employment that generates positive foreign exchange:

These policies, however, have been more often implemented by sending nationals abroad (e.g., Philippine, Thai and Korean nationals to the Middle East) than by seeking to bring international work in to the workers in their home country.

Policies favoring decentralization of population and employment:

Where these are combined with commitments to provide public facilities and services at dispersed locations, they help to create conditions in which telecommuting can flourish.

There are, however, other government policies (such as those in Malaysia and Thailand encouraging purchase of locally-produced automobiles), that, while generating home country employment, seem to be creating conditions of congestion similar to those faced in U.S. urban centers. These policies could unwittingly undo the developing efforts to encourage telecommuting in these same locales.

6. THE ADVANTAGES OF BEING A LATE ADOPTER OF TELECOMMUTING

With the exception of the developing usage of satellite offices in Japan, and the role of various Asian countries as providers of offshore office work for clients in other locales, telecommuting has not taken hold in the region very well, relative to its potential as noted above. We believe this is actually an advantage of sorts; this may be one case where being later is better, for the following reasons:

A. LEARNING FROM OTHERS' SUCCESSES - There has been a very good and continuing record of success in telecommuting applications, and a good deal of information about these programs is publicly available. Even though telecommuting is not necessarily a complicated process to implement, there is no need for newcomers to telecommuting to "re-invent" all of the policies and methods. For example, employers of telecommuters have developed selection and training methodologies that have been tested and applied in other nations.

This means that the payoff from telecommuting can come more quickly to companies and nations just entering the telecommuting marketplace. This may be an important concern for the growing number of nations that are concerned about the foreign exchange effects of telecommuting. Experience in some Caribbean nations has shown that skill level of telecommuters, and hence pay level, can be gradually upgraded over time, thus increasing positive foreign exchange impact to the employing nation.

B. LEARNING FROM OTHERS' MISTAKES - Similarly, there is no need to repeat the mistakes made by others. The ratio of success to failure in the last ten years has changed dramatically, with failures dropping to a very low level. However, mistakes were (and still are being) made, and almost all of them can easily be avoided.

C. USING NEWER TECHNOLOGY - When telecommuting got its start in the late 1970's, the personal computer was just being developed, fax machines were still relatively rare, ISDN was a dream, satellite downlinks for data transmission were not common, and fiber optics was not available. Modem speeds were slower and modem transmissions sometimes yielded uncertain results, and applications software was anything but user-friendly.

Communications and network technologies have been improved so that, telecommuting applications can be more easily custom-tailored to a nation's or region's unique needs. The connectivity frustrations of even four or five years ago were far greater than they are today. Today, we have no lack of technology, and the prices for that technology continue to drop. These factors work in favor of countries looking to implement telecommuting.

D. NOT BEING SEEN AS AN EXPERIMENTER - Sometimes there is a certain excitement about being among the first to use a new technology or new work method. In many cases, though,others do not look kindly upon those pioneers. It is often a struggle to justify the new method, and there is a kind of punishment for being at the leading edge. Now that telecommuting is widely used (though still not fully accepted), this is much less often a problem. In fact, those who adopt a new method once it has been proven (but before it is no longer considered an innovation) are often applauded for having the wisdom to take advantage of a new but proven method.

E. TELECOM EXPERIENCES - Last, the later-adopting Asian nations can derive benefit from the experience of western telecoms companies, such as America's "Baby Bells" and the UK's British Telecom, each of which have moved well along the learning curve with telecommuting experiments.

For these reasons, we believe that many Asian countries where telecommuting can be used will actually benefit from being later to adopt this work method.

7. ASIAN TELECOMMUTING: A MULTILEVEL PHENOMENON

Asian/Pacific Rim telecommuting will likely be implemented at three levels, simultaneously:

* within major metropolitan areas;

* within a nation, between urban and rural areas, or between geographically dispersed settlements; and

* internationally, in the form of what is often referred to as "offshore office work."

It is this third form of telecommuting (the gradual emergence of the "global office" to parallel the "global factory") that holds some of the greatest promise and excitement for innovative new forms of telecommuting. The example of India's software writers provides a glimpse of this possible future. India now graduates over 400,000 software engineers annually, the largest number of any nation in the English-speaking world. Many of these engineers work in India, in cities such as Bangalore, for American, British - and if present marketing efforts bear fruit, Japanese firms - producing software code that is "shipped" by satellite to its destination.

The importance of this group of telecommuters can be seen when it is recognized that these are some of the 10% of India's employees who generate over 40% of the nation's foreign exchange earnings. This experience can, and likely will, be duplicated in other nations in the years ahead. For example, it is reported that the producers of the American legal research database "Lexis" now does approximately one-third of its data entry operations overseas, with major operations in such Asian nations as South Korea, the People's Republic of China, and the Philippines.

At the other end of the spectrum, nations have recognized the kinds of benefits that can be derived from status as an "international financial center." Singapore's national programs of infrastructure development, training, and targeted encouragement of the location of appropriate international firms is one of the best current examples. Australia is now mounting a national effort to emulate Singapore in this regard. Other nations will follow, in this new form of high stakes, high technology, national economic development.

Telecommuting offers the possibility for Asian countries to further develop their role as global economic forces in financial services and other service-sector businesses, just as they have done in the manufacturing sector. Sophisticated knowledge-based work that can be done via telecommuting is truly location-independent; customers around the world can benefit from increasingly high education levels and improved telecommunications infrastructure in Asian countries.

A Comment About The Speed of Change: Perhaps the most fascinating aspect of the Asian telecommunications and telecommuting environment is the speed at which change is taking place. Statistics on telephone availability, such as those cited above, can be rendered obsolete in just a few years.

Witness, for example, the South Korean experience. The nation had less than two million phones in 1980. By 1991, the total had increased to 15 million, or approximately one for every three persons. Other Asian nations such as Thailand, Malaysia, and Indonesia are now prepared to invest in similar "leaps forward" in capacity.

Every bit as important as the sheer number of phones to be added is the way they will be added - in a fluid, free-form manner - cellular, mobile, as well as fixed lines. This influences both speed of installation and manner of use. Mobile phones have become popular in some nations because they permit users to bypass the long queues for standard service. And if the location of the phone is fluid, then the forms of use of the phone are less likely to be bound by the old forms of "office" and traditional work locations.

8. POLICY DEVELOPMENT OPTIONS

We believe there are some unique opportunities in Asia to stimulate telecommuting. This is a case where public policy can encourage private-sector initiatives, as opposed to seeking large publicly-funded projects.

Since Asian telecommuting will be a multilevel phenomenon - local, national and international - it seems appropriate that policies that guide its implementation likewise be multi-tiered. The role of city and metropolitan governments, and national governments, is relatively clear; the role of multinational and international institutions is, perhaps, less clear.

The rationale for encouraging public-sector involvement is that telecommuting is a very cost-effective way to help achieve goals common to many Asian countries. These include balanced economic development in rural and urban areas (to avoid over-concentration in central city areas), improved use of educated but underemployed workforces, and management of traffic and related air quality problems.

Here are some suggestions for policy initiatives, based on what we have seen (or seen the need for) in other countries:

A. LINK TAX INCENTIVES TO EMPLOYER TRIP REDUCTION - The *quid pro quo* for employer use of telecommuting to reduce commuter traffic could be some form of tax incentive. In some locales (such as Singapore), there are already rules limiting center-city vehicle travel during peak hours. Telecommuting could go even further toward this objective, and is the only trip-reduction method that directly benefits employers.

B. PROVIDE "SEED MONEY" TO ESTABLISH SATELLITE OFFICES - Unless downtown office space is at a premium, there is a disincentive to setting up a satellite office; it is less expensive to stay downtown (and take advantage of low lease costs) than it is to relocate workers to a satellite office in an area where lease costs are higher. One way to counteract this problem is for government to help underwrite the cost of setting up a satellite office, perhaps by making up the difference between the going rate for downtown space and the cost of new satellite office space.

C. PROVIDE AN "EDUCATION INVESTMENT RECOVERY REBATE" - In countries with high levels of state-supported higher education, it is a tragic waste of resources for university graduates to remain unemployed because they are unable to work in a traditional downtown office. As the economies in many Asian countries continue to develop, there could be a rebate (in the form of a tax credit) to employers who hire graduates who are not employed and have not been in the labor market for the previous two years.

In particular, we are thinking about women who left the workforce to start families but would like to return to work if they could find some kind of flexible work arrangement (such as telecommuting), or retirees who are still willing and able to work but now want to restrict their work hours or work locations. Employers who hire these or similar workers via telecommuting would be helping the country get a better return on its educational investment - and could be rewarded for doing so by having a portion of salaries paid to these workers reimbursed by the government.

9. THE ROLE OF INTERNATIONAL INSTITUTIONS

It has been noted that more money will be invested around the world in telecommunications infrastructure in the next five years than has been made in *all* the years since the invention of the telephone in 1876. Much of that investment will be made in Asia, where available resources combine with rapidly growing economies and national recognition of the importance of the telecommunications sector.

The large, long-term shift that will result from this massive investment is the transition of much of the labor force of Asia and the Pacific Rim nations from extractive and manufacturing work, to information work.

This will be a major shift, since office work is now a relatively small percentage of total employment for most Asian nations. If the transition can be achieved smoothly, positive effects will result in the form of economic growth, efficient resource use, and limited pollution and other negative environmental impacts.

It would seem, therefore, that such institutions as the Asian Development Bank, the World Bank, the Japanese foreign assistance agencies, and those United Nations agencies concerned with employment and resource use, should play an active role in ensuring the most effective employment impacts of the major telecommunications investments that will change the face of Asia during the next few years.

Once again, let us state that we are not calling for large-scale government investments for this purpose. Small "seed money" grants should be sufficient, especially when provided with the condition that matching funds from the private sector be secured before the funding is released.

I. CONCLUSION

It was not very long ago that the Asian countries were, with few exceptions, perceived as being technologically inferior and underdeveloped. This perception was especially strong when it applied to telecommunications infrastructure. In the eyes of some Western observers, this one feature alone could have been enough to prevent these countries from ever taking their place as thriving global economies.

Today, we know that these perceptions were incorrect. The level of investment in telecommunications throughout Asia has been and will be significant, often allowing these countries to bypass entire generations of technology that were the norm in the West. One of the benefits of this is the increasing suitability of the region for various forms of telecommuting activity.

We believe that telecommuting represents a true "win-win-win" concept for Asia. First, the employers will win because it will give them better access to talented workers and help reduce operating costs. Second, the workers themselves will win because telecommuting will help them avoid the costs and aggravation of the daily commute, and also help them more fully utilize their skills. Third, the countries as a whole will win because telecommuting will help them achieve their economic development goals without having to endure (or by being able to reduce) some of the problems that typically accompany this growth, e.g., traffic gridlock, air pollution, and labor market imbalances.

As is true in the West, the Asian community will not soon see a day when everyone will be working at home in their blue jeans, kimonos, or saris. The office as we know it will continue to exist for most of the workforce. However, there will be a growing role for telecommuting - assuming the right mix of public policy guidance and support and private sector initiative.

Southeast Asian Telecom

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In Southeast Asia, as in other parts of the world, new competition is giving more choices to telecoms users wanting to set up corporate networks. PTTs in established business centers like Hong Kong and Singapore are cutting tariffs and upgrading their networks. Telecommunication services are also improving elsewhere in Southeast Asia, as new service providers appear in Indonesia, Malaysia, the Philippines, and Thailand.

With economies booming across Southeast Asia, carriers are moving fast to improve their telecommunications networks. Eager to lure more foreign investors to the region, PTTs in established business centers like Hong Kong and Singapore are cutting tariffs and upgrading their networks. Telecommunications services also are improving elsewhere in Southeast Asia, albeit at a much slower pace, as new service providers appear in Indonesia, Malaysia, the Philippines, and Thailand.

As in other parts of the world, new competition is giving network managers more choices. In Southeast Asia, the competition comes from two directions: First, service providers in Hong Kong and Singapore are aggressively battling each other for the business of multinational corporations looking to build hubs for their regional networks. Both providers have scored some victories as growing numbers of American, European, and Japanese corporations abandon previous policies of leasing lines direct from their homeland to each individual country and develop regional networks hubbed out of Hong Kong, Singapore, or both.

Second, competition is starting to emerge in the provision of services in Southeast Asia's developing countries. Modernization plans for existing terrestrial networks are making it easier to get tail circuits from international gateways to customer sites. At the same time, alternative service formats such as privately operated satellite services are finding a foothold.

Throughout the region, governments are recognizing that good telecommunications services go hand in hand with other incentives to encourage foreign investment, such as the creation of tax-free zones for manufacturing facilities. As a result, multinational corporations are flocking to Southeast Asia and telecommunications spending is set to grow at a compound annual rate of 20 percent in the next five years, according to a recent study by Northern Business Information/Datapro (New York), a McGraw-Hill market research consultancy.

The spending forecasts for Southeast Asia also are reflected in major modernization programs by PTTs. By 1995, the vast majority of the region's lines will be digital. In Hong Kong, Singapore, and Thailand, digital lines will make up more than 90 percent of the total.

In addition, private operators are developing new services throughout Southeast Asia, and multinational companies and operators of international value-added networks (VANs) are making significant investments in private networks.

Motorola Inc. (Schaumburg, Ill.), for example, is beefing up its entire Asia-Pacific network, in step with its plans to increase manufacturing and design activity in the region. "We're getting away from just supporting business communications over the network," says Lucien Wang, Motorola's director for corporate communications systems in the Asia-Pacific region. "We want to provide more communications to our manufacturing and engineering community." By 1996, Motorola expects to have five T1 (1.544-Mbit/s) links connecting Hong Kong, Singapore, Tokyo, and Phoenix, Ariz., plus one between Singapore and Western Europe. The rest of the Asian network will be served by 64- or 256-kbit/s links.

Similarly, international VAN operator Infonet Inc. (El Segundo, Calif.) has built a fully meshed network that directly links points of presence in Hong Kong, Singapore, and the Philippines. In addition, customers can access Infonet via gateways in China, Indonesia, Macao, Malaysia, and Thailand. "What we've got in Europe, we've also got in Southeast Asia," says Jose Collazo, Infonet's president and chairman.

Motorola's development of its network illustrates the trend toward hubbing private networks within Southeast Asia. Until two years ago, communications lines between the company's sites in, say, Hong Kong and the Philippines were routed via a Motorola hub in the U.S. Today, Motorola's Asian sites are linked via one of two hubs--one in Hong Kong for traffic to northern Asia and the other in Singapore for southern Asia. "In most of the countries, [a leased line to] the U.S. is in the same pricing zone as any other Asian location," says Wang. "For example, Hong Kong to Singapore is the same price as Hong Kong to the U.S., or Hong Kong to Malaysia." Thus, it's less expensive to rent a single line between Hong Kong and Malaysia, because traffic routed via the U.S. takes up capacity in two leased lines--one from Hong Kong to the U.S. and another from the U.S. to Malaysia.

Hong Kong vs. Singapore

Singapore's efforts to rival Hong Kong as the region's leading business center include the provision of telecommunications--and fierce battles over hubbing corporate networks are already being fought between the British colony's main public network operator, Hongkong Telecommunications Ltd. (Hongkong Telecom), and Singapore Telecom.

The competition covers a wide range of issues, including general ones such as government incentives for foreign investors and the potential for political instability in Hong Kong, which is scheduled for return to Chinese rule in 1997. Despite assurances from the Chinese government that Hong Kong will continue to exist as a free economic zone for at least 50 years after that, investors and many Hong Kongers remain wary.

Because of these issues, a number of major private network operators are expanding their presence in Singapore. One of them is Societe de Telecommunications Aeronautiques (SITA, Paris), which operates a global network for airlines. SITA inaugurated its third-largest communications center in Singapore in November, citing favorable investment terms as one reason for its location. Two operators of financial information services, Telerate Systems Inc. (New York) and Reuters PLC (London), already have shifted Hong Kong operations to Singapore. "The prospect of changes in 1997 is what made us start thinking about relocating, and then Singapore offered such strong economic incentives that it became cost-effective to move," says Richard Lim, network manager for Telerate Asia Pacific Pte. Ltd. (Singapore), a financial services provider.

Spreading The Wealth

Other users are putting their eggs in two baskets to spread their risks and play Hong Kong and Singapore operators against each other. General Electric Information Services Inc. (GEIS, Rockville, Md.) maintains its main regional hub in Hong Kong but is beefing up its Singapore operations. "More and more operational headquarters of companies are moving from Hong Kong to Singapore," says M.Y. Yeow, GEIS country manager in Singapore. "Once the decision-making people such as the chairman and officers are here, the communications hub usually is not far behind."

Another company sharing its business between Hongkong Telecom and Singapore Telecom is the Hongkong and Shanghai Banking Corp. (Hong Kong). Indeed, the bank is keeping score on key telecommunications issues, such as availability, reliability, and cost of services. The bank also is rating the two carriers on their readiness to solve customers' problems and respond to changes in the regulatory environment.

Motorola's records on circuit delivery indicate both Hongkong Telecom and Singapore Telecom are slow in delivering leased lines, but the delays are not as severe as in many European countries. Timing for delivery of circuits is on par with Japan and better than Australia--where it takes about four months to get a circuit, according to Motorola's Wang.

In terms of tariffs, the battle between the Hong Kong and Singapore carriers to attract corporate customers has led to an average reduction of more than 20 percent in leased-line rates between 1988 and 1991.

Hongkong Telecom also cuts better deals than Singapore Telecom. "Hong Kong is very competitive in tariffs," says Wang. Still Hongkong Telecom's tariffing scheme could be improved, according to the Hong Kong Telecommunications Users Group. Late last year, the group filed a formal complaint with Hong Kong's telecom authority, the Hong Kong General Post Office, about the operator's proposed tariffs. Hongkong Telecom says its pricing scheme will bring a 20 percent decrease in the cost of regional connections for digital leased lines operating at 64 kbit/s to 2 Mbit/s. However, the highly complex scheme offers discounts to new customers at the expense of present-day ones, according to Tim Cureton, chairman of the users' group. "The net effect of the tariff decrease is that communications costs will increase by 11 percent," says Cureton, who also is manager of group telecommunications for the Hongkong and Shanghai Banking Corp.

The new tariffs also penalize users who want to retain analog circuits by charging up to four times more for them than for digital circuits. "There's been tremendous investment in digital technology and hence oversupply in that aspect," says Motorola's Wang. The outcome of the users' group's complaint is still pending.

Hongkong Telecom also has an edge over Singapore Telecom in terms of the number of outages, although the duration of outages in Singapore is much shorter, according to records kept by Hongkong and Shanghai Banking Corp. Although users never are happy with anything less than 100 percent availability of leased lines, both carriers' records compare favorably with the achievements of many European PTTs.

Corporate users also give Hongkong Telecom a much better rating than Singapore Telecom for meeting customer requirements. "Hongkong Telecom is generally very flexible because doing deals is part of the Hong Kong culture," says Cureton. The attitude of Singapore Telecom, on the other hand, is in tune with the island nation's highly disciplined environment, in which laws prohibit gum chewing, among other things. "Singapore Telecom's reaction to customers is often paternalistic," says Cureton. "What they offer is technically very good, but they offer what they want to offer."

This opinion is echoed by Telerate's Lim, who also is interim chairman of the Singapore Telecommunications User Group (STUG). Lim wishes Singapore Telecom would offer several levels of service for leased lines.

"Various users have different service requirements," says Lim. "Some can afford downtime. Others can't and would be willing to pay a premium for a higher level of service quality and maintenance on international links. But that option is not available yet."

Cureton says Hongkong Telecom signed a quality-of-service agreement with his bank, but a request for a similar agreement with Singapore Telecom was ignored.

In addition to the political uncertainty surrounding Hong Kong's return to Chinese rule in 1997, the British colony faces an unstable regulatory situation. Hongkong Telecom's franchise to provide domestic services expires in 1995; its international franchise runs out in 2006. The government is reviewing the regulatory environment, and is reportedly considering various schemes to introduce more competition. But no decision has been made yet about further market openings, and, as Hongkong and Shanghai Banking Corp.'s Cureton puts it, "the whole place is in a state of uncertainty: competition or no competition?" Pending the announcement of the government's telecom policy, Hong Kong users are paying the price of uncertainty: "Hongkong Telecom won't invest in or introduce new services," says Cureton.

In Singapore, the government has published a draft law proposing the privatization of Singapore Telecom, and shares may be traded by year's end. But this corporate revamping will have little, if any, impact on users since Singapore Telecom will retain its monopoly over everything except VANs and terminal equipment. Moreover, the VAN market in Singapore effectively has been cornered by Singapore Network Services Pte. Ltd.

While retaining its monopoly, Singapore Telecom is investing heavily in future services. This includes an outlay of $250 million over the next three years for undersea optical fiber cables linking Singapore to the rest of the industrialized world. Other examples of new investments include Singapore Telecom's virtual private network and an ISDN service, both of which are being attached to foreign networks for international coverage.

Elsewhere, Many Needs

For all their technological might, there is one regional issue that sophisticated network operators in Hong Kong and Singapore can't solve: the dismal state of telecommunications in Thailand, Indonesia, the Philippines, and to a lesser degree, Malaysia. The bottom line for users is that while circuits are readily available for international gateways in the region, it is still a problem to go "the last mile" to build domestic networks in these countries. Most nations in the region still are struggling to provide basic voice and data services over inadequate domestic networks. These countries are still a long way from fulfilling the growing demand for reliable data communications but they are trying. The Asian Development Bank (ADB, Manila), an international organization that offers low-interest loans to developing Asian countries for infrastructure projects, has lent $600 million for telecommunications ventures since 1966, and it is approving more and more telecommunications loans, according to ADB senior economist Bruce Murray.

Malaysia is probably the best positioned to supply users with domestic leased lines. Its telecom network is more developed than those of its neighbors, with more phones per customer and more available leased lines.

Furthermore, the Malaysian government launched an agressive economic development program last year that will further enhance the telecom infrastructure. The country's operator, Syarikat Telekom Malaysia Bhd (STM, Kuala Lumpur)--which was privatized in 1987 but remains under the purview of the government--was awarded a five-year (1991-95) budget to upgrade its infrastructure. Projects include expansion of STM's four main data offerings: Datel, for low-rate links over the public telephone network; Maypac, the packet-switched X.25 data network; Maycis, the circuit-switched service; and Telemail, an X.400 electronic-messaging service. STM is also in the process of developing ISDN services, which are scheduled to be commercially available next year in the capital city of Kuala Lumpur.

Next on the performance list is Thailand, where an estimated 1.2 million people and businesses are waiting for phone lines. All domestic service is controlled by the Telephone Organization of Thailand (TOT, Bangkok), which has undertaken several network expansion projects, some of which will be handled by private entities with foreign partners. For example, Nynex Network Systems Co. (White Plains, N.Y.) has a 10 percent stake in a project with Telcomasia Corp. Ltd. (Bangkok) to build and operate a 2-million-line digital network in Bangkok.

These projects are aimed at fulfilling basic telephone needs, not at providing sophisticated corporate data services.

Indonesia, which one telecommunications manager characterized as "a last-mile nightmare, particularly in Jakarta," also is seeking foreign help to upgrade its network. The country's domestic, not-for-profit telecom operator, Perumtel (Jakarta), has defined a five-year (1993-1998) plan to add 5 million lines to its network. The Indonesian government is allowing foreign participation in the project, but only for the building phase, not for ownership or operation of the network. Nevertheless, a number of foreign operators--including U.S. regional Bell operating companies (RBOCs) and PTTs from Western Europe and elsewhere in Asia--reportedly have expressed interest in the project.

As for the Philippines, the country may enjoy the fastest-growing telecommunications networks in Southeast Asia over the next few years. Because the country's public terrestrial network has been so inadequate for so long, users needing reliable domestic communications have long employed creative solutions in setting up private networks. One of the country's largest food and beverage conglomerates--San Miguel Corp. (Manila), which has numerous manufacturing plants, distributors, and offices across the Philippine Islands, built its own microwave towers and operates its own links to ensure reliable voice and data communications.

Furthermore, the Philippine telecom market historically has been run by private entities. The country's largest operator, Philippines Long Distance Telephone Co. (PLDT, Manila), which controls 94 percent of the public network, is publicly traded on the Manila and New York stock exchanges. The Philippine market is open to competitive forces, even if competition is controlled by the country's National Telecommunications Commission (NTC). There are three other main players, all partly owned by U.S. or U.K. interests, and about 40 small local operators.

Another major boost to Philippine telecommunications could come from the NTC itself, whch recently amended PLDT's operating license to include data services, according to Manila-based telecommunications consultant Charles Horne of Halidon International Holdings Ltd. (Hong Kong). Until now, PLDT only could provide voice services to subscribers; for data, it acted solely as "a carrier's carrier" by leasing lines to providers of data services, Horne says.

The Satellite Solution

With its thousands of islands, Southeast Asia is ideally suited for another solution to poor terrestrial service: privately owned satellite data networks. These networks, most of which use very small aperture terminal (VSAT) technology, are springing up all over the region, encouraged by government policies that award VSAT licenses to multiple private operators.

But there are only two regional satellite systems that provide transponder services--Asiasat, owned by Asia Satellite Telecommunications Co. Ltd. (Hong Kong), which in turn is partly owned by Cable & Wireless PLC (London); and Palapa (Jakarta), owned by the Indonesian government.

The Pacific Rim satellites of the International Telecommunications Satellite Organization (Intelsat, Washington, D.C.) also carry some intraregional traffic, and Thailand and Malaysia each are planning to launch their own domestic satellite systems by 1994. For now, however, capacity is short by about 60 to 70 transponders, according to Andrew Jordan, Asiasat's marketing manager. About 20 percent to 25 percent of Asiasat's current capacity is used for VSAT systems, Jordan says, and several transponders on Asiasat's second generation of satellites--to be launched in 1994-95--already have been earmarked for VSAT use.

"VSAT technology is particularly applicable to the area" for two main reasons, Jordan says. First, in island nations such as Indonesia and the Philippines, terrestrial networks are either impractical or too expensive to install, whereas a satellite system easily can cover a geographically dispersed area. Second, in countries with poor terrestrial networks, satellites are the only means to reach distant locations.

In Indonesia, a public data network service operator called Lintasarta (Jakarta), partly owned by Perumtel, is setting up a nationwide 250-VSAT network with equipment supplied by Hughes Network Systems Inc. (HNS, Germantown, Md.), for public data network services.

In Thailand, four private operators are operating two-way VSAT networks. One of these, Compunet Corp. (Bangkok), has already installed some 250 VSATs in the country and plans to expand its network by about 200 VSATs per year, according to managing director Philip Richards. For its largest customer to date, the Bangkok Metropolitan Bank, Compunet has installed and is managing a 63-VSAT network in Thailand. Cable & Wireless has a 40 percent stake in Compunet. The other operators of VSAT networks in Thailand are Samart Telecommunications Co. Ltd. (Bangkok), Thai Skycom Ltd. (Bangkok), and Acumen (Bangkok).

VSAT networks also have a bright future in the Philippines. NTC, the country's telecom authority, has licensed four two-way VSAT operators to carry voice, data, and video services.

The largest player, Globe-Mackay Cable and Radio Corp. (Manila), already has installed 120 VSATs (supplied by HNS) across the country, and plans to have 175 terminals up and running by the end of the year, according to Angelo Molato, the company's vice president for sales and marketing.

Globe-Mackay's basic offering includes leased lines for voice and data and equipment rental. Prices run 34,000 Philippine pesos (about $1,400) for a 9.6-kbit/s data link and 48,000 pesos (about $1,975) for a 9.6-kbit/s data plus a 16-kbit/s voice link. The VSAT option is attractive enough for American Express Co. (New York) and Texas Instruments Inc. (TI, Dallas) to consider satellite links for their Philippine operations.

San Miguel also has been won over by VSATs. The conglomerate is phasing out its microwave-based private network and replacing it with a VSAT network to be implemented and managed by Globe-Mackay. Plans call for 150 VSATs to be installed over the next two years serving San Miguel's data and voice needs. The other Philippine carriers with VSAT services are PLDT, Liberty Broadcasting Corp. (Manila), and International Communications Corp. (Manila).

Malaysia, too, is turning to satellites--but not to VSATs. The Malaysian government has granted a second license to private operator Information Networking Corp. Sdn Bhd (INC, Kuala Lumpur) for data services as well as access to international databases, all via the Asiasat satellite. The system, which is hubbed in Kuala Lumpur with an international gateway in Hong Kong, is one of the few in Asia to incorporate FDDI technology, according to Ron Cattell, director of marketing for Datacraft Asia Ltd. (Hong Kong), the network integrator that is implementing INC's system.

The Future of Value-Added Networks in the Pacific

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ABSTRACT

U.S. telecommunications services companies view the Pacific as a fertile, untapped marketplace for value-added services. While certain nations already have telecommunications networks capable of supporting value-added services, many do not; the latter nations will be the focus of telecom development in the near future. In order to prepare themselves for value-added telecommunications and the economic benefits it can deliver, such nations must consider liberalizing their networks or risk falling further behind.

I am delighted to have an opportunity to speak to you today about the future of value-added networks in the Pacific.

It's a perfect topic for MCI, because we're vitally concerned with all three -- the future, value-added networks, and the Pacific.

With respect to the future, we are one of the most forward-looking companies I know. We are actively preparing for a future that will benefit our users and our shareholders, by making substantial investments in our network, technology and people.

Second, we are dedicated to value-added telecommunications. We learned long ago that telecom companies that define themselves only as carriers have limited impact and limited prospects for growth. Consequently, we built MCI as the premier supplier of value-added telecommunications solutions, and we will continue to be just that.

By the way, it's important to make sure that we all mean the same thing by "value-added telecommunications," so let me tell you exactly what these words mean to me. They mean telecommunications that transcends the mere transport of electronic signals. They mean the storage and processing of information and the addition of unique features possible only on a digital, intelligent network like MCI's.

Believe me, I understand that not all Pacific telecommunications systems are ready in a technical sense to support value-added communications. But I believe they will be soon. Multinational corporations crave value-added communications. Global commerce demands it. I am convinced that today's underdeveloped communications systems will find ways to accommodate the need...and soon.

Consider this: Five years ago, we were still rolling out Common Channel Signaling System #7 across the United States. For those of you who don't know, SS#7 is the out-of-band enabler of all value-added services. Five years ago, we just didn't have the digital switches and ports to deploy it nationwide.

Today in the United States, nearly two-thirds of all of the traffic on MCI's network is value-added traffic. All of our domestic and international Friends & Family and Friends of the Firm calls are value-added calls. Personal 800 is another service that we rolled out recently, and it, too, is value-added, as are network management, time-of-day routing, store-and-forward fax, data bases, electronic messaging, call-detail reporting, virtual private networks, packet-switched data and the other 50-plus services available from value-added service suppliers like MCI.

And that brings me back to my opening statement. I said at the opening that MCI is concerned about the future of value-added networks in the PACIFIC. Let me talk for a moment about our interest, and the interest of value-added suppliers everywhere, in this marketplace.

Simply put, the Pacific represents enormous opportunities for telecommunications services companies worldwide.

Together, the 34 countries that encircle the Pacific and the 23 island states scattered across its 70 million square miles account for more than 50 percent the world's population and half its total wealth. Its 3+ billion people speak more than 1,000 languages and display the richest religious and culture traditions of any region on Earth. Pacific nations possess 21 percent of the world's oil resources, 63 percent of its wool, 67 percent of its cotton, 87 percent of its natural rubber and 97 percent of its natural silk. And now, they have established new monopolies over information technology in semiconductors, superconductors, audio and video systems, and are rapidly moving on to establish dominance in artificial intelligence and satellite launching rockets.

And don't forget that the Pacific isn't just Asia, the South Pacific and Micronesia, but also most of the countries of North, South and Central America.

It's an immense area -- with some of the most important economic and communications links of the future.

When companies like MCI view the Pacific, we see thousands upon thousands of businesses and billions of individuals who are potential users of the value-added services we provide. And, because so much of the Pacific is not yet hooked in meaningfully to the global network, it represents a tremendous underdeveloped marketplace that MCI plans to address.

I've mentioned the potential of the Pacific marketplace. What about the accomplishments that have already been made? U.S suppliers are encouraged by the dramatic steps that have been taken by our Pacific neighbors in the last five years. For example, Japan has one of the world's most advanced and open networks, with three domestic network control centers competing for local traffic and two international long distance carriers competing with KDD. In Malaysia, the Philippines, Australia, Mexico and other countries, free competition has created modern telecommunications systems and an almost insatiable demand for value-added services. And New Zealand has what may fairly be described as the most competitive marketplace of all.

In each of these marketplaces, value-added telecommunications has helped to deliver economic benefits. For with value-added communications, there has never been a greater array of methods for attracting foreign investment -- without spending billions in the process. The opportunities lie equally in service and manufacturing industries.

In services, for example, the personal computer, fax machine, and telephone form a trio of highly affordable communications devices that allow engineers, architects, economists, writers, researchers, accountants, programmers, attorneys, insurers, environmentalists, physicians -- virtually all professionals -- to win contracts wherever they may be located.

When these professionals have access to a value-added network, they can electronically send and receive funds, x-rays, reports, manuscripts, charts, blueprints, market updates, spreadsheets, data bases, contracts, photographs and other information -- and they can bring hard currency to any nation where they're working.

Along with this goes the idea that hospitals, financial centers, office buildings, libraries, laboratories, communications centers, teleports, and similar facilities can now be located -- very practically -- in many places once considered "remote."

This means that every nation's uniqueness can be seen as an advantage -- the traditional industrialized model of economic success need no longer be the only model. Even tourism is enhanced when visitors to a country know they can easily stay in touch with loved ones and business associates back home.

The possibilities to profit from value-added global telecommunications are endless. But let me sum up what I'm saying with this thought: value-added telecommunications offers huge opportunities for those who grasp its potential today. You can measure these opportunities in increased hard currency, improved balances of trade, diversification of economic development, as well as "spillover" benefits such as improved residential phone service, expanded education and healthcare facilities, and so on.

There's another, more ominous half to my thought, however. Nations that don't aggressively embrace the opportunities created by value-added telecommunications risk falling even further back in the economic race. And this threat of falling behind grows each day as technological advances and international telecommunications agreements -- like those concerning ISDN -- continue to race forward.

Fortunately, service providers -- and I'm proud to number MCI among them -- stand ready to provide virtually any country with sophisticated value-added services. MCI, for example, already brings most if not all of these services to the many of the over 200 nations we serve. We're ready to discuss doing even more to help spread the wealth of the telecommunications resource.

Before anyone accuses me of taking a simplistic view of things, however, let us share a hard look at reality. Today's Pacific telecommunications scene is a striking study in contrasts. In some places -- like Hong Kong -- satellite conference calls, fax machines, electronic mail, and private networks are taken for granted, while in others -- like Vietnam -- the distance of the average person to the nearest telephone can be measured in miles -- and in years.

While residential users in Japan access a host of information and financial services through their telephones and personal computers, many Vietnamese are unable to fulfill the simple human need of quickly phoning for help in an emergency.

The social and economic implications of these imbalances are clear -- and far-reaching: In places without value-added networks, capital investment will be slight, and businesses, hospitals, universities, and other vital institutions will be scarce.

The question that we at MCI must constantly address is how to turn this around -- how to make it possible for anyone, anywhere to have access to the benefits of value-added telecommunications. One of the ways to achieve this end is through competition.

Indeed, competition has generated remarkable results wherever it has been introduced. In the U.S., competition has resulted in a fundamental overhaul of what was already considered the world's most advanced telecommunications network. In the years since divestiture in the U.S., the telecommunications market in the U.S. has grown by more than 60 percent, into an almost $200 billion industry. The competitive long-distance market along is more than a $55 billion industry -- despite average rate reductions of more than 40 percent since divestiture.

In the U.S., competition has made available a full range of value-added services: videotext, video conferencing, virtual private networks, store-and-forward fax, electronic mail, data base services, network management and security services, data transmission, electronic data interchange, ANI and a host of others. All of these can be available in any nation willing to open their networks. In every instance where countries have opened their networks, it has led to positive results.

At MCI, of course, we believe that competition is healthy and in the natural order of things. As a matter of fact, we have -- by virtue of our acquisition of Western Union International and RCA Globcom -- about as much experience in the area of cooperation as we do in the field of competition.

Especially in areas such as the Pacific Rim, where political and economic systems range from unbridled capitalism to military dictatorships -- we are seeking ways to cooperate in addition to seeking ways to compete. We do not seek to impose our competitive legacy on others. However, we do seek empowerment of the end users.

"Empowering the end user" requires the right balance of both of these elements. Sometimes this is a little tricky to achieve, but history, both recent and distant, shows us that we can do it.

For example, a century and a half ago, agreements were reached that allowed telegraphy to blossom into a powerful, worldwide communications tool. Likewise, thousands of other cooperative decisions, on issues ranging from the shape of phone jacks to the X.400 communications standard, have been required to allow people to talk to each other.

Through good-faith negotiations and regulatory progress, these decisions have been worked out. And today more than ever -- with ISDN on the horizon -- it is important to note the regulatory progress I'm speaking of requires the right combination of cooperation and competition. Cooperation in realizing the goals of universal access and global connectivity -- competition in the traditional business sense of striving always to bring the best possible offerings to the marketplace.

These are not frivolous concerns. In a recent examination of telecommunications in the Pacific, the respected Columbia Journal of World Business put it this way: A country cannot be an economic power without a strong and efficient telecommunications network. Conversely, people who have access to value-added telecommunications can expect intensified economic activity and prosperity.

For developing countries throughout the Pacific, the message is clear. The establishment of a value-added telecommunications infrastructure is vital to success in attaining economic development goals.

Value-added telecommunications means business. It means jobs and an opportunity to participate in the mainstream economy. And it means that participation in the world economy -- brought about through better telecommunications -- can break the ground for other improvements....better roads, housing, schools and medical care. Value-added telecommunications enables whole regions to lift themselves up by the bootstraps.

The nations of the Pacific Rim are counting on us, you and me, to spread the benefits of value-added telecommunications. To make this happen, we must talk to each other, sharing our visions and goals and plans. Only in this way can we work out the myriad details that confront us and thus bring ourselves closer to the ideas of universal connectivity and prosperity. World events have ushered in an era of great promise for value-added telecommunications, and we must cooperate closely as partners, providers and users if we are to realize that promise.

Now, let's take just a few moments to take a glimpse of the future. Everywhere throughout the Pacific, exciting and historic things are happening in value-added telecommunications.

The most obvious trend is the rapid improvement of networks, and I don't just mean in countries where networks have not previously existed.

Thanks to competition, the PTTs of Japan, Mexico and New Zealand, to name just three, will spend a total of some $100 billion on systems modernization by 1999. Japan, in fact, is about halfway into a 15-year, $150 billion project to digitize and fiberize its network -- an effort that many other developed nations will soon have to consider undertaking. And in the United States, it appears from recent court rulings that CATV will provide wide-band access to American homes and businesses without the need for re-wiring the nation. The result, of course, would be still further proliferation of value-added services in that marketplace.

Even for Pacific countries like Singapore that have not yet privatized, the introduction of competition in the region has, at the very least, acted as a catalysts to accelerate the re-examination of government monopoly and led to networks capable of delivering value-added services.

There are other exciting trends in the Pacific, as well. For instance, in the next decade, we will -- thanks to cellular technology -- empower millions of once-isolated people and businesses. It's particularly important to island states like the Philippines, Canaries or Marianas, where the main island may have fiber connections but outlying islands may have no service at all. And here's more good news: In the near future, new technology will enable cellular systems to deliver many of the value-added capabilities of traditional systems.

Another driver of value-added communications in the Pacific is affordability. Unfortunately, at the moment, Pacific communications are not as cost-effective as they should be. For many big multinational companies, private networks are the ONLY kind of network available. However, the development of modern public switched networks in places like Japan, Australia Singapore and Hong Kong is allowing suppliers like MCI to deploy much-more-efficient, software-defined international virtual private networks. We have learned that companies are much more willing to expand operations in areas where the local network will support virtual networks, which is another reason we urge Pacific nations to get ready for value-added services. By providing a public switched, intelligent network, you not only help customers avoid the expense of private networks, you allow them to install and use a whole host of money-saving, productivity-improving applications.

As different economies in the Pacific grow and deregulate, you will see the bigger carriers looking for opportunities to compete on a regional basis -- carrying intraregional traffic. Thus, it may be possible for carriers like MCI to compete for value-added traffic between, say Japan and Australia -- traffic that has no U.S. leg. Such truly global competition, when it occurs, is sure to generate reduced prices and better services for Pacific users, everywhere.

Another trend in the Pacific is driven by the relatively high cost of circuits in developed nations like the U.S. and Japan. In the next 10 years, we are going to see a much higher percentage of hubbing emanate from the Pacific. This is especially costeffective for, say U.S. or Japanese companies that have substantial operations in the Asia Pacific area. These companies are already discovering that they can send all of their traffic to a hub where circuit costs to the rest of Asia are lower, and then disperse the traffic around the world from there. It's another example of how a company like MCI, working with its Pac Rim partners is adding value to the Pacific telecommunications scene.

Naturally, there are still many question marks -- and some caution signs -- about the future of value-added telecommunications in the Pacific. Few movements in history have marched straight forward, never zig-zagging. But it is precisely in times of uncertainty that we need to remember our guiding visions, and adhere to the basic principles of liberalization, competition and cooperation.

These principles will help the Pacific Rim to successfully blend together the interests of the American and Asia telecommunications systems so that everyone benefits. These principles will also help us decide on other basic regulatory and policy issues like licensing, Open Network Provisions, and regional standards.

I, for one, am confident that the industry we're all part of is up to facing these challenges, just as we are all eager to explore the unimagined opportunities yet to come. After all, very few fields can compare with telecommunications in terms of the challenge and excitement offered to all of us today. You and I are privileged to be living at this time, with the responsibility of shaping such a basic component of humanity's economic and social happiness.

We can not and will not let them down.

NASA's Experimental Satellite Program for Future Telecommunication Services

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Honolulu, Hawaii

1. ABSTRACT

The Advanced Communications Technology Satellite (ACTS) represents the next generation of NASA's advanced satellite communications research. The primary objective of the ACTS Program is to develop and demonstrate revolutionary technologies that may be incorporated into future operational systems. ACTS advanced features include onboard processing and switching; fast-hopping, high-powered spotbeams; Ka-band components, and a steerable antenna. To compliment the capabilities of the satellite, NASA has developed an extensive system of ground stations and interfaces designed to maximize commercial applications experiments. The NASA ACTS Experiments Program makes the ACTS system available to the public and private sectors for conducting experiments of potential applications.

The Pacific Space Center (PACSPACE); a team of industry, university, government, and non-profit affiliates; is a participant in the ACTS Experiments Program. PACSPACE intends to utilize a NASA-developed T-1 VSAT and a High Data Rate (HDR) terminal for experiments. Potential experiment opportunities are available to interested organizations in the Pacific region under the guidelines established by NASA. Telecommunications will be instrumental in shaping future global economic development in the Pacific region. The advanced technology represented by the ACTS system holds key economic opportunities for the future.

2. INTRODUCTION

From its inception some thirty years ago, we have seen communications satellites evolve from a reflecting balloon in space which gave us the first, albeit faint, transoceanic two-way voice transmission via satellite to today's high-powered, sophisticated satellites which provide voice, data, and video telecommunications services on a world wide basis.

Through much of this period, NASA, together with a host of U.S. industry partners, developed the rockets and spacecraft called Echo, Telstar, Relay, and Syncom, thereby introducing to the world, the basic spacecraft building blocks: batteries, power conditioners, solar arrays, attitude control, spacecraft structures, orbit insertion techniques, and communication payload components; which spawned a satellite communications industry. Following Syncom, NASA sponsored U.S. industry in the development of a series of Advanced Technology Satellites (ATS) that introduced a host of new telecommunication applications such as: land, aeronautical, and maritime mobile communications; position location; data collection; disaster communications; direct video and audio broadcast; and others, many of which are being exploited today. It is difficult to imagine that many of the satellite-enabled telecommunications services we enjoy today were drawing-board concepts a decade ago. They've become such an integral part of our lives that we often wonder how we ever got along without them. But what about the future?

Future expectations for the telecommunications market in general, and satellite communications services in particular, are optimistic. Financial institutions are predicting an explosion in the telecommunications industry in the 90's; voice, data, and video network services--local and long distance, domestic, and international--will emerge as one of the great growth industries of all time.(1) This industry is expected to grow at three times the rate of the overall industrial economy.(2) The annual global sale of telecommunications equipment will grow from $135B in 1990 to about $235B by the next decade. Telecommunications services enabled by this equipment will have an estimated value in the trillions of dollars, of which hundreds of billions of dollars can be contributed to satellites. Satellites will therefore continue to be a key element of this industry despite strong competition from other transmission media.

Migration of certain satellite voice services to fiber optics will more than be made up by the demand for telecommunications services which are unique to satellites. Very-Small Aperture Terminal (VSAT) networks have become, and will continue to be, a major application of communications satellites. Mobile satellite services will soon be introduced in the U.S. and have already been introduced elsewhere. Video and audio direct broadcasting satellite services will also begin to emerge over the next decade. Satellites with onboard processing capabilities have already been demonstrated in space, albeit for military applications. Major enhancements of this technology are being readied and will be validated in space during the 90's for commercial applications of the early 21st century. These advanced space systems will feature onboard switching and multiple hopping spotbeams that will provide opportunities for smaller-sized VSAT to VSAT (direct) connectivity, direct station-to-station mesh interconnectivity, and networking that is dynamically reconfigurable to adapt to changing types and rates of traffic; and it will be provided on-demand. We will see future satellite systems which will help provide personal communications on a global basis. The future for the satellite communications industry continues to look promising, and NASA will continue to be a part of it. This paper examines NASA's Advanced Communications Technology Satellite (ACTS) program, an experimental satellite program that will usher in the next generation of satellite communications technology.

3. ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE (ACTS) AND EXPERIMENTS PROGRAM

To accommodate the expected increase in demand for greater telecommunications services, technology innovations are needed that will provide these services on a cost effective basis. ACTS accomplishes this by developing and demonstrating on-orbit, revolutionary technologies that may be incorporated into future operational systems. The on-orbit validation of the technology establishes the confidence that is needed for embracing and applying the technology to operational systems. The benefits realizable from this program include the introduction of new services, more cost-effective delivery of existing services, growth in the capacity of satellite systems, and effective utilization of spectrum and orbit. Key spacecraft technologies to be validated as part of the ACTS program include:

- High EIRP fast-hopping spot beams
  - Spectral reuse through spatial diversity
  - Higher throughput VSAT's (T-1 rate)
  - Smaller ground terminals
  - Efficient capacity assignment to geographically non-uniform demand
- Ka-band components
  - Opening a new frequency band
  - 2.5 GHz bandwidth
  - Dynamic rain fade compensation
- Onboard processing and switching
  - Switching and routing on-board at individual voice circuit level
  - Single-hop mesh voice network
  - Improved signal-to-noise ratio

4. ACTS OVERVIEW

The ACTS system consists of a flight segment and a ground segment. The flight segment will be launched on June 30, 1993 aboard the Space Shuttle and placed in geostationery orbit at 100 degrees W. longitude. ACTS will measure 46.5 feet from tip to tip along the solar arrays and 30 feet from one antenna to another. The on-orbit configuration of the satellite is shown in Figure 1.

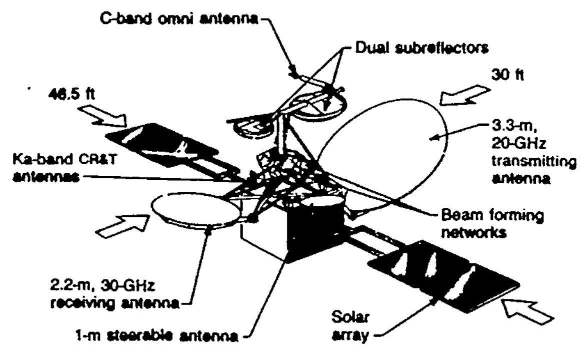

Figure 1. ACTS Spacecraft Configuration

During the operational mission phase, the spacecraft is stabilized in three axes with the large antenna reflectors facing the earth and the solar array panels rotating once per day to remain facing the Sun. Given the experimental nature of the spacecraft, batteries are provided to supply power during eclipse periods to essential bus loads only. The flight segment is comprised of two sections: the advanced technology payload called the multibeam communications package (MCP) and the spacecraft bus which provides support functions to the payload. Prominent features of the MCP are the use of electronically hopping multiple spotbeam antennas, onboard storage and baseband switching of communication traffic, and Ka-band transmission.

Separate Ka-band (30/20 GHz) antennas are provided for transmitting and receiving signals. The antenna system provides two hopping spotbeam families (east and west) plus three fixed beams. The east and west families are discriminated by polarization. Figure 2 identifies the coverage area associated with each family. The east family of beams comprises an east scan sector and six additional spotbeams for isolated location coverage outside the contiguous scan sector. The west family comprises a west scan sector, seven additional spotbeams for isolated location coverage outside the contiguous scan sector, and a steerable spotbeam to provide Hawaii and Alaska coverage.

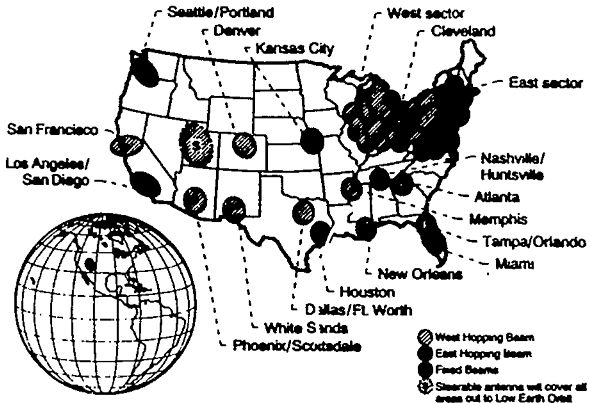

Figure 2. ACTS Multibeam Antenna Coverage

The multibeam communications package provides the means for receiving, processing, switching, amplifying, and transmitting signals that carry high-speed digital communications traffic in a TDMA network. A functional overview of the ACTS flight system is shown in Figure 3.

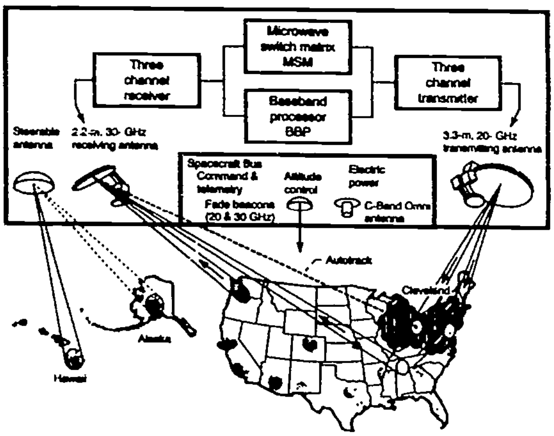

Figure 3. ACTS Flight Segment

Two types of switching, one at baseband with storage and the other at an intermediate frequency (IF) have been incorporated into ACTS. The baseband switch, which is referred to as the Baseband Processor (BBP) provides single-hop interconnectivity between all spotbeams. Hopping beams are most useful for serving areas where traffic is spread geographically and for isolated areas having insufficient traffic to justify the use of a stationary spotbeam. Beam hopping aggregates the traffic from such regions. In this mode, communications to the satellite will be by demand-assigned multiple access (DAMA). The IF switch, which is referred to as the Microwave Switch Matrix (MSM), is based on satellite-switched time division multiple access (TDMA) and is primarily used to interconnect the three stationary beams of the ACTS satellite, although it may also be used to connect the hopping beam locations during predetermined periods of time. The three 900 MHz bandwidth channels of the MSM provide the flexibility for a variety of communication investigations. Microwave switch positions may also be fixed to allow frequency demand multiple access (FDMA) communications.

A major feature of the ACTS system is its use of a dynamic rain fade compensation technique. Rain fades can be detected by monitoring the amplitude levels of the flight system beacons. The ACTS flight system will incorporate three beacons for real-time fade measurements: two in the downlink frequency band and one in the uplink frequency band. Signals from all three beacons will cover the full continental United States. The downlink frequency beacons at 20.185 GHz (vertical polarization) and 20.195 GHz (horizontal polarization) are modulated with telemetry and ranging information, but they also double as fade beacons. The uplink frequency beacon at 27.505 GHz (vertical polarization) is unmodulated and will be used for power monitoring (fade information) of the ACTS spacecraft. The beacons, however, are not derived from the same local oscillator and, therefore, are not coherent relative to each other.

To complement the capabilities of the satellite, NASA has developed or is in the process of developing an extensive ground system infrastructure that is comprised of three elements: the NASA ground station (NGS), the satellite control center (SCC), and several classes of experimenter terminals. A functional overview of the ground segment is shown in Figure 4. The NGS, located at NASA Lewis Research Center, Cleveland, Ohio, will include the Master Control Station (MCS), a low-burst rate terminal for BBP mode of operation and a Link Evaluation Terminal (LET) for MSM mode of operations. The SCC located at GE Astro-Space in East Windsor, New Jersey, will be linked to the NASA ground station via terrestrial voice and data circuits. Transfer orbit support and operations back-up to the SCC will be provided by a C-band command, ranging, and telemetry (CR&T) station located at Carpentersville, New Jersey.

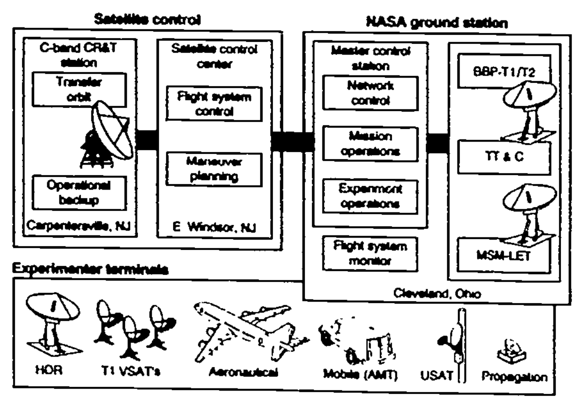

Figure 4. ACTS Ground Segment

5. EXPERIMENT PROGRAM OVERVIEW

The NASA ACTS program offers a unique opportunity to the U.S. public and private sectors (corporations, universities, and government agencies) to experiment with satellite communication technology that is expected to be operational at the turn of the next century.

A two-year period of experimentation is planned after the launch of the ACTS spacecraft, following a nominal one-month period for on-orbit checkout. Sufficient propellant will be carried onboard to provide station keeping for at least four years. If sufficient experimenter interest is identified and additional operation funds are allocated, the experiment period may be extended an additional one or two years.

In addition to performing tests and experiments that verify the on-orbit performance of the advanced technology components of the flight system and that characterize the transmission medium, NASA is emphasizing the selection of experiments that demonstrate the commercial viability and market acceptability of new voice, data, and video networks and services.

This experiment emphasis is based upon an industry recommended focus for the experiment program that would address a number of potential high-payoff application areas:

- 1.5 Mbps voice, video, and data networks;
- 300 Mbps supercomputer and HDTV networks;
- Aeronautical voice and data applications;
- Integrated services digital networks; and
- 2 kbps control and data acquisition networks.

In conjunction with aeronautical applications, industry advisors have also emphasized the importance of obtaining a characterization of the propagation transmission path.

The experiment terminals being developed to provide an experimenter capability in these application areas are under development. The experiment terminals are classified into five types:

- Very Small Aperture Terminals (VSAT) for digital networks which provide on-demand, full-mesh connectivity at T-1 rates over a single hop;
- High Data Rate (HDR) Terminals for point-to-point or point-to-multipoint networks at 1 Gigabit per second rates;
- Ultra Small Aperture Terminals (USAT) or "personal" terminals for low data rate (kilobits per second) supervisory control and data acquisition (SCADA) type networks;
- Mobile (both land and aeronautical, narrowband and broadband); and
- Propagation Terminals for characterizing the transmission media at Ka-band.

Under a 1990 NASA Research Announcement grant awarded to the Hawaii Pacific Space Center (PacSpace), experimental concepts utilizing ACTS technologies were designed that addressed four major applications areas. The PacSpace application experiments require the use of the NASA developed T-1 VSAT and HDR experimenter terminals described in Figure 5. The T-1 VSAT, which has an Integrated Services Digital Network (ISDN) capability, will be loaned to PacSpace for approximately a six-month period during the first year of the experiments program. PacSpace has committed to the purchase of an HDR terminal and will place the terminal in operation at the conclusion of experiments conducted with NASA's T-1 VSAT.

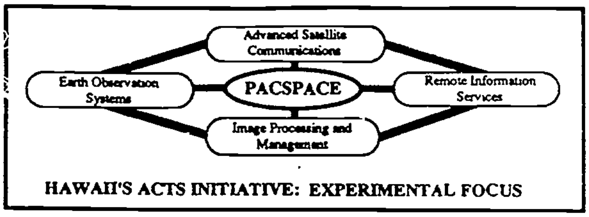

Figure 5. Hawaii Application Experiments

6. PACSPACE/HAWAII OVERVIEW

Hawaii provides an ideal environment in which to test and validate ACTS technologies. The State's strategic mid-Pacific location has secured its role as a hub for international telecommunications and places it well within the footprints of numerous communications satellites serving Pacific Rim nations. Local industry is developing an extensive inter-island and fiber-optic network to complement the existing inter-continental network linking Hawaii with nations around the region and maintains collaborative research programs with the University of Hawaii that continue to pioneer state-of-the-art communications systems and protocols. ACTS' state-of-the-art technologies will enable Hawaii to utilize these unique strengths and capabilities to advance methodologies for data networking, management, and analysis, thus enabling the State to serve as both an innovator and testbed for advanced space communications and information systems.

The Pacific Space Center (or PacSpace) is currently mobilizing industrial, academic, and governmental resources to support Hawaii's ACTS Experimentation Program. The academic branch of this triad is led by the University of Hawaii, which provides an exceptionally talented faculty and outstanding on-campus facilities to support research and development in space science and technology. The industrial element is represented by the Pacific International Center for High Technology Research (PICHTR), whose ongoing programs in energy research, information technology, and educational training are helping advance international cooperation and development in these areas. Finally, governmental interests are being promoted through the Hawaii State Office of Space Industry, which has been working to both expand and diversify Hawaii's space-related activities with special emphasis on business development and technology transfer, aerospace education, public information/community outreach, international cooperation through joint space ventures, and the development of Hawaii's commercial space launch potential.

7. PACSPACE EXPERIMENTAL FOCUS/OBJECTIVES

Recent advances in the areas of information collection, high-speed communications, and high-performance computation are revealing new opportunities for commercial applications in these areas. Intelligent satellite communications will effectively complement terrestrial networks by offering high-speed channels to remote areas of the world and by providing dynamically reconfigurable networks for specialized purposes. Similarly, developments in image processing and management will expand the productive use of captured images and provide new paradigms for computer/user interactions. These capabilities facilitate applications which will enable humans to observe, model, and eventually manage earth and ocean resources and their dynamic processes. An outgrowth of this remarkable expansion in human capability will be a rapid proliferation of new information concerning our world and our relationship to it. Advanced communications technologies will also facilitate access to remotely situated information, thereby creating a new marketplace in information services for each basic information type.

In light of these significant technological developments and opportunities, PacSpace will explore experiments in four major areas that will validate ACTS technologies and promote utilization of these technologies through commercial and governmental applications.

7.1 ADVANCED SATELLITE COMMUNICATIONS

While telephony-based communications have developed with a speed and capability that would hardly have been imaginable only 25 years ago, advanced satellite communications will take this technology to a higher level of efficiency and productivity through the 1990s. Satellites will help bridge the miles in providing high-speed communications currently offered by terrestrial networks. This type of enhanced communications capability is required to speed the transfer of remotely collected data to processing centers and to move large amounts of archived data to remote users. NASA's ACTS, with its associated Ka-band capacity, Gigabit transmission speed, and steerable antenna, is ideally designed to service these needs.

7.2 EARTH OBSERVATION SYSTEMS/GLOBAL CHANGE RESEARCH

The task of monitoring the Earth's resources has proven to be formidable, especially as the desired data often resides in remote and inhospitable environments. There is a continuing need to extend the reach and quality of scientific and commercial data collection to these areas using sensors developed for atmospheric and wind current measurements, remotely-operated instrumentation, and autonomously-operated underwater vehicles. ACTS' unique communications capabilities will prove instrumental in addressing these needs as they will facilitate both the remote geographic access and high-capacity transmission capabilities required for global monitoring. The methodologies being developed through ACTS-related experiments to support image processing, management, and visualization will, in turn, enable users to make sense of the enormous amount of remote sensing data being collected.

7.3 REMOTE INFORMATION SERVICES

Remote locations (e.g., within the Pacific islands and rural communities of North America) are largely limited to low-speed phone lines for data communications that significantly constrain the types of information transfer which can be offered. Moreover, areas of lower industrial density will tend to have fewer high-end computing resources than urban areas. ACTS' advanced communications and image processing capabilities will provide the enabling technologies to facilitate the transfer of much larger streams of data for remote information services.

7.4 IMAGE PROCESSING AND MANAGEMENT

In addition to enhancing data collection and transmission from earth- observing satellites, there is a need to develop efficient methodologies for processing and retrieving these data so they may be put to productive use. There are literally terabytes of information being collected about the earth, demanding that compression schemes be employed to reduce the system bandwidth required of an image for communication and storage. Key features should be extracted and recognized to enable processing of the image at higher levels of abstraction, thereby increasing throughput and user understanding. The image/data must be organized into image databases, where issues of distributed access and personalized browsing, as well as centralized processing and organizational management, are handled intelligently and responsively. Finally, there is a need for enhancing intelligent image analysis capabilities so that incomplete information can be inferred for more complete image reconstruction. Hawaii's ACTS experiments team will give heavy emphasis to these types of improvements which, collectively, should both complement and enhance ACTS data transmissions capabilities.

8. DESCRIPTION OF EXPERIMENTS

Experimental ACTS projects to be addressed at PacSpace focus on developing, validating, and transferring technologies in remote image processing, management, and communications for applications in earth observing, data communications, and remote/rural information services. The proposed projects are categorized under the four major categories presented above.

8.1 ADVANCED SATELLITE COMMUNICATIONS

Modern communication systems increasingly rely on a combination of terrestrial and space-based communications networks for efficient operation. As the demand for the transmission of high resolution images and full motion video grows, flexible and reliable communications networks will become essential. Intelligent satellites such as ACTS, with controllable switching and steerable linkages, provide both the complementary coverage and critical backup required to help achieve this level of performance.

In order to establish truly complementary satellite and terrestrial communication networks, many underlying technological issues will require both research and system development. To address this need, PacSpace will conduct industry-supported R&D in hybrid networks and satellite communication technologies. It will also explore novel concepts in the modulation, coding, and multiple access of data that can be used with ACTS-like systems.

8.1.1 HYBRID SATELLITE/TERRESTRIAL NETWORKING

Satellite networks can be used to connect a number of surface networks or to augment a singular network. A terrestrial network is organized into multi-node local area networks (or LANs) connected by short-distance cables. Each LAN can also contain one node with access to a satellite. The surface network normally carries traffic between nodes, diverting it to the satellite system only when its capacity is exceeded (this routing is usually desirable if satellite transmissions experience long delays). On the other hand, satellite links might have such low operating costs that it becomes more economical to route traffic through the nearest satellite node (even if the number of communication "hops" is thereby increased).

To explore these alternatives, Hawaii's ACTS team is designing a series of experiments which will investigate flow and congestion control in communications networks, routing algorithms, buffer and network management, and network topologies. Flow and congestion control techniques can be used in terrestrial networks to augment the possibility of diverting traffic to satellite networks when congestion occurs or when the data can tolerate transmission delays. Routing algorithms can be designed to maximize throughputs of network using terrestrial and satellite links. Buffer and network management will be needed to allocate buffers in the network nodes to handle "bursty" traffic. Finally, network topologies can be developed to partition communication architectures into different network types, as well as to allocate satellites to appropriate partitions within these networks.

The Maui Research and Technology Center (MRTC) was recently awarded a $19.5 million grant to establish a supercomputer Image Information Center on Maui. In addition, the Hawaii State Legislature has appropriated $549,000 to establish a supercomputer-compatible ground station on Oahu. Together with microwave and fiber-optic links between Maui and Oahu, these facilities will enable the State to test and validate hybrid satellite/terrestrial networking. It will also position Hawaii to make a significant contribution to networking supercomputer testbeds through the National Research and Education Network (NREN) -- a major emphasis of the President's Initiative Program on High Performance Computing and Communications.

8.2 EARTH OBSERVATION SYSTEMS

Unprecedented volumes of remote sensing and *in situ* data will be collected over the next 25 years to help scientists unravel the system attributes of Earth. This will require state-of-the-art advances in a variety of areas, including information extraction, data and information management, mass storage, high performance computing, and telecommunications applications. Data systems for earth system science are expected to acquire data at the rate of terabits per year over this period and will involve communications and collaboration among thousands of investigators world wide. To support this effort, Hawaii's ACTS team will actively pursue new and better systems for satellite instrumentation, space-based communications, and information management.

8.2.1 ATMOSPHERIC RADIATION MEASUREMENTS USING ACTS

The U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) Program is a key component of the DOE's global climate change research activities. The central purpose of ARM is to improve the predictive capabilities of General Circulation Models (GCMs) for regional and long-term climate change in response to increasing atmospheric concentrations of greenhouse gases. Specifically, ARM will enhance our understanding of important cloud and radiative processes, ultimately providing for near real-time processing of data and execution of atmospheric models.

A fundamental objective of ARM is to establish four to six permanent observational base sites, with the first site located in the center of the continental United States. The second site will be situated in the Pacific near the equator. This latter site (scheduled for completion by the fall of 1993) will undoubtedly pose some severe communication problems for ARM, since large volumes of information (between 1 and 2 Gigabytes of data) will need to be transferred daily to the Experimental Control Center (ECC) at the Pacific Northwest Laboratory in Richmond, Washington.

Argonne National Laboratory (ANL) has been a principal participant in DOE's ARM program from its early stages. ANL has also been working closely with key institutions in Hawaii for nearly three years, including the University of Hawaii, the East-West Center, and PICHTR. The joint ANL-Hawaii team proposes to use the Pacific ARM site to test the high data rate capabilities of ACTS in the region (even using the wide bandwidth available through ACTS, however, it is expected that collected data will be stored and broadcast in daily bursts, with a total transmission time of about one hour per day). This testing will include transmission from the Pacific site to the ECC, located at the Pacific Northwest Laboratory in Richmond, Washington; from the ECC to the Central Archive at Oak Ridge National Laboratory; and from several non-ARM cooperative experiment sites to the ECC.

If ACTS remains functional throughout the life of the Pacific site (currently scheduled to operate for five years), the satellite would be used daily to transmit all ARM data from this location. If the Pacific ARM/ACTS test proves successful, it may also be possible to develop another experiment based upon the mobile observing system planned for the ARM program. In all, this dynamic research opportunity will (1) test ACTS' unique communications capabilities; (2) integrate the ACTS network with environmental studies instrumental to DOE's research activities; (3) demonstrate the value of Hawaii's potential contributions to our nation's High Performance Computing and Communications Initiative; and (4) enhance the potential of future international connections with other high performance networks by using Hawaii as a vital communications bridge to the Pacific.

8.2.2 DEVELOPMENT OF AN OCEAN ROBOT SERVICE CENTER (ORSC)

Over two-thirds of Earth's surface is covered by water. As such, the ocean plays a critical role in the development of Earth's weather patterns and affects virtually all ecological systems. Furthermore, the underlying sea floor and subsurface contain vast and largely untapped sources of energy and mineral resources. Yet the ocean's bottom remains a relatively hostile environment for human exploration.

A technology that would afford humans safe *access* to the oceanic environment involves the use of a robot designed for undersea applications. This device (known as a Remote Operated Vehicle, or ROV) could be semi-autonomous to the extent that it remains tethered to a "mother" vehicle while being electronically controlled through a remote human/computer interface. Several ROV systems currently exist or are under development.

The goal of the Hawaii ACTS team is to develop an Ocean Robot Service Center (ORSC) which would utilize ACTS to relay data from the ROV to analysts at a remote location. This project, which would receive support through an NSF-funded project at PICHTR and the University of Hawaii, is being developed around an acoustic communication and sensor fusion simulation environment, where the computer can perform machine learning during the ROV teleoperational mode so that docking functions can subsequently be performed automatically during an AUV (autonomous underwater vehicle) phase.

8.2.3 PACIFIC OCEAN INITIATIVE (POI)

PacSpace is establishing POI to provide a unique technical, organizational, and research structure to help meet specific challenges of the U.S. Global Change Research Program in the Pacific region. This initiative explicitly recognizes the growing interest in small satellites for remote sensing of the Pacific Ocean environment, as well as the growing need for rapid acquisition, processing and distribution of Pacific Ocean data. The PacSpace Ocean Initiative includes a broad spectrum of activities involving information transfer and data management to support Global Change research. Specific examples include:

(1) Transfer of real-time, archival data from small satellites with earth-viewing missions. Data from small satellite programs such as DOE's ARMSAT, the commercial SEAWIFS program, and Pathfinder programs for NASA's Earth Observing System (EOS) are being considered in this initiative.

(2) Development of local area coverage (LAC) high-bandwidth data handling methodologies for such programs as Landsat, ERS-1, and eventually EOS. This activity also includes the development of interfaces to NASA's EOS Data Information System (EOSDIS).

(3) General education applications such as interactive displays of environmental information for students in grades K-12. This initiative would incorporate interactive TV with local area fiber-optic networks. ACTS' high-bandwidth capabilities would be used to provide links to the U.S. Mainland.

(4) Assessment of the potential use of data from Earth-viewing satellites for shipping, sport fishing and other ocean-based industries in Hawaii.

8.3 REMOTE INFORMATION SERVICES

ACTS' high-speed, high-bandwidth communications channels will facilitate a whole new class of remote information services. Hawaii ACTS team members plan to use this innovative technology to develop and propagate advanced applications in such areas as telework/teleconsulting (using multimedia and computer-supported collaborative work), simulation and data visualization (using remote supercomputing resources), and teleoperations/telescience (using virtual perception and multimedia feedback).

8.3.1 HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS

While conducting its experiment programs, PacSpace will have access to some of the world's most powerful computation resources. Using ACTS, Caltech is planning to link its Touchstone Delta System (~30 Gflops, and currently the world's most powerful computer), as well as the CASA Gigabit network testbed, with Hawaii's supercomputer facility on Maui (providing access to supercomputer resources at Los Alamos National Laboratory, the San Diego Super Computer Center, and JPL). MRTC will also be able to interface with other supercomputing stations nationwide, including Argonne National Laboratory's Intel Touchstone (~500 MFlops). The combination of widely-dispersed supercomputing resources, high-speed satellite communications, and Gigabit computer network linkages will ultimately create a natural testbed for researching and developing technologies required for advanced national communications networks, especially the NREN.

8.4 IMAGE PROCESSING AND MANAGEMENT

Technological advances such as ACTS, which dramatically enhance bit-rates and bandwidth, will inevitably place increasing demands on a variety of communications subsystems. For example, the transmission of image sequences such as video remote sensing data from satellites and reconnaissance aircraft already requires such advanced communication techniques as data compression, feature extraction, object recognition, model-based scene analysis, image understanding, data archiving, and overall image/data management. One promising area in which these advanced techniques can be effectively integrated with ACTS technologies is the field of medical imaging.

8.4.1 REMOTE AND COOPERATIVE MEDICAL IMAGING

The use of medical imagery is expected to expand dramatically with the development of higher definition imagers, displays, and intelligent multimedia technologies that are interfaced with high performance computers. The combination of imagery with text, patient information, and doctor's diagnostic annotations will become useful electronic patient records that will enable and enhance remote access, on-line processing, and cooperative diagnoses among various medical experts at geographically disparate sites.

A Hawaii-based team (comprised of the University of Hawaii, PICHTR, Tripler Hospital, the MRTC, and PacSpace) has been working to develop the medical imaging system technologies and infrastructure required for an advanced health care system. One of the sites proposed for this program is the Tripler Army Hospital in Honolulu, which is scheduled to become a center of excellence as a Medical Diagnostic Imaging System (MDIS) teleradiation hub (it already serves as a center for military operations in the Pacific region).

The long-term goal of Hawaii's medical imagery experiment will be to establish the technical feasibility and economic viability of satellite-based communications for medical imagery. Hawaii's geographical separation from other medical resources on the U.S. Mainland, along with its potential for providing medical services to other regions in the Pacific, makes it an ideal test site for this type of investigation. Specific objectives for this experiment will include (but not be limited to): (1) demonstrating the feasibility of using ACTS for remote medical visualization; (2) ascertaining the ability of ACTS technology to facilitate the participation of remotely-situated experts in critical medical situations; (3) developing new techniques for real-time, user-steered segmentation (allowing remote experts to more precisely investigate structural damage following natural disasters); and (4) introducing and testing emerging sensor technologies in trauma aid to disaster sites (with significant implications for maximizing survivability for vascular damage and head trauma).

In summary, NASA's ACTS Experiments Program and PacSpace/Hawaii experiments initiative are founded on the belief that a cooperative alliance of academia, government, and industry will foster a scientifically sound and commercially viable approach to validating ACTS technologies and that this unique pooling of resources, in combination with Hawaii's strategic mid-Pacific location, will afford the ACTS network a unique testbed for pioneering innovative applications in advanced communications. We therefore would welcome the interest and inquiries of potential investigators who would like to consider PacSpace/Hawaii as a potential partner in developing experimental ACTS-tivities.

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For the 1993 Pacific Telecommunications Conference
Database Of The World: Converging Technologies

Winston R. Hindle, Jr.
Digital Equipment Corporation
Massachusetts, USA

This presentation is a high level overview of the socioeconomic impact of the convergence of the information technology and telecommunications in our society today with unlimited potential for the future. Examples are drawn from Health Care, Business, Education, Environment and Space Exploration.

1. CONVENTIONAL MAP OF HAWAIIAN ISLANDS: (FAMILIAR LITTLE DOTS OF LAND -- FLAT, UNIFORMLY BLUE PACIFIC)

We all recognize this view - the Hawaiian Islands. Ages ago, people had to get familiar with the islands themselves. They built roads and highways to get around on the surface. They navigated between the islands. They even explored far and wide across the uncharted Pacific. They established transportation networks.

Many of us here today, of course, arrived at PTC by plane instead of by sea, but we basically used the same transportation network that was pioneered by our predecessors. Now... just imagine how much more of the same territory we could explore if that huge stretch of ocean could be made ... transparent.

2. TOPOGRAPHICAL MAP - THE PACIFIC BASIN LOOKS QUITE DIFFERENT: (EVERY FEATURE OF THE OCEAN FLOOR IS DETAILED... PLAINS, VALLEYS, AND GORGES CAN BE SEEN THROUGHOUT THE PACIFIC BASIN)

Once we make this vast body of water transparent, we can see very graphically that these isolated parts of the surface, which we call "islands", are part of the same continuous expanse of land. The configuration of the ocean's vast floors becomes as familiar. as navigable, as rich in resources and possibilities as the land surface that we're used to. The more we could explore it, the more information. resources, and capabilities we could gain.

And that is the point of my illustration. Increasingly today. islands of information have become connected by networks of communication. The convergence of Information Technology and Telecommunications has already given us a transparent ocean. a continentally unified planet for the full. free exchange of information anywhere.

Converging technologies have given our societies the power to explore their resources as never before. In fact. this image of the ocean floor surrounding Hawaii was literally produced by converging technologies. It was made using Geographic Information System (GIS) software called EarthVision from Dynamic Graphics, which runs on Digital VAX, Ultrix, or Alpha AXP workstations. GIS implementations like this have wide environmental uses in such markets as natural resources management, infrastructure and transportation, and a variety of modeling and mapping functions. These are important to government and industry worldwide.

3. GIS-TYPE TERRAIN MODELING: (UNUSUAL ANGLE ON THE HAWAIIAN ISLANDS AS SEEN FROM UNDERSEA)

Here is an illustration that makes another point about converging technologies. By showing an entirely different depiction of the Hawaiian islands. It was also produced on the EarthVision product from Dynamic Graphics. Technology makes it possible today to construct visualizations from viewpoints that can't be experienced by real people in real time and space.

The convergence of Telecom and IT gives us the ability to create and transmit complex, data-intensive imaging such as the pictures I have been showing you. We also use it in a wide variety of applications, such as the GIS implementations I have mentioned in order to explore our surroundings and optimize our use of resources.

4. CONVERGING TECHNOLOGIES: TELECOM & IT

GIS is one example among many others, of our theme. Telecom and IT are a perfect match of complementary technologies. Both of these technologies are rapidly expanding. Professor Michael Dertouzos, who is director of the Laboratory for Computer Science at Massachusetts Institute of Technology, has estimated that...

"computing and communicating tools have been improving at the annual rate of some 25 per cent for at least the past two decades."

Of course, there are many different ways to calculate such a general measurement. But it's true that if we take the speed of communications 20 years ago, when telephone wiring capacity generally was around 10.000 bits of information per second ... and compare it to today's fibre-optic capacity of approximately 1 billion bits per second -- we get a factor which is well above professor Dertouzos' estimate -- an annual growth rate of 78%! And we would find a similar ratio in comparing the cost of information processing 20 years ago. I might have spent over 1 million US dollars for a mainframe having less computing power than a desktop device today. A computer would cost only about $2,000 US dollars today!.

Today, complementary technologies are a part of the infrastructure of all industrial development; in the developing economies as well as the developed economies. Converging technologies enable us to offer new, improved services that have become essential to the world's peoples. They open up substantial business opportunities in many worldwide industries, including finance, manufacturing, health care, education, and environmental management. But what has all this really meant in terms of people's everyday lives, today? What is the impact of converging technologies on people themselves, and the quality of life?

5. SAVING LIVES (HEALTH CARE)

We are already seeing very striking examples. One of the most significant that I've seen is called MBS, or Media Broadband Service, from NYNEX. MBS is an intelligent-network-based visual communications capability that allows collaborators who are located in geographically dispersed areas to share high resolution images.

The most dramatic application of MBS could save many lives. Currently, it is running on systems from Digital at two hospitals in Boston, part of a multi-hospital test site where MBS is being used experimentally. MBS allows doctors to exchange not only medical images, but voice and text as well. And it gives them access to full information contained in a patient database. MBS will allow smaller hospitals to share the resources of larger ones ... allow doctors to access critical medical information from remote sites ... and support critical opinion-sharing and decision-making among medical personnel, no matter where they may be located.

I believe MBS will prove to be especially important in the Asian Pacific, with its widely dispersed geography and resources. Incidentally, there will be a presentation and a video about MBS right here at PTC '93, given by Mr. Cas Skrzypczak on Tuesday morning. In the future, I believe we will see MBS and many other medical applications used to link the healing skills of physicians around the globe.

6. WORKING PRODUCTIVELY

Next, I'd like to speak about converging technologies' impact on the world of business. As we know, the world marketplace is changing dynamically. Globalization and decentralization are major organizational trends in many industries. Working relationships themselves are changing, and this is where our converging technologies are playing a big part in supporting our customers' new business needs.

Most visibly, the proliferation of wireless communications, supporting mobile voice and data networks, has meant that field workers in many industries can not only exchange messages, but also retrieve and process information from databases anywhere. Manufacturers and insurers; transportation companies and automobile rental agencies; and field workers ranging from emergency repair crews to journalists benefit from this new generation of mobile systems.

Such major insurers as the Prudential Company of America are among leading US users who are already relying on wireless communications to streamline their field employees' tasks. The impact of wireless communications is recognized as so critical to automobile rental agencies, that they will soon be offering mobile telephone facilities in most rental vehicles.

All this has contributed to another visible trend, the decentralized office, with people doing their work easily and efficiently from remote sites, as needed. "The wireless office," we might call it. Trials of "wireless office" systems are under way in major US companies today, including AT&T and Hallmark Cards, among others. Because this entire new business within Telecom requires new forms of IT support... Many suppliers are bringing a new generation of wireless office products to market.

One product, "The Virtual Office," represents a cooperative development of several partners, including Nippon Electronic Corporation (NEC), Digital, and SKYTEL, a US paging company. The Virtual Office is currently being tested by leading customers in the US, including Xerox, MCI, and PACTEL. Using the Virtual Office, any person anywhere has office tools at their fingertips - including E-mail, bulletin board, voice mail, fax, paging, and other essential services. With the Virtual Office, mobile workers in certain jobs can gain from 15 to 100 per cent in productivity.

The Virtual Office is one among many examples of how Information Technology suppliers work cooperatively with telecommunications vendors worldwide in order to deliver total solutions. For example, we are currently working with Ericsson, a leading supplier of mobile networks, switches, and other mobile data communication products, to integrate Ericsson's Mobitex radio networks with Digital IT networks. The Mobitex intelligent network technology is based on an open architecture standard and is widely operational today in a number of countries in Europe and North America.

We are also working with service providers. This past year, we teamed up with RAM Mobile Data and BellSouth Enterprises to develop mobile data solutions worldwide. RAM's Mobitex network is operational in Europe and North America. A trial in Digital's services organization is currently in progress, using Mobitex in a dispatch service application. The operator is CANTEL, a major Canadian wireless operator.

Another important wireless application that is being discussed here at PTC '93 is Digital's G*STAR, a product which enables wireless service providers to improve customer service quality by providing automated, structured trouble call reporting and management functions. A presentation of the G*STAR product will be given at PTC '93 by Mr. Chandan Seernani on Monday morning.

7. WORKING COOPERATIVELY

I've mentioned cooperation repeatedly in these examples. It's a theme I want to emphasize. On many fronts around the world today, working relations between companies are changing. We see partnerships, alliances, and other collaborative ventures between Telecom Service Providers, IT suppliers, and equipment manufacturers.

Certainly in the case of our converging technologies, IT and Telecom; we at Digital believe that cooperation is the fundamental key to success in our growing markets and success in making a positive, long-lasting impact on our global society. As an example, let me mention a very challenging project that Digital took part in, for a leading client here in the Pacific region. Recently the Nomura Research Institute (NRI) needed to build a global network to support a wide range of functions.

NRI's Global Network System had to support not just messaging; not just traditional transaction processing; but real-time trading and risk-management functions for such NRI institutions as the Nomura Group, which is the largest financial organization in the world. Building NRI's Global Network System meant conforming to international standards, and integrating the efforts of different IT and Telecom companies. As a result, the network was a joint effort of a number of world-class IT and Telecom providers, including Digital. Instead of seeing ourselves as competitors, all of us worked together and got the job done. Today, as a result of this cooperative effort, virtually all NRI users benefit from NRI's Global Network System, using the network for functions which range from securities bonds trading to system research.

8. LEARNING GLOBALLY (EDUCATION)

Let me turn next to the world of education. Here, converging technologies have had a clear and obvious positive social impact. I can cite examples of long distance learning programs that are operating today in different parts of the world.

There's a project in the Canadian province of Ontario, linking 3 schools that are 50 to 100 kilometers apart (30 to 60 miles apart). They can share writing, math, and history activities as well as computing and environmental projects. A system like this increases the number of available learning opportunities, offers a richer educational experience and reduces the isolation of teachers in geographically dispersed areas.

Global networking is also transforming institutions of higher learning; extending the university beyond all traditional boundaries - even those of nations, continents, and cultures. For example, academic libraries increasingly play the part of a "knowledge center" serving as the hub of a widespread information system in which the scholar can search not only the holdings of the immediate library but catalogs; statewide, regionally, nationally - even across the Pacific

Let me mention a project that has been taking place at Sonoma State College in California. Using the software developed at Sonoma State, any user accessing the Internet on a Digital Equipment system can browse through hundreds of library catalogs from 36 states and a number of countries worldwide with transparent ease of use.

In addition to these on-line card catalogs other library systems are being developed that offer keyword searching and database access. Implementations like these open the way for the network to become an increasingly rich information retrieval utility with the eventual goal of delivering full text and image, exactly as originally published, to users anywhere on the system.

An example of this capability is a large-scale commercial electronic library of image data which has been in use for several years, in Japan. It's called the Electronic Library and it was developed by an alliance including the Electronic Library, Digital Japan, and Toshiba. Hundreds of business and government subscribers today receive over 2,000 articles daily from the Electronic Library. Users can also order any particular item from an archive containing more than a million articles. Within 3 minutes, the subscriber receives the exact image of the original article on a fax machine, complete with all photos and graphics. With services like the Electronic Library, today's converging technologies are helping libraries accomplish their historical purpose: converting information into productive knowledge.

9. PROTECTING THE ENVIRONMENT

Finally, let us consider technology in support of environmental issues. I think we would all agree that an important area of social impact today is the global environment. Here too, I am glad to say that our converging technologies are being harnessed in positive and far-reaching applications that bring hope for the future.

For example, one of today's critical issues is to gain full understanding of the consequences of environmental problems such as the "greenhouse" effect, ozone depletion, deforestation, and a diminishing water supply. And yet, in order to reach this goal, earth scientists need data storage that are 3 to 4 times larger than what is currently available. They also require massive information access capabilities and they require a means of collaboration among scientists who are working at remote sites.

Today, a project known as Sequoia 2000 aims to create the solution; linking together global change researchers and computer scientists on 6 campuses of the University of California, and other institutions. Sequoia 2000 proposes to build a huge information storage and retrieval system that can hold the equivalent of 150,000 hard disks, and develop methods for rapid data retrieval. The project is a model of cooperation, bringing earth scientists, who have information storage and management needs together with information scientists, who are building the technology to make it happen.

Let me briefly mention another example of a significant implementation that is making an important contribution to environmental protection. As you know, air pollution is an environmental problem of worldwide proportions. Today, however, an advanced air quality modeling system, called GEMS (Geographic Environmental Modeling System) provides a way to evaluate different options for environmental control. It has been developed at Carnegie Mellon University in the United States. Because GEMS involves very large, distributed databases, it is a very good illustration of how harnessing converging technologies is necessary for success. GEMS currently focuses on air pollution, but it is easy to foresee that many of its aspects will be applicable to other environmental problems that confront us today. Some problems are water pollution, ground water contamination, hazardous waste disposal, and climate change.

10. "THE DATABASE OF THE WORLD" HARNESSING CONVERGING TECHNOLOGIES

In all the areas I've mentioned today, the role played by converging technologies is fundamental and highly positive. Our two industries, converging with such speed and power, are today laying the foundations of a unified, global, intelligent network and giving the world's people fuller access to what I might call the "database of the world."

How can we continue to harness the converging power of our technologies? Let me offer some simple, basic suggestions. I believe that our joint mission is: First, to work together building infrastructures. Second, to collaborate on standards. There are promising examples of both, taking place today, here in the Asian Pacific region.

A far-sighted instance of the first is to be found in Singapore, which has articulated a vision of itself as an "Intelligent Island" by the year 2000 -- a networked nation destined for economic growth and high productivity ... and a global hub for research & development, manufacturing, and transportation. Singapore's vision is entitled "IT 2000." Its strategic cornerstone, as many of you know, is the building of a National Information Infrastructure supporting high bandwidth communication. To quote the words of Singapore's National Computer Board, IT 2000 promises to help turn Singapore into a "highly efficient switching center for goods, services, capital, information, and people."

Singapore's IT 2000 vision is central to a national economic strategy for business, services, and transportation development. Its high-capacity infrastructure will be the foundation for such added value as advanced business functionality, extended distance learning capabilities, and an integrated airport information network - a "smart" airport. IT 2000 is a forward-looking plan which actively embraces the full potential of multimedia and promises to facilitate the growth and effectiveness of a wide range of industries. Digital has been involved as an advisor to Singapore's National Computer Board on the architecture that is essential to the projected information infrastructure. We are also involved with the Telecom service providers in consulting on IT2000's planned multimedia capabilities.

I also mentioned the vital importance of collaborating on standards. An example of this took place recently when Nippon Telegraph and Telephone (NTT) formed a consortium to work out the technical standards for a procurement specification for general purpose computing. The development consortium consisted of NTT, NEC, Fujitsu, IBM Japan, Hitachi, and Digital. By using a consortium, NTT achieved vendor agreement on the requirements, and participating vendors were able to influence the results. In the same spirit, the next-phase consortium will include additional vendors and users. With the adoption of this procurement specification by NTT, Digital and its collaborators took a major step towards global standardization.

As I reach the conclusion of this talk, let me sum up my support for the general theme of this symposium. By harnessing converging technologies, the world's peoples will at last gain full access to what I have called... the "database of the world" - optimizing the world's rich resources for present and future generations.

11. DISCOVERY
(DRAMATIC PICTURE OF EARTH, SEEN FROM SATELLITE)

So far, I've considered converging technologies as globally based ... which they certainly are. Yet it's very dramatic to realize that our vision is not even limited to earthbound communications. Today, communications encircle the earth ... tomorrow, they will span the universe. Think of today's complex automated space missions.

In the past year, IT and Telecommunications have successfully sent an unmanned mission which will send us information about Pluto, the virtually unknown outermost planet of our solar system as well as a mission to explore the nearest planet, Mars, in greater detail than ever before. Haven't the world's past, present, and future space missions ranked among the supreme achievements of converging technologies?

After all, this image was transmitted, received, enhanced, and distributed to the Earth's population thanks to Information Technology and Telecommunications. If it were not for converging technologies, we would never be able to contemplate and study our own planet as it appears in space.

As we behold it, let me conclude ... with the words spoken by the Saudi Arabian astronaut Sultan Salman al-Saud aboard the Discovery space shuttle several years ago, as reported in the press at the time.

"The first day or so, we all pointed to our countries. The third or fourth day, we were pointing to our continents. By the fifth day we were aware of only one Earth."

Today we have talked about these converging technologies as they apply to our earth. At some future PTC conference, we will no doubt be looking beyond the earth, and discussing societal applications pertaining to exploration and communication throughout the universe. What exciting opportunities lie ahead!

SUNDAY, January 17, 1993

Plenary

NOTES

MONDAY, January 18, 1993

Monday Plenary

NOTES

Telecommunications Development in Taiwan, ROC

A Study Case for Modernization

by P. Y. Lee
Director General
Directorate General of Telecommunications
The Republic of China

1. Introduction

In recent years, the worldwide trend moves toward political democracy, economic liberalization, and social diversification. Consequently, the capability of the economy and trade has become one of the major measurements of a nation's strength. The economic achievement in Taiwan, ROC has been widely cited as one of the "economic miracles" of development from a poor, heavily agricultural dependent economy to one of the most remarkable New Industrial Economies (NIEs) in Asia. DGT, Directorate General of Telecommunications, is a government owned organization and responsible for promoting network construction and operation as well as introducing satisfactory telecommunications services to the ROC. It has been playing a strategic and vital role in contributing to the dramatic economic growth of the ROC. On this special date, I am very honored to be here and would like to take this opportunity to share its outstanding experiences with you.

2. Current Status of The Telecommunications in The ROC

To keep pace with the rapid economic growth in our country, the development of telecommunications was astonishing during the past forty years. As of June, 1992, several milestones were reached and the result could be seen from the following statistics:

1) The number of telephone subscribers is over 7 million, ranking 16th in the world.

2) 97.71% of all families have telephone service.

3) There are 34.5 telephone main lines for every 100 people.

4) The number of direct international telephone circuits is over 5,600.

5) The International Subscriber Dialing (ISD) service has been available to 197 countries/areas, and the international outgoing traffic reached 329 million minutes in the fiscal year of 1992.

6) The number of radio pagers is well over one million, accounting for a 21.8% growth rate over the last year.

7) The number of cellular mobile phones is about 300 thousand, amounting to a 117% growth rate over the last year.

8) The local telephone switch has 10.4 million lines, of which 58.7% is digital.

9) The toll switch has 0.56 million lines, of which 96.8% is digital. It is expected that all toll switch lines will be completely digitalized by the end of 1994.

3. DGT's Experiences in The Development of Telecommunications

DGT has encountered many difficulties during the past four decades, for example, the shortages of capital funds, technologies, materials, and skilled workers, the rapid growth of subscriber application, higher trouble complaint rate, etc. However, it has successfully launched a variety of dynamic, innovative strategies and efficient measures to overcome the obstacles. The specific experiences accumulated by DGT over the past years are briefly stated as follows:

1) Under the self-supporting policy, DGT has adopted a tariff policy of levying high installation charge and low monthly rental on local telephone subscribers so as to enhance its financial structure. Such revenue has been used for expanding the domestic telecom infrastructure to expedite the development of local areas. Today, DGT's debt ratio is only 14.51% that indicates an evidence for sound and strategic approach.

2) In 1968, 1976, and 1984, DGT introduced cross-bar electro-magnetic switching, analog ESS, and digital switching equipment respectively. These introductions have created many good opportunities for the development of local telecom industry and thus encourage the establishment of 2 cross-bar manufacturers, 2 analog ESS manufacturers, and 3 digital switching manufacturers in respective phases. Their products have satisfied the urgent demand during the rapid growth period that the annual growth rate is over 20% from 1968 to 1981.

3) DGT has spared no efforts in implementing a series of the Four-year Mid-term Telecom Development Plans since 1953 to expedite the Telecom Modernization Plan and thus achieve the goals of providing modern telecom services in urban areas, popularizing the telecom services at countryside and rural areas, and upgrading the network infrastructure islandwide. The achievements were fruitful in forming a sound foundation for the future development. At present, the Tenth Mid-term Telecom Development Plan is under way. In addition, to cope with the Six-year National Development Plan, DGT has already mapped out the consecutive Mid-term Telecom Development Plan to be launched in the fiscal year of 1994 in order to realize the goal of completion of ISDN in 2000.

4) DGT, not only completed the goal of providing the telephone service at every countryside in 1975, but also achieved the target of installing the telephone sets at every village in 1980. Since then, the telephone service is available throughout the whole island in the ROC. Meanwhile, at the villages of remote areas, the local telephone switching equipment was installed and the old equipment was replaced with a view to provide the enhanced services and thus balance the development of all areas.

5) DGT introduced the International Subscriber Dialing (ISD) service in June 1978. It has facilitated the local people to make overseas calls, increased DGT's revenue, and relieved the heavy load of the operator-assisted service. Moreover, the CAMA (Central Automatic Message Accounting)system, which was developed by the Telecom Laboratory, one of DGT's subordinate organizations, has eventually provided the C400 cross-bar telephone switching equipment with the automatic billing mechanism and thus stimulated the tremendous growth of the ISD service.

6) To reduce the subscriber's burden for making telephone calls, DGT merged 280 business basic tariff rate areas into 16 ones in June, 1990. Meanwhile, the measurement of calculating local telephone calls on a five-minute basis has been implemented and thus laid a stable foundation for the development of the dial-up services.

7) To meet with the economic development and the demands from the subscribers, DGT completed the single tone type radio paging system in 1976, introduced the numeric display type radio pager in 1988, and opened the Chinese character display type radio paging service in August, 1992. DGT introduced the cellular mobile telephone service to the public in 1989, and inaugurated the handheld mobile telephone service in July, 1990. Since the introduction of the mobile telephone service, the annual growth rate has been skyrocketing. Besides expanding the radio channels and installing the additional base stations, DGT is currently accelerating the plan of digitalization so as to meet the market needs and provide the firm foundation for opening more data communication services to the information society of the ROC.

8) The success or failure of an enterprise lies greatly on the use of its human resources. Every year, DGT spends about US$ 20 million for training its 37,000 employees. Each employee receives about one week of training in a year on the average. Besides on-the-job training, the

employees are also given the career planning. The human resource cultivation will continuously remain as one of the major tasks to DGT.

4. DGT's Restructuring Plan

Under the impacts of globalization and liberalization, DGT realized that in addition to accelerating its network construction, the organization structure itself needs to be changed to fit the more competitive environment. In doing this, the existing Telecom Act and the relevant regulations must be revised first. DGT will be segmented into two separate parts. The regulation function will remain in DGT as a government organization. On the other hand, the business operations will belong to a state-owned telecom operating company with more flexibilities and autonomies in personnel management, procurement of equipment, budgetary and auditing systems. The draft proposal including the "Laws for Chinese Telecom Corporation", the "Regulation for DGT's Organization", and the "Telecom Act" has been submitted to the Legislative Yuan for approval.

5. The Major Development Plans of DGT

As the telecom industry is getting more important for Taiwan to achieve its goal of becoming an Asia-Pacific regional financial center, as well as an int'l cargo transport hub, in line with the Six-year National Development Plan, DGT has launched the Intelligent Multi-dimensional Network Development Plan which consists of ten major projects in 6 categories, namely, digital switching system, optical fiber system, optical fiber submarine cable system, personal communication system, intelligent network and integrated services digital network. The plan will require a total investment of US$ 4.8 billion during the period from 1991 to 1996.

It is assumed that after the completion of the plan, DGT can provide higher efficient mobile communications and upgrade the telecom services on the offshore areas such as Kinmen and Matsu islands and develop high-quality and diversified telecom services.

6. Conclusion

The above presentation summarizes the past forty-year development of the telecommunications in the ROC. It provides the valuable experiences for the developing countries to plan their telecom strategies when they face the similar difficult situation. I sincerely hope that through the sharing of these experiences, the mutual understanding and close relationship between us may step further.

Thank you for your attention.

Development of Multipoint Teleconference
System Using Multipoint Control Unit (MCU)

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1. ABSTRACT

This multipoint teleconference system can be used for teleconferences with motion pictures, documents, VCRs, and audio. The system is comprised of a Multipoint Control Unit (MCU), Master Controller (MAST CONT), and multiple conference terminals (Visualinks AD series). The multiple conference terminals located in remote locations are connected by video, audio, and data multiplex transmission digital lines in a radial network with the MCU and MAST CONT in the center. Each MCU can connect up to 8 locations and can simultaneously handle the multipoint teleconferences of two groups that are independent of each other. (The MCU can connect up to 14 locations using a cascade connection.)
This system provides functions that enable all participants at all locations to see the video of a person speaking. It also provides various modes which allow video selection at any location and automatic screen switching to the video of the person speaking. Also, audio functions can be selected for simultaneous discussions at all participating locations.
The multipoint teleconference system is much more effective than conventional point-to-point teleconference systems.

2. INTRODUCTION

The teleconference system market environment has been improving rapidly of late due to changes in user outlook, down-sizing, price reduction, development of communication networks such as ISDN, and recommendation of CCITT standards for video CODEC.
While teleconference system installations are becoming widespread, their applications are no longer limited to conferences only.
Teleconference systems are widely used for numerous purposes such as company education and training (for employees) and remote lectures.
As a result, there is an increasing demand now for systems with various capabilities to cope with diverse applications.
To meet such needs, we have developed the multipoint teleconference system which can run (in addition to conventional point-to-point conferences and broadcasts) an audio-visual teleconference which all participants at multiple remote locations can join in. This document introduces the features, configurations, and functional outline of the multipoint teleconference system that uses the Multipoint Control Unit (MCU).

3. SYSTEM FEATURES

The features of the multipoint teleconference system are summarized below. Table 1 gives the main specifications of the system.

(1) Uses video CODEC complying with CCITT/TTC.
(2) Handles a wide range of communication speeds and various communication lines.
(3) Makes simple system configuration possible by its application of the MCU and Visualinks AD series.
(4) Allows wireless remote control of almost all its functions during a conference.
(5) Enables setting and clearing of desired type of conference easily from any of the conference rooms.
(6) Enables simultaneous discussions at multiple locations by the use of an echo canceller system.
(7) Superimposes the menus of operations (required during a conference) on the screen for smooth handling. The feature takes the man-machine interface into consideration.
(8) Provides various modes, such as selection of conference room picture to be received, voice activation control, operator, and local conference room transmission. These modes allow video reception to be selected according to the type of application during a multipoint teleconference.
(9) Provides three camera control methods. These are the manual mode, the automatic mode using voice activation control, and the preset mode which moves the camera to preset positions.
(10) Allows extra functions such as electronic board and graphics system to be added easily.

4. SYSTEM OVERVIEW

This multipoint teleconference system consists of a Multipoint Control Unit (MCU), Master Controller (MAST CONT), and multiple conference terminals (Visualinks AD series). The multiple conference terminals located in remote locations are connected by 1.5Mbps video, audio, and data multiplex transmission digital lines in a radial network with the MCU and MAST CONT in the center. The system configuration is shown in Fig. 1. The configurations of conference terminal and peripheral equipment are shown in Fig. 2.

4.1 MULTIPOINT CONTROL UNIT (MCU)

The MCU performs simultaneous network control (communication line setting, video switching, and audio mixing) of communication line connections to multiple remote locations in the multipoint teleconference system which uses video, audio, and data.
Each MCU can connect up to 8 locations and can simultaneously handle the multipoint teleconferences of two groups that are independent of each other. Two MCUs cascaded each other can connect up to 14 locations. The MCU is shown in photo 1.

4.2 VISUALINKS AD SERIES (TELECONFERENCE TERMINAL)

The Visualinks AD series is a compact, all-in-one type teleconference terminal configuration consisting mainly of the video CODEC (VL5000) which complies with the recommendation of CCITT /TTC standards; the teleconference controller (TC5000) which is equipped with a high-grade man-machine interface; and the teleconference terminal (TV5000). The Visualinks AD series is is shown in photo 2.
The video CODEC VL5000 complies with CCITT recommendations (H.221, H.230, H.242, H.261, H.320) related to picture phone and teleconference. The video CODEC processes video and audio signals used for picture phones and

Table 1 MAJOR SPECIFICATIONS

Item	Specifications
Communication interface	
Communication speed	56K to 1.92Mbps (B8ZS)
Applicable line	o High-speed digital leased circuit o INS 64/1500
Audio system	
Control system	o Echo canceller system simultaneous two-way)
Transmission band	o Broadband (7KHz)
Video CODEC	
Input TV signal	NTSC
Resolution	480 lines x 352 pixels (NTSC)
Coding algorithm	Complies with CCITT H.261 recommendation.
Audio coding system, speed	o SB-ADPCM (CCITT G722 7KHz) o 64Kbps
Data port	o MLP interface (RS-232C) o 4.0Kbps or 6.4Kbps
Video system	
Video transmission display	1 screen transmission/display
Monitor	o 33-inch monitor o Picture-in-picture display for receiving/sending screens
Camera	o Camera (Remote control functions using remote controller) (Voice activation control) o Documents camera (manual) o External camera (manual)
VCR	Recording and playback
Control system	
Video switching control during multipoint teleconference	o Automatic switching by voice activation control o Operator control o Reception selection control o Local conference room transmission control
Line switching control	o Point-to-point connection o One-way connection (broadcast) o Multipoint connection
Line setting control	Control using terminal
Conference operation control	Control using wireless remote controller

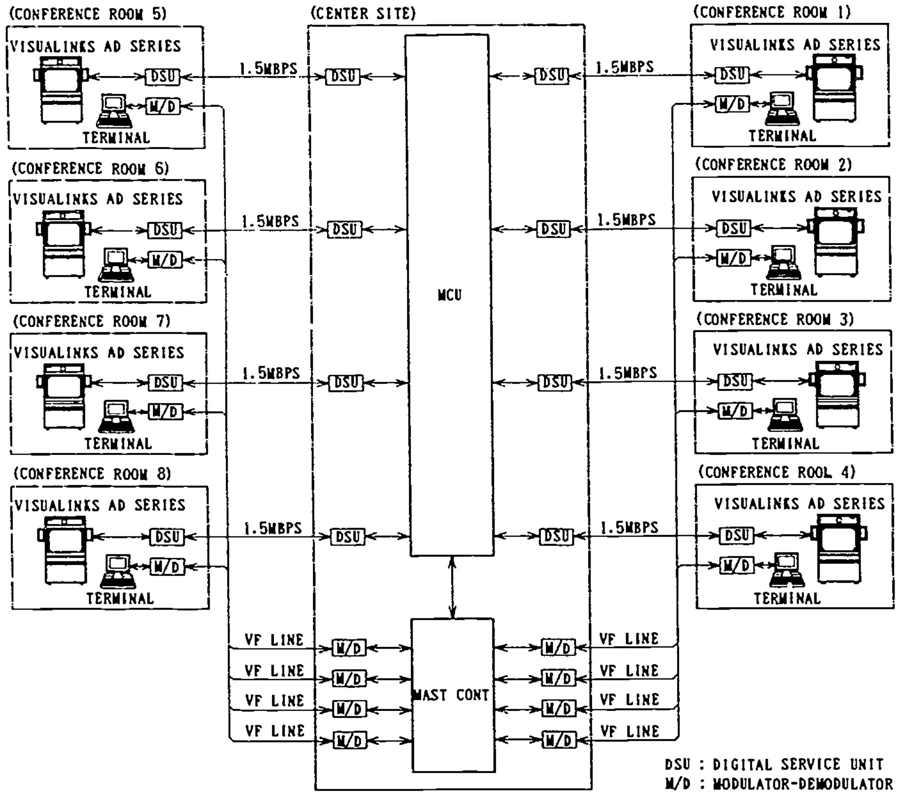


Fig. 1 SYSTEM CONFIGURATION

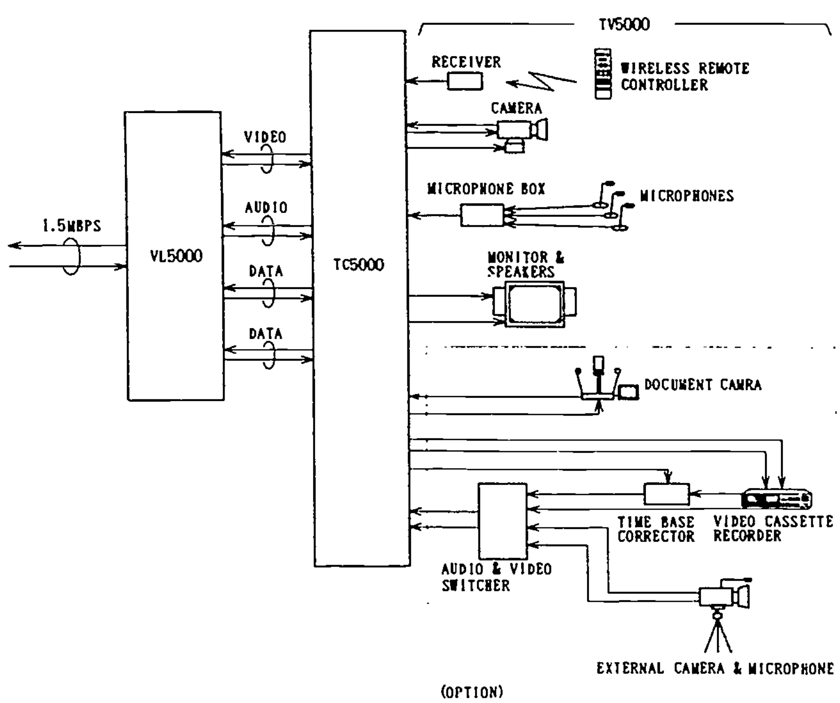


Fig. 2 CONFERENCE TERMINAL CONFIGURATION

teleconference systems by compression coding, multiplexes the signals together with various data signals, converts the signals into digital signals of 56Kbps to 1,920Mbps, and transmits these digital signals. The VL5000 is shown in photo 3.

The teleconference controller TC5000 controls the camera, audio, picture-in-picture screen, superimpose functions, field multiplex function for two full-screen images, still-picture graphics transmission function, and voice activation control function. In view of conference operating efficiency, almost all controls during a conference can be performed with a wireless remote controller. The TC5000 is shown in photo4.

The teleconference terminal TV5000 consists of a portable structure system rack which holds audio and video input/output devices such as monitor, camera, microphones, speakers, and peripheral equipment.

4.3 MASTER CONTROLLER (MAST CONT)

The master controller controls communications, such as various conference setting information between MCUs, in accordance with the information specified at conference terminals installed in each conference room. It also controls system operating statuses and network management.

The MAST CONT mainly handles all the procedures for starting and ending a conference and also keeps a record of the system operations.

5. SYSTEM FUNCTIONS

5.1 CONFERENCE MODE

This system has functions for setting and clearing of the desired type of conference, which can be done easily by looking at the terminal (personal computer) screen installed in each conference room.

The types of conferences which can be held using this system are the multipoint teleconference (connects conference rooms in up to 8 locations , conventional point-to-point teleconference (connects conference rooms in two locations), and broadcasting (performs simultaneous transmission from any one conference room to multiple conference rooms). The system allows having different types of conferences simultaneously within the permissible combination range. (When having multipoint teleconferences, however, up to two independent groups can simultaneously hold conferences using this system.)

The media used for teleconference consist of audio and video data which is transmitted and received between conference rooms.

The available conference modes and the media used for each conference mode are summarized in the table below.

Table 2 CONFERENCE MODE AND MEDIA

Conference mode	Video	Audio
Point-to-point teleconference	Picture of connected remote conference room.	Voice of connected remote conference room.
Broadcast	Simultaneous transmission of leading conference room picture to all participating conference rooms.	Simultaneous transmission of leading conference room voice to all participating conference rooms.
Multipoint teleconference	o Selection mode for conference room reception Each participating conference room selects the desired picture of another conference room taking part in the conference. o Voice activation control mode The picture of the desired conference room is automatically selected from participating conference rooms using the voice activation control function (point detection) and transmitted to all conference rooms. o Operator mode The conference room acting as leader of conference selects the picture of the desired conference room and transmits it to all conference rooms. o Local conference room transmission mode Transmits the picture of local conference room to all conference rooms.	Mixed voices of all participating conference rooms will be distributed to each conference room. (The voice in the local conference room will be excluded, however.)

5.2 CONFERENCE CONTROL

Almost all operations required for running a conference, including start-up of system power and various camera controls, can be performed during the conference using a wireless remote controller which is basically same as the ones used for home electrical appliances.
To enable participants to concentrate totally on conference proceedings without having to bother about conference equipment operations, this system offers a number of useful control functions. For example, the preset function moves the camera to preset positions simply when a key is pressed on the remote controller. The camera voice activation control function automatically moves the camera to a person speaking by responding to the person's voice over the microphone. The system also provides an automatic point switching function which automatically switches the screen to the picture to be received during a multipoint teleconference when a different person in a different conference room starts to speak. The superimpose function provided clearly displays the operation conditions and system status on the monitor.
The main functions of conference operations are given in the table below.

Table 3 MAIN FUNCTIONS OF TELECONFERENCE OPERATIONS

Category	Function	Description
Video system	(1) Monitor display screen selection	Selects the video to be displayed on the monitor from receiving picture, transmitting picture, VCR, local conference room document, and remote conference room document.
	(2) Picture-in-picture	Displays the transmitting picture on the receiving picture, using the same monitor screen.
	(3) Superimpose	Displays the remote conference room name and system status text on the monitor.
	(4) Transmission picture selection	Selects one picture from pictures of motion picture, documents, VCR, and moving camera and transmits it to the remote conference rooms.
	(5) Reception picture selection (during multipoint teleconference)	Sets either reception selection mode, voice activation control mode, or operator mode in accordance with the type of conference to select the picture to be received.
Audio system	(1) Microphone ON/OFF	Enables mute control of local conference room microphones.
	(2) Volume adjustment	Enables volume control of local speaker units.
Control system	(1) Local conference room camera control	In addition to the normal manual operations, this function automatically moves the camera using voice level detection to a person who is speaking.
	(2) Remote conference room camera control	Enables control of a remote conference room camera which is transmitting the picture.

6. CONCLUSION

Facsimiles and personal computers brought great changes to the business system. The teleconference system will revolutionize it. To have more teleconference systems installed and to make them popular, we are working toward reducing the unit prices, creating the optimal system which can cope with various applications, and making arrangements to provide network functions such as reservation management. Through such efforts, we hope to develop a teleconference system that will be even more user-friendly.

7. REFERENCES

(1) Toshiyuki Onaka, et al., "Teleconference System (VisuaLinks AD series)", NEC Technical Journal (Vol.44, No.6), 1991

(2) Mitsuo Nishiwaki, et al., "Visualink 5000 Video CODEC", NEC Technical Journal (Vol.44, No.6), 1991

(3) Toshiyuki Onaka, et al., "MCU (Multipoint Control Unit)", NEC Technical Journal (Vol.44, No.6), 1991

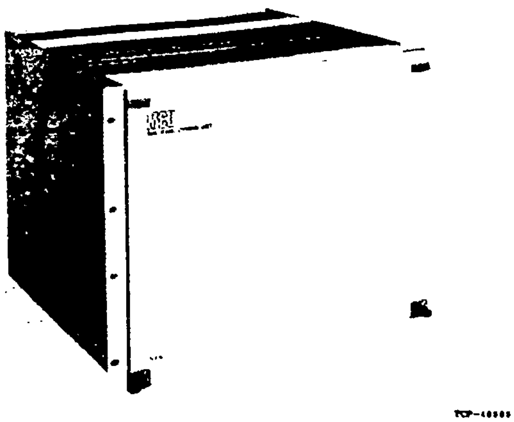


Photo 1 MCU

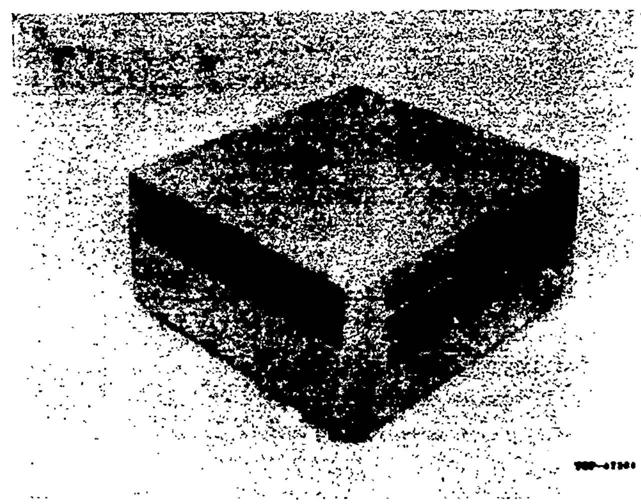


Photo 3 VL5000

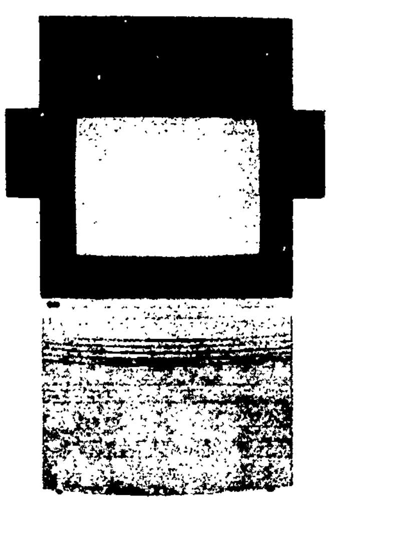


Photo 2 VISUALINKS AD SERIES (AD100)

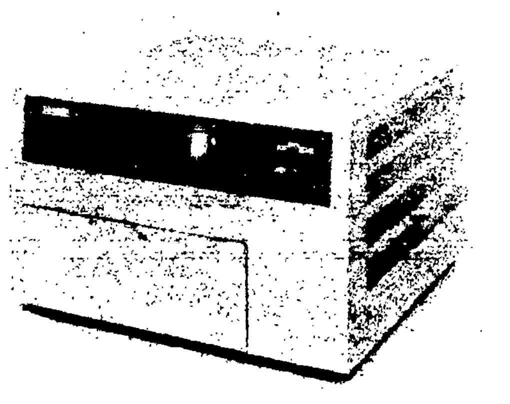


Photo 4 TC5000

THE NEW GENERATION OF ISDN APPLICATIONS AND BEYOND

Dale T. Rogers - AT&T
Jerry Nowicki - ESI Systems

ABSTRACT

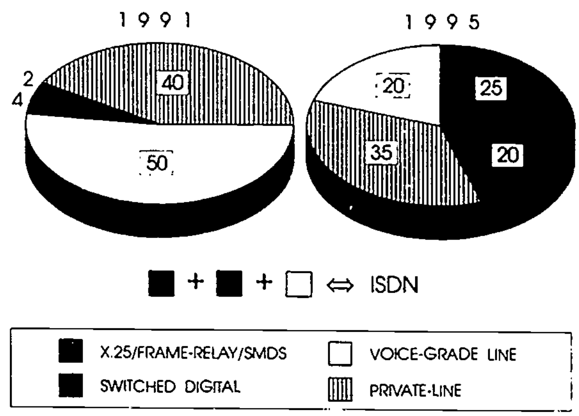
A great deal of energy has been focused on ISDN deployment to provide advanced technology solutions for the business environment. The emergence of Global ISDN interconnectivity coupled with newer technologies such as frame relay, SMDS, and eventually ATM networks, will provide new applications which will benefit society as a whole. These applications are mainly in the following areas; health care, education, travel and recreation, and enhanced entertainment.

We are witnessing several new emerging applications in California and elsewhere whose benefits can be extended throughout the ISDN equipped countries of the Pacific Rim and the world. Ubiquitous applications are important to PTT's worldwide because it will help them better serve their multinational customers as well as allow them to take advantage of their investments in ISDN, frame relay, and other wide band technologies. Our effort explores some of these applications and addresses the expanding data needs, the principle drivers, and the key elements to successful deployment and mass marketing of these techno-applications.

1. INTRODUCTION - DATA IN A CHANGING WORLD

Today, the world's the socio-economic structures are rapidly changing and so are the trends in data networking which provide the important informational linkages between peoples. In fact there are those who argue that the proliferation of technological advances and deployment of data networks is having a direct impact on changing world events. Some recent well known examples include events at Tianamin Square, the outcome of the Gorbachov coup attempt followed by Yeltsin's rise to power, and the short duration of the Kuwait-Iraq war. In all three events, the role of fax, email and other data network services to rapidly communicate important information via non-traditional means is now recognized as having had an important impact on the outcome of these events.

Coincidental with the emerging trends in data communications is the merging of voice and data networks, and the shifting of data trends from centralized process networks toward user-to-user networking. The rapid dispersion of powerful, high speed computing applications down to the individual's desktop is simultaneously driving users toward more data intensive network application requirements. We have observed that advances in computing, audio, and video technology is driving this rapid trend toward networking "global data-tization" as shown in figure 1.



NOTE
THE USE OF PACKET-BASED AND SWITCHED DIGITAL SERVICES TO LINK LAN'S WILL GROW. ACCORDING TO THE YANKEE GROUP TYPES OF SERVICES USED FOR LAN INTERCONNECTION ESTIMATED IN 1991 AND PROJECTED 1995 BY PERCENT DO NOT TOTAL 100 DUE TO ROUNDING

SOURCE COMMUNICATIONS WEEK 9/14/92

Figure 1
Global Data-tization

Today almost 40% of data traffic is carried via low-to-medium speed modems over the traditional analog voice network. Approximately 50% of this traffic and 10% of the private network traffic is expected to shift to higher speed circuit and packet type networks that are publicly accessible. We see this shift occurring over the next five years. Clearly, data networks are changing and the application requirements for more bandwidth and integrated voice/data capabilities is creating increased demand for standardized advanced services such as ISDN, frame relay, SMDS, and ATM by users in the major industrialized countries. We believe that any country wishing to enter the global economy or to remain economically competitive in the 21st century must make a commitment to deploy these advanced communication networks as infrastructural necessities.

For example, the ease of use and economic advantages of a single integrated ISDN interface to multiple networks (including frame relay, SMDS and ATM) is an important factor in ISDN's success globally. In the computing world, ISDN is beginning to gain favor as an element in meeting the challenges of cluster-server applications and user-to-user network applications. These applications are principally found in the small and medium business markets. However a new trend for telecommuting is emerging which will impact the need for advanced services at the residence. Many large corporations are decreasing the size of their payrolls through outsourcing work to low cost cottage industries which typically work at home.

These rapidly growing market segments are driving the changing data network market needs which in turn are driving changes in the role of Information Systems(IS) management. The move away from centralized legacy applications is shifting IS managers focus from overseeing private data domains toward helping their data users build more efficient and dispersed data networks. As a result we are observing more Information Systems focus on: LAN-LAN, LAN-MAN/WAN, multi-media conferencing, file server-LAN, and countless other flexible and widely distributed data needs. Besides data networking, the new role of the IS manager now includes network management and integrated voice/data management applications. In such an environment the IS manager is beginning to recognize that ISDN and other public network services can offer many immediate and cost effective solutions that are compatible for use with both existing and future advanced networking technologies.

2. CHANGING USER NEEDS

Recent trends indicate that it is not business as usual any more. Data users have more options and are more knowledgeable on how to use those options. Additionally, costs are becoming more and more of an issue and purchase decisions are moving down the scale in terms of years required before payback. Equipment investments once calculated between 3-5 years are now required to break even in 1.5-3 years. The increasingly short payback requirements are necessary to the success of businesses despite the fact that investment decisions are often further complicated by lagging tax depreciation laws.

We find that networking trends are just as dynamic as computing trends. Voice and data users are beginning to look beyond commodity transport services towards value added networks. They are discovering that value added networks are giving them strategic advantages with their suppliers and customers. These intelligent networks are capable of running applications instead of just carrying raw data and are becoming more cost effective than provisioning expensive proprietary customer premise equipment on the ends of a rigid and static pipe.

What is driving this phenomena? The driving forces come from the application requirements of both the strategic planners in corporations and the departmental user as depicted in figure 2. Network speed, flexibility and low cost are key decision elements for all applications over time.

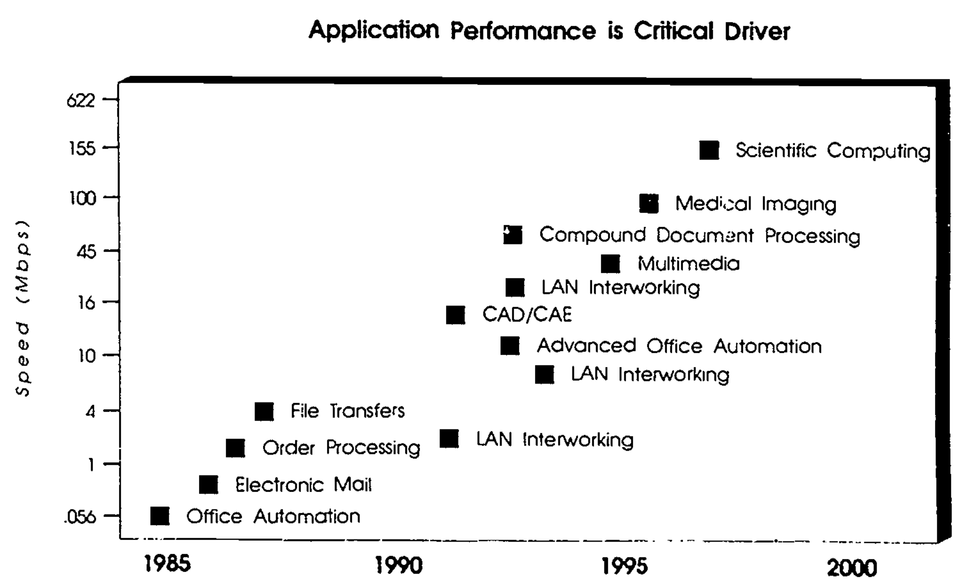


Figure 2
User Applications Require and Often Demand Higher Bandwidth

Some of the corporate strategic decision elements include:

- shifting data networking and frequency requirements from centralized computing to shared files amongst individual PC or workstation users, and

- changing corporate business strategies, re-engineering corporate structures to decrease costs, improve customer access, and to prepare themselves for a new business environment.

Coming from the departmental user perspective, the key elements include;

- departmental managers finding value in personal computing (PC) proliferation with the corresponding need for PC-PC interconnection not necessarily in the same physical or geographic location, and

- proliferation of workstations, LAN's and associated interconnect devices such as bridges, routers and brouters.

Probably the single most important factor in data networking is the dramatic increase in low cost bridges, routers, and inverse multiplexers with ISDN interfaces and other public network services that can easily link the thousands of existing LAN's in todays corporate world.

3. CHANGING DATA NETWORKING ENVIRONMENT

The changing data networking environment of today has its roots in the evolution of computer processing (see figure 3). As such, historically most businesses developed embedded legacy systems centered around main frame computing systems. These horizontal systems dictated how users operated and were not usually interdependent. As computing advanced toward more vertical infrastructures new data trends emerged where users needed access to multiple systems. Today file servers have emerged to help fill this growing need by individuals to download and process individual requests. Todays advanced business environment requires virtually instantaneous and unplanned individual ad hoc information queries and processing to meet rapidly changing business needs.

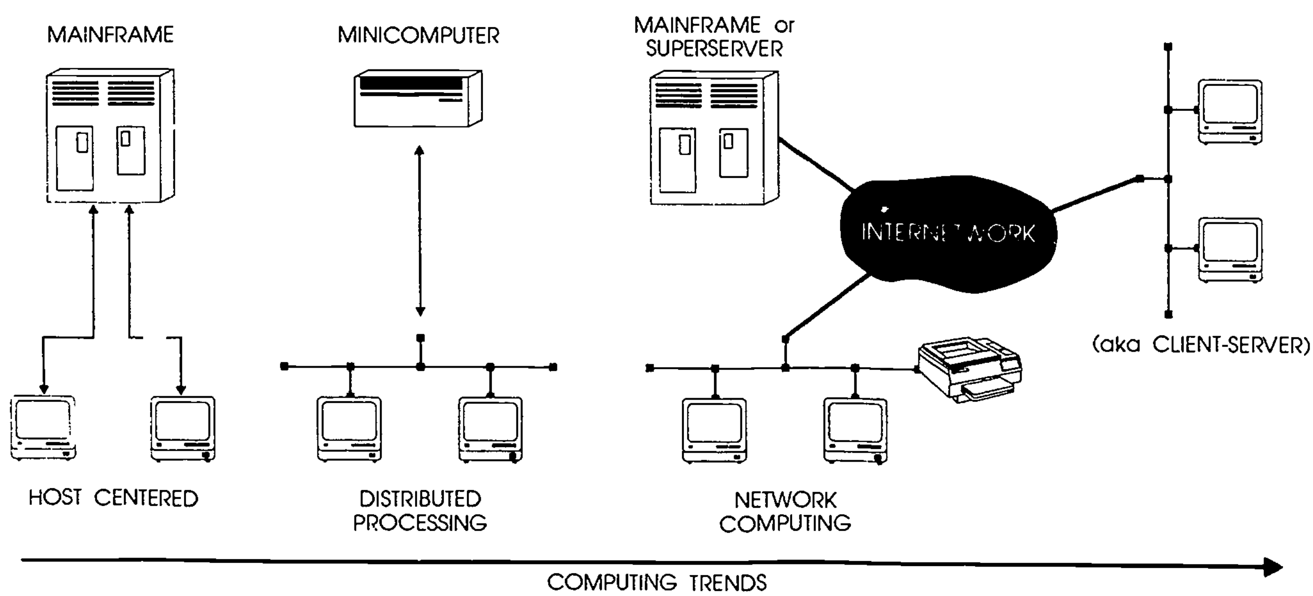
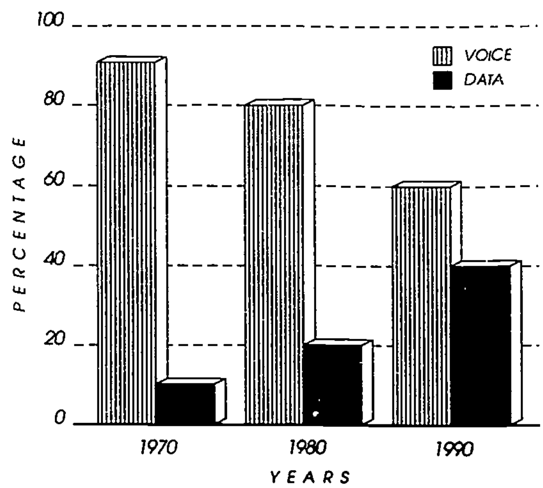


Figure 3
Changing Data Networking Environment



- 1970's: 10% User Dollars Spent on Data
- 1980's: 20% User Dollars Spent on Data
- 1990: 40% and More Spent on Data
- Data, Image, and Video are Strategic Drivers - CAGR 25 to 33%

SOURCE: International [illegible] Development

Figure 4
Strategic Drivers Shifting Toward Data Intensive Applications

This requirement for instantaneous information that often resides on widely dispersed PC's or microcomputers is spurring the growth of data networking. Data intensive applications requiring resource sharing are now accomplished by drawing upon all information resources available both within and outside an organization. This trend toward data intensive applications is apparent when tracking percent of user dollars spent on data and voice between 1970-1990 as shown in figure 4. By the year 1995 we expect that the funds spend on data communication will surpass traditional voice communications.

The merging of information systems and networking presents a challenge to both IS and telecommunication managers to effectively respond and to coalesce their functions so that the best of both worlds can be effectively achieved. We see successful organizations carefully blending the best private and public network offerings to craft hybrid solutions that provide the productivity and flexibility needed for future information networks.

The challenge that faces the telecommunication industry is the provisioning of value added networks to support the cost effective transfer of integrated voice, data, and imaging applications. The "need for speed" is a key driver. Users are seeking new applications that offer standardized, low cost, and widely available public networking solutions to meet their strategic business needs (see figure 5).

IMAGE	INFORMATION CONTENT	TRANSMIT TIME		
		Ordinary ✦ Phone Line	One ISDN B-Channel	24 ISDN B-Channels *
Digitized Photo	1 Megabit	1.7 min	15.6 sec	0.7 sec
CAD/CAM	2 Megabits	3.4 min	31.2 sec	1.4 sec
CT Scan ✦	5.2 Megabits	9 min	1.4 min	3.3 sec
X ray ✦	12 Megabits	21 min	3 min	8 sec

* Equivalent of one T1 line
✦ Typical medical consultation [illegible] 60 images
✦ 9600 baud modem

Source: Ascend Communications 10/12/92

Figure 5
The Need For Speed = ISDN Data And Beyond

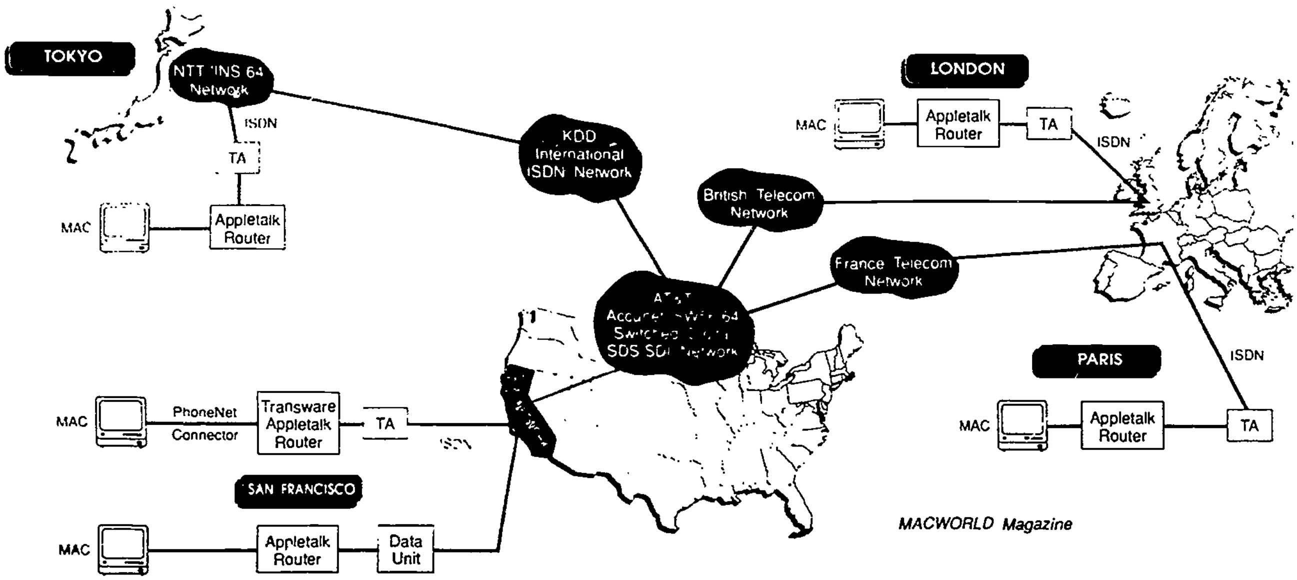


Figure 6
New Generation Example: ISDN On-Line Journal Customer Application

The realization of on-line journals (figure 6), and other new types of data transfer, data sharing, and imaging industries is only possible on a cost effective basis by the continued deployment of ISDN both on the local and global level public networks today. These industries can then continue to develop and flourish followed by expansion of bandwidth into SMDS/ATM frameworks as they become available in the future.

4. NEW CHALLENGES

Many new data networking challenges on the horizon will involve some sort of client-server computing applications. Such applications tend to be more distributed, demand standard application programming interfaces and usually share data on servers. Faster and more powerful desktop devices will require faster and widely accessible data networks which can effectively handle many varieties of image, audio, video and live animation in a low cost manner for use by the general public. This is an important point to remember since the large corporations of the past are outsourcing some of their work out to smaller business units and individuals who generally depend upon the public network for their telecommunication needs.

ISDN can play an important role in meeting these growing user needs and the telecommunication providers who can supply these user needs will reap the monetary benefits of this growing market segment. Additionally, as certain user applications require more and more bandwidth, ISDN will play an important low cost access or bridging function to various higher speed private and public networks that will evolve in the future. Despite all the press regarding widespread future ATM deployment the fact remains that most of these higher speed networks will probably be directly accessible by the general public on a very limited basis and in only selected metropolitan areas. Publicly accessed ISDN BRI and PRI CCITT standardized interfaces will provide users cost effective access to these higher speed backbone networks and the applications will run at far greater data speeds and with higher quality than possible with currently available modem type technology.

One U.S. local exchange carrier has been trialing such an application with a major university with excellent results (see figure 7). A similar "next generation" ISDN application scenario may also be tested with ISDN and SMDS. The actual data throughput speeds exceed those of LAN's since there is no contention for service. Data throughput on a simple BRI-D channel usually exceeded that of a 10Mhz LAN for this simple reason. The idea of linking all parts of the widely distributed campus and off campus residences to the campus frame relay backbone network is very exciting to the customer. They will be able to provide virtually all university personnel with high speed ISDN BRI or PRI interfaces to access any university computer system for a cost of as little as $30.00 US per month via the public network. The university could not provide this type of service any other way since the cost of extending private LAN, WAN network infrastructures is cost prohibitive. Additionally, users will be able to access the universities powerful computer systems from any ISDN connection worldwide.

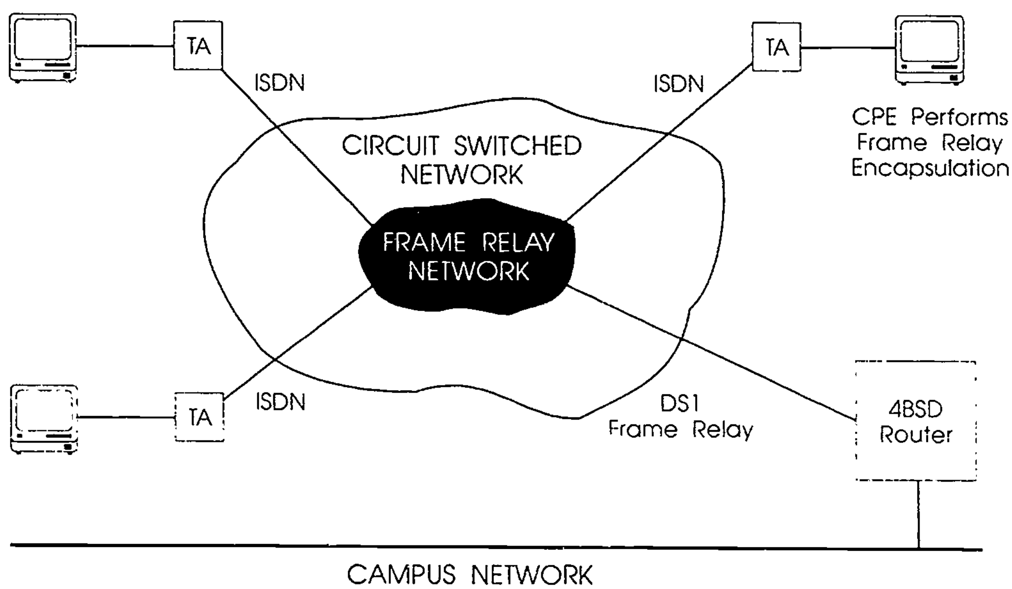


Figure 7
NEXT Generation Example:
University Campus Network ISDN-Frame Relay LAN Interconnection

Another next generation application addresses the challenges of accessing widely distributed data base systems of varying types. In this case Pacific Bell sales teams are accessing various key data bases which allow it to serve its customer base with the highest quality standards. This configuration is facilitated by a software system designed by ESI Systems which incorporates numerous BRI and PRI public and private network interfaces to the various data bases as displayed in figure 8.

This system is now on line and represents a new and very cost effective approach to automating their sales office functions throughout California. This is an important step toward Pacific Bell's ability to use new technology to mediate cost effective advanced technology solutions for their customers. Instant access to national business profile data bases as well as separate access to their own customer billing, ordering and provisioning data sources allow the Pacific Bell sales teams to call on critical information and resources to better serve their customer base.

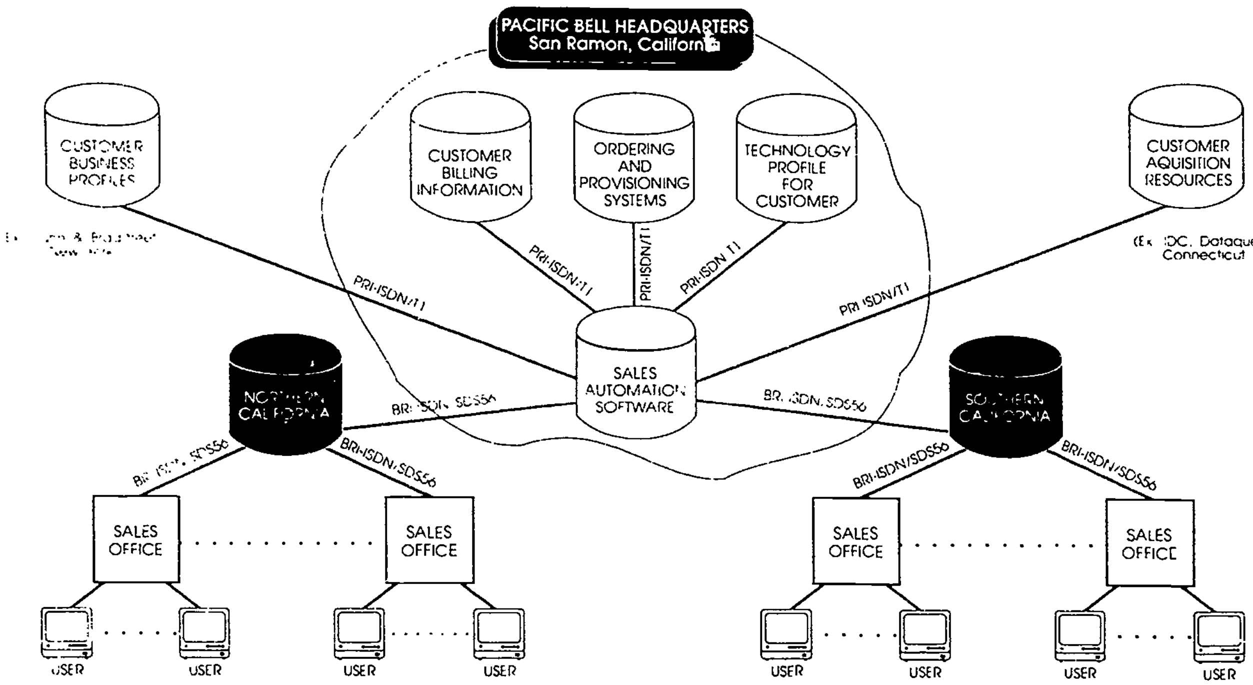


Figure 8
NEXT Generation Example:
Pacific Bell Sales Office Automation Application

5. CONCLUSION

Throughout the modern world, the appetite for data rich applications is enormous and growing. With all the available networking choices there is no one single answer for all data networking needs. One can summarize this concept with the following equality;

NEW APPLICATIONS = INTELLIGENT NETWORK SOLUTIONS = INDUSTRY PROFITS + CUSTOMER SATISFACTION

ISDN will play an important role in satisfying many of these applications. It is available today and with selective network augmentation will satisfy the needs of users for many years in the future.

The telecommunications industry challenge is not only to assist in applications development and support, but to also effectively sell these applications. Most important to all industry partners and customers is the ability of the public and private network service providers to meet the growing appetite for high bandwidth services through the deployment of N-ISDN, frame relay, SMDS, and eventually Broadband-ISDN on a globalized basis. Integrated elements will be critical to the success and effectiveness of voice and data networks. The importance of integrating these elements within Asia is necessary toward making the Pacific Rim strategy a competitive one for its customers. It is important for users and providers to better understand how data applications can be served by various network applications as illustrated in figure 9.

Users needs will untimately drive network capabilities and it is important for the Asia Pacific Region telecommunications service providers to incorporate user needs into their network provisioning decisions. Formalized user groups both regionally and locally can help to assure that technology and applications investments are meeting the expectations of the regions customers. The power of economics continues to be a major factor in how rapidly networks and applications are built and this can be best accomplished through regular cooperation to assure that everyone's objectives are met.

APPLICATIONS / SERVICE TYPE	LAN INTER-CONNECT	CENTRALIZED I/S DATA APPLICATIONS	OFFICE AUTOMATION AND PERSONAL PRODUCTIVITY		CAD/CAM SCIENTIFIC MODELING	POINT OF SALE	TRANSACTION/ RESERVATION SYSTEMS	VIDEO	IMAGING/ GRAPHICS	DISASTER RECOVERY AND DATA CENTER BACKUP
			PC/WORKSTATION	MAINFRAME						
ISDN	✪	✪✪	✪✪	✪✪	✪	●	●	✪✪	✪✪	✪✪
Point-to-Point	✪✪	✪✪	✪✪		✪✪✪	●		✪✪✪	✪✪✪	✪
Multi-Point		✪✪✪		✪✪✪		✪✪✪	✪✪✪	✪✪		
Bridges and Routers	✪✪✪	✪	✪✪✪	●	✪✪✪				✪✪✪	✪✪
CPE Multiplexer	✪	✪✪✪	✪✪	✪✪	✪✪	✪✪✪	✪✪✪	✪✪✪	✪✪✪	✪✪✪
CO-Based Mux Service	●	✪✪✪	✪	✪✪	✪	✪✪✪	✪✪✪		✪✪✪	✪✪
Public X.25	✪	✪✪	✪	✪✪		✪✪✪	✪✪			
Public Frame Relay	✪✪✪	✪	✪✪		✪✪✪				✪✪✪	✪✪
Private Frame Relay	✪✪	✪	✪✪	●	✪✪			●	✪✪✪	✪✪
SMDS	✪✪✪	●	✪✪		✪✪✪				✪✪✪	✪✪

● POOR MATCH - Technically feasible but rarely used and performance is not good
✪ FAIR MATCH - Can be used but performance may suffer
✪✪ GOOD MATCH - Often used with good performance
✪✪✪ PERFECT MATCH - Most often used and optimal for application

Figure 9
Data Applications and Various Network Types

Optimization of VSAT Systems
and Application in Asia-Pacific Area

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1. ABSTRACT

In a satellite communication system having VSATs (Very Small Aperture Terminals), a set of equations to determine the optimum antenna gains of VSATs, are introduced to minimize total system cost including the transponder and earth station cost. Using these equations, a multimedia shopping system and a voice/data communication system are studied.

2. INTRODUCTION

Since our presentation on the Pacific regional satellite system at PTC '83 [1], 10 years has passed and available satellites have been increasing.

From now on, VSAT systems will be ubiquitous in Asia-Pacific area, too.

Satellite trasponder power has been increased due to powerful solar arrays on satellites. Smaller dishes than before of VSATs can receive information from a satellite.

Also, voice compression technology will contribute to reduce space segment cost of a VSAT system [2]. Basic PCM requires 64 kbps and the latest digital mobile telephone does only several kbps.

3. MULTIMEDIA SHOPPING SYSTEM

3.1 OUTLINE OF THE SYSTEM

Shopping terminals which are connected to VSATs are installed in stores, shopping centers, train stations, and everywhere easily accessible by consumers.

VSATs are linked to a hub station in star-shaped manner as shown in Figure 1.

VSATs are receiving only, and the hub station transmits multimedia shopping information upon request of users. An user will touch the screen of a shopping terminal to access wanted information and the access signals are sent to the shopping data base through ground lines. The shopping data base will findout the wanted information and transfer it to the hub station to send it to the VSAT. Now, the user will see the wanted information on the screen of the shopping terminal.

The multimedia information is time division multiplexed (TDM) at the hub station with a terminal identification number to make it possible to pick the information up at the terminal (Figure 2).

For a store having the more terminals, the transmission bit rate is the higher, to utilize the transponder effectively.

By the varying bit rate mechanism, rain attenuation might be also relieved knowing the attenuation of the link to the terminal through ground lines [3], [4].

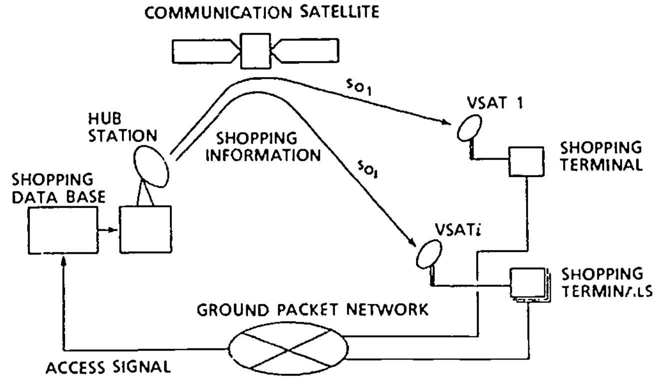

Figure 1 MULTIMEDIA SHOPPING SYSTEM

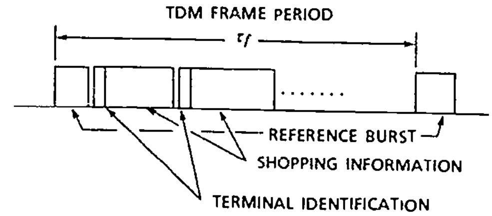

Figure 2 TDM FRAME CONFIGURATION

3.2 SYSTEM OPTIMIZATION

The annual expense E_t of the portion of a transponder used by this system is given below.

$$E_t = \frac{b}{k} \sum_{i=1}^{n} \frac{s_{oi}\, t_i\, \tau_f}{g_i} + b\, \tau_o \qquad (1)$$

Where,
- n: number of VSATs
- b: annual expense of a transponder per τ_f below
- k: TDM burst rate per g_i/t_i of a VSAT
- g_i: receiving antenna gain of the i-th VSAT
- t_i: receiving system noise temperature of the i-th VSAT
- s_{oi}: average busy hour traffic of the i-th VSAT in bit rate.
- τ_f: TDM frame period (see Figure 2)
- τ_o: total period of all over-heads as preambles and guard times of each burst.

Total annual expense E_e of all VSATs is assumed as

$$Ee = nEo + c \sum_{i=1}^{n} g_i + d \sum_{i=1}^{n} h_i \qquad (2)$$

Where,
- E_o: fixed expense of a VSAT
- c: proportional coefficient to antenna gain of a VSAT
- d: proportional coefficient to channel capacity (number of shopping terminals) of a VSAT
- h_i: channel capacity of the i-th VSAT

Summation of E_t and E_e is minimized at the antenna gain g_i determined from the following equation.

$$g_i = \sqrt{\frac{b\, s_{oi}\, t_i\, \tau_f}{ck}}, \qquad i=1,2 \ldots n \qquad (3)$$

3.3 LINK BUDGET CONDITION

The up link from the hub station is not critical as the station can easily have sufficient EIRP (Effective Isotropic Radiated Power). Then the down link to VSATs should be studied.

The received power of the i-th VSAT has at least to be equal to a threshold value q_d times the receiving system noise power of the VSAT. As a conclusion, k has to satisfy the following equation.

$$k = \frac{S}{k_o\, L_d\, q_d} \qquad (4)$$

Where
- S : satellite EIRP
- k_o: Boltzman's constant (= -228.6 dBK)
- Ld: total down link loss including propagation, atmospheric absorption, rain attenuation losses and required margins.

The q_d is determined from required BER (Bit Error Rate).

3.4 AN EXAMPLE OF SHOPPING SYSTEMS

A shopping system consists of 10,000 VSATs is studied. The satellite communication frequency is Ku band.

5,000 VSATs have a shopping terminal each and the rest have four terminals each. Then total terminal number is 25,000.

The system and cost parameters are assumed rather arbitrarily but not too far from the real world and shown in Table 1.

Table 1. System and cost parameters

S	: satellite EIRP	52	dBW
k_o	: Boltzman's constant	-228.6	dBW/K
Ld	: down link loss	214	dB
q_d	: down link threshold	8	dB
t_i	: noise temp, VSAT	26	dBK
s_{oi}	: traffic to a VSAT	0.5	kbps
τ_o	: duration of over head	1	ms
τ_f	: TDMA frame period	10	ms
b	: transponder exp./τ_f	4×10^8	\$/y
E_o	: fixed VSAT expense	2×10^3	\$/y
c	: VSAT expense/gain	0.1	\$/y
d	: VSAT expense/channel	2×10^3	\$/y

The average traffic is obtained assuming two users will occupy a terminal in a busy hour for ten minutes (average) each. During the ten minutes, an average user receives ten pages of text and two photographes.

From the equation (4),

$$k = 52 + 228.6 - 214 - 8 = 58.6 \quad \text{(in dB)}$$

Then, from the equation (3)

$$g_i = 0.5 \times (86 + 27 + 26 - 20 + 10 - 58.6) = 35.2$$

(in dB for 1 terminal VSAT) and = 38.2 (in dB for 4 terminal VSAT).

Obtained system parameters are shown in Table 2.

Table 2 SYSTEM PARAMETERS OF THE SHOPPING SYSTEM

Parameters	1 terminal VSAT	4 terminal VSAT
VSAT antenna gain	35.2 dB	38.2 dB
g/t of VSAT	9.2 dB/K	12.2 dB/K
TDMA burst rate	6.0 Mbps	12.0 Mbps
VSAT antenna diameter	0.6 m	0.8 m
annual expense of VSAT	\$1,600	\$2,900

Assuming the annual expense of the hub station is a million dollars, the cost of the hub station and the transponder per page of text and per photographs is ¢0.2 and ¢4 respectively for 1 terminal VSATs.

4. VOICE/DATA COMMUNICATION SYSTEM

4.1 OUTLINE OF THE SYSTEM

A voice/data VSAT system is studied here. The voice traffic is dominant and is compressed by the voice codec.

VSATs are linked to a hub station in star-shaped manner as shown in Figure 3.

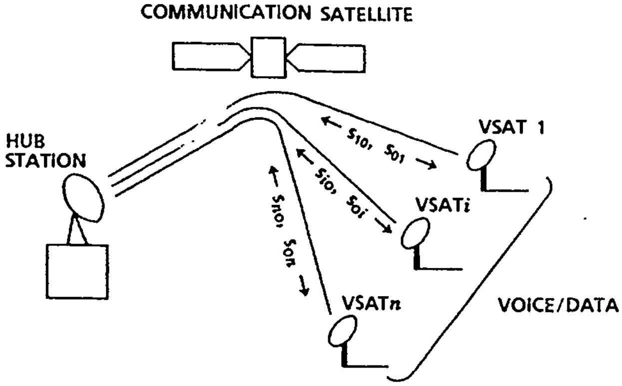

Figure 3 VOICE/DATA COMMUNICATION SYSTEM

The communication scheme is SCPC (Single Channel Per Carrier) and the EIRP of the hub station is controlled in inversely proportion to the receive sensitivity of the communicating VSAT to utilize the transponder effectively.

The transponder is operated in the power limit condition in outbound links from the hub to VSATs and in the frequency limit condition in inbound links as the hub station has sufficiently high receiving sensitivity.

The hub station has the VA (Voice Activation) function to increase EIRP per channel of transponder to VSATs.

The EIRP control mechanism can also relieve rain attenuation to a VSAT [5][6][7].

4.2 SYSTEM OPTIMIZATION

The annual expense E_p of the portion of a transponder used by the system is given below.

$$E_p = \frac{Et}{P_\ell}\left(a \sum_{i=1}^{n} \frac{e_o\, s_{oi}}{g_i/t_i} + b \sum_{i=1}^{n} s_{io}\right) \quad (5)$$

Where, n : number of VSATs

E_t : annual expense of a transponder

P_ℓ : maximum liner output of a transponder

a,b : proportional coefficients

e_o : reference EIRP of the hub station per channel

s_{oi}, s_{io}: outbound traffic (channels) to the i-th VSAT and inbound one from the VSAT, respectively.

g_i : receiving antenna gain of the i-th VSAT

t_i : receiving system noise temperature of the i-th VSAT.

Total VSAT cost Ee is assumed as same as the equation (2). Summation of Et and Ee is minimized at the antenna gain g_i determined from the following equation.

$$g_i = \sqrt{\frac{a\, e_o\, E_t\, s_{oi}\, t_i}{c\, P_\ell}}\ , \ i = 1, 2, \text{---}\ n \quad (6)$$

4.3 LINK BUDGET CONDITION

Similar to the shopping system, only the critical down links to VSATs are studied. Corresponding to the equation (4),

$$a\, e_0 = \frac{k_o\, L_d\, r_o\, q_d}{G_t} \quad (7)$$

Where r_o: bit rate per channel

G_t : satellite transmission antenna gain

4.4 AN EXAMPLE OF VOICE/DATA COMMUNICATION SYSTEMS

A voice/data communication system of 100 VSATs is studied. The satellite communication frequency is C band.

50 VSATs are single channel capacity and the rests are 4 channel capacity.

The system and cost parameters are assumed rather arbitrarily but not too far from the real world and shown in Table 3.

Table 3. SYSTEM AND COST PARAMETERS

Gt	: satellite ant. gain	25 dBW
P_ℓ	: linear TPD. power	7 dBW
Ld	: down link loss	201 dBW
q_d	: down link threshold	5 dB
t_i	: noise temp. of ES	23 dBK
r_o	: bit rate per channel	10 kbps
E_t	: TPD. expense	2×10^6 \$/y
E_o	: fixed VSAT expense	2×10^3 \$/y
c	: VSAT expense per gain	0.3 \$/y
d	· VSAT expense per chan.	2×10^3 \$/y

TPD.: Transponder

The traffic to 1 ch VSAT is 0.4 and to 4 ch VSAT is 1.6 with VA. factor of 0.4.

From the equation (7)

$$a\ e_o = -228.6+201+40+5-25 = -7.6 \quad \text{(in dB)}$$

From the equation (6)

$$g_i = 0.5 \times (-7.6 + 63 - 4 + ?3 + 5.2 - 7)$$

$$= 36.3 \text{ (in dB for 1 ch VSAT) and}$$
$$= 39.3 \text{ (in dB for 4 ch VSAT).}$$

Obtained system parameters are shown in Table 4.

Table 4 SYSTEM PARAMETERS OF THE VOICE/ DATA COMMUNICATION SYSTEM

Parameters	1 ch VSAT	4 ch VSAT
VSAT antenna gain	36.3 dB	39.3 dB
g/t of VSAT	13.3 dB/K	16.3 dB/K
VSAT antenna diameter	2.0 m	2.8 m
Annual expense of VSAT	$5,300	$12,600

Assuming 7 KHz per channel using QPSK (Quadure Phase Shift Keying) total inbound links occupies 1.75 MHz of a transponder band width. From the equation (5), the transponder expense for this system is 211K$/year.

When the hub station expense is 500K$/year, the total system expense is 1.6 M$/year. This corresponds to $540/month/channel. With this network, 2400 bps data transmission will be possible, too.

Possible interference to adjacent satellites due to the small dishes is not studied here.

5. CONCLUSION

By optimization equations, the antenna gains of VSATs to minimize system cost are easily obtained.

As an example, a multimedia shopping system consisting of one way VSATs and a high power Ku band satellite is studied. Very high speed and less expensive data transmission than any ground services is possible.

The other example is a two-way voice/data communication system using a C band satellite and it is economical when the distance is more than 40 km comparing with Japanese leased line rates.

For a two way C band VSAT with a small dish, interference with adjacent satellites and ground microwave stations has to be studied or adoption of spread spectrum technology will solve the problem.

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Business, Legal, and Technical Implications of the Proliferation of Global Data Communication Networks

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ABSTRACT

This paper examines business, legal, and technical issues in the application of global data communication networks. We describe that commitment in terms of cost, time, and personnel which turn out to be substantial. The diverging standards adopted by the national PTT's need to be harmonized. The burden to create industry standards falls on organizations like CCITT to provide a worldwide standard for greater efficiency and lower cost.

1. Introduction

As the world transforms into the information age, the collection, processing, storing and retrieval of information have become a paramount issue for survival in the business world. Since the value of a particular piece of information is directly correlated to its timeliness, the efficiency in locating and retrieving needed information is crucial. Coupled with the emergence of a global economy where businesses form worldwide alliances or have scattered offices around the globe, the construction of global data communication networks has proliferated. Thus, we can see a stockbroker in Chicago buying European petroleum company shares without going through a trader in New York, and hundreds of thousands employees at a multinational company communicating via an electronic mail using a global network that spans 145 countries and moves 3 trillion characters of information a year (Keller et al., 1988).

Due to their geographical scope, global data communication networks pose unique issues that were not apparent when networks were limited to a building or a country. The network developers have to contend with a multitude of technical standards and government policies in each of the country that the network spans. This paper discusses issues related to the proliferation of global data communications network.

2. Business and Legal Issues

Global data communication networks have had a great impact on the way business is conducted. It has also altered the legislative and enforcement power of the government. The relationship between business and government is discussed in the following sections.

2.1 The Financial Sector As An Example

A good example to illustrate issues in this area is the financial industry. It is an information intensive industry whose size and scope have expanded to a point where the financial systems of many countries are now interrelated. For example, a rumor that Japan is tightening its monetary policy will cause bond prices to drop in New York. Global networks have sprung up to service this industry. Information databases where information can be bought include Federal Reserves' Flow of Funds, World Bank's World Debt Tables, International Monetary Fund's Balance of Payments and International Financial Statistics, Chase Econometrics Foreign Exchange, Reuter's Economic services, Standard & Poor's and Moody's, among others. Telematics developments in financial markets to facilitate financial exchanges include FedWire, BankWire, CHIPS (Clearing House Interbank Payment System), SWIFT (Society for Worldwide Interbank Financial Telecommunications), Euroclear, Cedel, Reuters, Telerate, and Instinet.

These projects require a large investment and a high degree of legal and political coordination.

The development of global networks among the financial markets have opened up opportunities for new ways of doing businesses. Many institutions are now operating on a 24 hours a day around the world basis. Trading on the world's stock markets can be carried out via international links like Chicago Mercantile Exchange/Singapore International Monetary Exchange (CME/SIMEX) and between the COMEX and the Sydney Futures Exchange (Jussawalla and Dworak, 1989). This increase in the fluidity of the flow of international capital has increased the efficiency of the matching of the availability of funds to the needs for funds.

Taking advantage of the development in global communication together with a wealth of information that no other organizations possess (e.g., customer specific information), banks have also diversified from their traditional money lending role to become information service providers. In much the same way the distinction between hardware manufacturers and common carriers blurs as the former gets into telecommunication business and the latter starts manufacturing hardware after deregulation in the United States, this new development has also started to blur the distinction between banks and the traditional providers of information services, such as Reuters (Spero, 1989). Large corporate customers of banks can now, via terminals in their offices, access foreign exchange information, initiate electronic funds transfer and letter of credit transactions. Banks that do not have the necessary investment to provide these non-credit services are in danger of being abandoned by their multinational corporate customers. Reuters, on the other hand, is also encroaching on the banks' territory by entering the business of arranging transactions, other large companies are also beginning to expand from simply supplying data into providing data analysis services. These new phenomena give rise to some interesting issues that will be further examined in the next two sections.

2.2 Implications For Developing Countries

The customers' desire to have non-credit services from their banks mean that competition in banking will favor big banks with huge communication resources. This may exclude even the biggest bank in a small country, especially those in the developing world. The strategy that the small banks can pursue then, is to seek access to the big banks' networks through a correspondent relationship. Correspondent relationship is currently prevalent among domestic United States banks. It works as a chain of relationship from small banks through larger local banks and regional banks to those in the money market centers. These correspondent banks provide clearing facilities, participation in loans, and other services that the small banks find financially infeasible to provide on their own (Mey, 1989). In the face of internationalization of banking services, this form of alliances may become an attractive option in international banking.

However, the banks that have the direct and full access would still have the edge in marketing their services. This raises the possibility of the smaller countries closing off its domestic market to protect its own industry. The resistance from these countries can be illustrated by their reluctance to open up their market for transborder services despite pressure from the Organization for Economic Cooperation and Development (OECD), this has become an important issue in the General Agreement on Tariffs and Trade Services (GATT) negotiations (Aronson, 1989). However, cutting off their own access to international financial networks also means the termination of access to new development funds from foreign investors. More and better information on the developing countries' market, made available through the global financial networks, would be needed for the international investors to make investment decisions.

These governments could have two choices (Aronson, 1989): One is to overcome national jealousy, resolve questions of equity and adjustment across borders, and accept the reality of global interdependence. Or, they can retreat from these complexities in order to improve control on domestic policies, but risk future trade growth and job creation. This, of course, is a potent issue. Striking a balance will depend on the ingenuity and creativity of each country.

2.3 Implications For Government Policies

Since the operations of the financial sector have serious implications on the financial health of a country, it naturally invites government regulations. The new flexibility provided by global networks though, has created new challenges to the framers of national economic policies and those responsible for regulating the industry. Much of the existing regulations were created long before the information revolution and are inadequate to control the effects of the innovative ways that banks have come up with to conduct transactions on these networks.

The flexibility and speed with which transactions can be conducted on the communication networks on a global scale have severely negated the ability of current legislations to regulate the financial matters of each country. For example, high speed fund transfer allows illiquid asset to become liquid and the ability of a bank to tap into offshore funds results in monetary growth which reduces the efficiency of some domestic monetary policies designed to restrict monetary growth. The financial markets have also become so interdependent that the ability of individual government to pursue particular monetary and fiscal policies within its own borders is reduced.

The global networks also provide banks with a low cost and high speed access to speculative markets. They may engage in risky behavior without a fear of detection. This change in the risk characteristics of the banks may undermine the integrity of a country's financial structure.

These issues characterize the ongoing process of conflict between the regulators' attempts to regulate and the attempts of the regulated to lessen the burden of the regulation. Two opposing points of view emerge—regulators are for economic stability, financial system integrity, efficiency and equity, whereas banks are concerned with profit and the ability to remain competitive (Jussawalla and Dworak, 1989; Chung and McGowan, 1992).

All in all, governments may find it difficult to keep pace with the constant flux in information technology developments since their reactions are usually based on past experience and necessity, not on future trends or the need for planned action. To complicate the matter further, constant changes in technology makes permanent equilibrium impossible. Given the situation, governments can no longer afford to take an isolationist stance. Greater effort in arranging international cooperation is needed. In this respect, four broad stages of approaches to cooperative arrangements among governments can be characterized as Krommernacker (1989) described: The first stage is the periodic meeting between nations to discuss about common problems, to review the development in each country and to listen to explanations of actions that have been taken. However, ultimately, each country still stands alone to fend for itself. The bulk of current international efforts remain at this level.

The second stage of development goes beyond the first in requiring consultation and justification on measures that will restrict international data flow on the networks. Greater international supervision is involved in order to promote a freer but regulated orderly flow of data. The OECD has achieved this level in some respects.

The third stage entails bilateral or multilateral approaches for closer cooperation in the information technology policies. The governments have developed sufficient confidence in the policy judgments of their counterparts in other countries to make them willing to share legislation. The experience between the United States and Canada, and the GATT trade negotiations are in this direction.

The last stage of development comes when countries have a high degree of agreement on the information technology policies and have close coordination to avoid regional divergence in these policies. The close cooperation will guide the countries as a whole towards its information technology objective. This situation would prevail to a large extent in the European Economic Community after 1992 as time elapses. There would be no barrier to the movement of capital, labor, goods, services and information.

The evolution of international cooperation shall depend on the individual government's willingness to change their way of governing. They need to realize that in the new global economy, no nation can accomplish all its regulating needs alone. Liberalization with adequate amount of control seems to be the current trend, this may mean a monitoring role instead of an active involvement role for the governments. However, going against the trend could mean being left behind in the rapidly changing technological environment, that will have grave consequences for the country's growth potential and competitiveness.

3. Technological and Standard Issues

Technological difficulties and the issues of system development management for an undertaking as big as a global communication network is enormous. In addition, the system designers have to deal with a variety of proprietary technology offered by different vendors. The situation is further aggravated by restrictions imposed by the different countries. State-run phone authorities—Postal Telephone and Telegraph (PTT) in most of Europe and the developing countries still inhibit the development of private network by controlling the type of equipment that can be used and used by whom. They also enforce strict control on the flow of data across borders, this has forced companies to set up duplicate computer centers in different countries at a very high cost.

The issues of system development will be discussed in the context of the development of the Society of Worldwide Interbank Financial Telecommunications (SWIFT) II. The working of standard setting bodies like the Consultative Committee on International Telegraph and Telephone (CCITT) will then be examined.

3.1 The Case of the Society of Worldwide Interbank Financial Telecommunications (SWIFT)

SWIFT is a good example of international cooperation. It was conceived by a group of major European community banks to provide an international version of the United States' BankWire. It was designed to provide an automated interbank fund-transfer message system and went operational in late 70's. In about 10 years, it grew from a membership of several hundred founding banks in 11 countries to more than thousand members banks in above sixty countries. The daily volume of messages grew from 27,000 to 1.12 million (Murphy, 1988).

SWIFT was widely regarded as a success. It was fast, reliable and affordable (e.g. A US$0.43 charge per message in 1988) and offered some security to the users by assuming responsibility and liability while messages were in its hands. But more importantly, it set up a common set of standard for use in sending messages. Language barriers between banks in different countries were eliminated and all communications could be handled using the common codes of SWIFT.

However, the crunch came when SWIFT II was proposed. SWIFT II was meant to be the successor to SWIFT as the latter was running out of capacity. It would have greater security features, including acknowledgement of safe receipt of a message, and storage of information in more than one place so that malfunction in one area would not lead to a loss of information (Boult, 1988).

The SWIFT II project ran into trouble in mid 80's. The implementation date was delayed when it was found out that the new network control software supplied by a computer company was too complicated to handle. The project was then delayed again due to a combination of factors:

Concerns of parties wanting to make SWIFT II as reliable as possible placed a lot of demand on the development team. The functionality that the design called for was too complex for the environment. The new system was supposed to be able to allow new bank onto the system at any time of the year, instead of the current quarterly system, that posed great problems in controlling the needed updating processing. Suggestions were also made to add value to the services, SWIFT II would perform back-office processing, use expert system for message processing and bring on non-bank institution. When the eight projects that made up SWIFT II came to be integrated, they were still far from successful. The mismatch between the parts were so severe that it indicated abysmal project management effort (Murphy, 1988; 1989)

The SWIFT II debacle, a $40 million project that was 3 years overdue, illustrates some potential pitfalls in managing a big system project. First, a good appreciation of the size and complexity of the project was lacking. Expectation of the end users was also unduly built up with excessive publicity of the project. An executive of SWIFT conceded that "We wrongly changed the focus of SWIFT II from a strategic tool for new services to a visiting card demonstrating SWIFT's technical ability. As a consequence we created expectations that have come back to haunt us" (Murphy, 1988). An external factor also came into play. When SWIFT II was being designed, the company had to ensure that they comply fully with the regulations of the various European PTTs, this led to the idea of decentralized processing centers. However, this requirement added further complexity to the project.

Global system developers can learn from the experience of SWIFT. A global system adds on a lot of extra requirements compared to a organization-wide or even a national system. A good understanding of the peculiarities of legislation of each country is helpful, but most important of all, project management skill must be utilized to take on such an undertaking.

3.2 Consultative Committee on International Telegraph and Telephone (CCITT) As A Standard Setting Body

In global network projects, a standard procedural logic discipline and binding legal rules are necessary compliments to the technical equipment. However, in the arena of standard setting, things were generally being carried out in an ad hoc manner. Most existing international telecommunication arrangements were negotiated between national monopoly PTTs, mostly done without much concern of compatibility to existing standards of other countries. Quite often, telephone, data sets, switching equipment, private branch exchange and transmission equipment designed for America may not work in Europe without some modifications and vice versa. Worse still, in Europe, not only is it hard to leap over national boundaries on public networks, but transmission is often poor. Big companies and other consortium of companies and alliances had also set up their own standard, mostly for their own advantage. Others in the industry had to follow because of these companies' wide installed base, however, these followers were at a competitive disadvantage in terms of technical know-how and the control of the direction the industry is going.

Users, on the other hand, have long urged manufacturers to produce standard based systems in order to increase the connectivity of their hardware and software in which they had made substantial investment. Banks were particularly hard hit as they tried to digest the multiple systems that they inherited during the intensive period of merger and acquisition in the 80's (Swift, 1990).

After the American Telephone and Telegraph (AT&T) divestiture, some changes in the attitude and motivation can be seen among the vendors, especially among the telephone companies. Because of the increased competition in the telecommunication industry, they need to commit themselves to provide the best service at the best cost. To do so, they are vigorously seeking out the best technological sources without regard of national boundary. The incompatibility of foreign equipment can only hinder the pursuit of the best technology.

With both the United States purchasers and worldwide vendors striving for more universal recommendations on telecommunication equipment, the situation may demand the expanded role of the CCITT. It is a permanent body of the International Telecommunication Union with the aim of harmonizing the technical, operational and tariff aspects of international telecommunications services. One of its principal mechanisms is drawing up study questions for consideration by expert groups around the world who will then draft recommendations that will be submitted to the CCITT plenary assemblies for approval (Williamson, 1989).

However, in the process of defining a standard, the CCITT may encounter some problems. As in the case of the Integrated Systems Digital Network (ISDN) standard, one of these problems is the different level of development in different countries. some, like America, do not have the interest, others, like the developing world, lack the financial resources to convert or to comply. It should be mentioned that one of the unenviable tasks in standards setting is to balance the national interest of different countries.

4. Conclusion

Global data communication networks have changed the ways in which business is conducted, notably in the banking sector. With the increased flexibility that the global network provides, banks have been able to circumvent governments' attempts to regulate the financial market. Greater cooperation among nations are needed in defining a legal framework in which financial transactions can be conducted smoothly and ethically.

Although a global communication network may provide a lot of benefits to many countries, the work entailed in the development of one is phenomenal. Projects could fail because of the failure to realize the scope and the range of issues involved in the process. An excellent expertise in project management is vital. Commitment in cost, time, and personnel may also turn out to be substantial.

On the technological side, the diverging standards adopted by the national PTTs may be hindering the development of global telecommunications. With the lethargic attitude of most countries in agreeing on a worldwide protocol, development of information exchange, may it be for business, social or science, will be hindered. The burden to create industry standards falls on organizations like the CCITT. A worldwide standard will mean greater efficiency and lower cost for the consumers.

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New Multilaterally Agreed Rules For International Trade In Services

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ABSTRACT

Through the application of the Uruguay Round results, world trade in goods and in services should experience considerable growth and, consequently, restore employment and prosperity. A multilateral trading system that facilitates adjustment to change through strengthened disciplines and meaningful commitments to rules in the context of the GATT and GATS texts will reduce uncertainty, smooth the adjustment process and enhance the stimulus to economic growth from constant innovation.

The General Agreement on Tariffs and Trade - GATT - is a binding contract between 105 governments which together account for around 90 percent of world merchandise trade. The objective of the contract is to provide a secure and predictable international trading environment for the business community and a continuing process of trade liberalization on which investment, job creation and trade can thrive. In this way, the multilateral trading system contributes to economic growth and development throughout the world.

Since 1986, the GATT has been undertaking the most complex and comprehensive trade negotiations ever, the Uruguay Round. One of the objectives in the Punta del Esta Declaration that launched the Uruguay Round included the creation of a new set of multilaterally agreed rules for international trade in services, that is a new contract among governments to liberalize services trade. After more than six years of negotiations, the governments have before them a package of twenty-eight multilateral agreements in goods and in services, contained in a draft Final Act of over 400 pages. It is worth noting that among the twenty-eight agreements, agriculture counts for one and services for another.

The draft rules of the General Agreement on Trade in Services - GATS - add up to a code of orderly conduct of trade in all services, including telecommunications, transport, construction, financial, professional services and tourism.

International trade in commercial services was worth US$865 billion in 1991, and is estimated to be growing at 6 per cent per year. This figure represents reported trade between residents of one country with residents of another. But the negotiated scope of coverage of the GATS include transactions carried out by foreign corporations locally, i.e., through a commercial presence or establishment; this includes, say, an American bank establishing itself in Paris and selling services to French residents. Although no precise figures are available, GATT estimates that the coverage of GATS including transactions by foreign affiliates is probably far closer to US$2,000 billion.

Moreover, the total commercial services production potentially covered by the GATS is many times larger (perhaps US$15,000 billion worldwide). This is because the agreement contains general obligations applying to government regulation of all non-governmental services production whether provided by domestic companies or foreign ones.

The draft General Agreement on Trade in Services (GATS) consists of three elements: (1) the multi-lateral framework (or Articles of the Agreement), (2) the sectoral annexes dealing with the specificities of four sectors and (3) initial commitments to liberalize trade in services.

The first element, the Articles of the Agreement, contains two main sets of provisions. One set comprises general obligations which will be applied automatically to all services by all parties to the GATS. The most important obligation relates to the most-favoured-nation treatment (m.f.n.), under which a trade concession granted to one country, such as allowing foreign banks or telephone companies to operate locally, must be given on a non-discriminatory basis to all parties to the GATS.

Other obligations of a general and automatic application relate to (1) measures to improve transparency, (2) disciplines regarding the implementation of domestic regulations, (3) measures facilitating recognition of standards and qualifications, (4) disciplines on monopolies and restrictive business practices, and (5) measures to prohibit restrictions on payments and transfers. In addition, development-related provisions throughout the GATS provide for the increasing participation of developing countries in world traded services and appropriate flexibility is allowed for individual developing countries in the process of liberalization.

The second set of specific obligations of a negotiated (as opposed to a general and automatic) application provided in the GATS relates to market access and national treatment. These obligations are not applied to all services sectors, but are agreed upon through bilateral negotiations, with the implications that governments can apply limitations on how these obligations are implemented. Concretely, this GATS approach means that access to a foreign market and the ability to compete on an equal footing in that market (which are a bilaterally negotiated process) will be realized only where specific commitments are undertaken by individual parties to the GATS.

Ultimately, the results of these bilaterally negotiated liberalization undertakings with respect to market access and national treatment will be extended to other parties to the GATS through the application of the m.f.n. treatment. Remaining provision in the GATS deal with institutional and final provisions, including a dispute settlement mechanism.

The second element of the GATS relates to the sectoral annexes, the aim of which is to clarify, interpret or qualify the application of the GATS provisions in the light of four sectoral peculiarities in telecommunications, financial and air transport services, and on the movement of personnel supplying a service.

The Telecommunications Services Annex substantially relates to the question of providing access to and use of public telecommunications network services. The Financial Services Annex recognizes inter alia the right to keep or introduce discriminatory measures for prudential reasons. These reasons include the protection of investors, depositors, policy holders or persons to whom a fiduciary duty is owed by a financial service supplier. The Air Transport Services Annex, which exempts traffic rights, relates essentially to the questions of aircraft repair and maintenance, selling or marketing of air transport and computer reservation services. The Movement of Personnel Annex essentially provides for the member countries to negotiate specific commitments on the movement of all categories of natural persons providing a service.

The third element of the GATS relates to the package of "offers concerning initial commitments" negotiated among the parties to the GATS, that is the opening of new business opportunities to be agreed in bilateral negotiations. This means essentially that countries undertake to maintain or improve current levels of openness of market access and operating conditions in their markets. Today, sixty-seven countries accounting for over 90 per cent of world traded services have offered to liberalize in major services sectors. Other smaller countries are in the process of circulating their offers. The extent of liberalization of world traded services that will follow from the Uruguay Round, however, will depend not only on the initial commitments, but also on the extent to which parties to the GATS will seek exemptions from the m.f.n. obligation. The rules in the GATS would have little operational value in the absence of substantive commitments to liberalize world traded services on the part of all signatories. And in the final analysis, the question of time - bound exemptions from the m.f.n. requirements of the GATS is one which has to be accommodated without compromising the basic GATS itself. This is a very delicate issue and the final commercial value of the GATS will, to a large extent, be determined by how this question is resolved.

Subsequent negotiations will be directed to the further reduction or elimination of services trade restrictions. The benefits of the GATS are that there can be no discrimination in world traded services between countries signing the Agreement and between national and foreign services suppliers.

Essentially, the results of the Round can be divided into four different kinds of trade accord which together form a cohesive global package. First there are market-opening measures like tariff concessions, the traditional business of the GATT. Second, there are agreements which seek to strengthen the rules of the General Agreement on Tariffs and Trade. Into this category can be put stronger anti-dumping and subsidies rules but also trade in textiles - which has been subject to a negotiated market-sharing arrangement in the GATT for the past 20 years - and trade in agriculture which has been subject to loose and partly-ineffective GATT rules.

The third element in the package are agreements on new sectors of economic activity not previously covered by GATT - notably, trade in services and trade-related aspects of intellectual property protection. Finally, there are understandings on institutional matters; in particular, improvements to the dispute-settlement system and the establishment of a new Multilateral Trade Organization.

With the exception of the results of the tariff negotiations and the rather similar liberalization commitments for trade in services, largely-agreed draft texts on every one of these elements were tabled, last December, by GATT Director-General, Arthur Dunkel, in the so-called Draft Final Act of the Uruguay Round. This remains the only negotiating document at the multilateral level.

Opening markets

The aim is to bring the average level of tariffs (customs duties) down by more than 30 per cent. After seven previous trade rounds they are already low - around 5 per cent for the main industrial countries. However, some high tariffs remain. It is expected that some industrial sectors will see import tariffs abolished altogether, while many developing countries should secure significant market-access improvements for tropical products and natural resource-based products. And not only will tariffs fall, many other kinds of border restrictions - import quotas, for instance - will be wholly or partly liberalized.

Re-writing the rules

Many of GATT's rules are concerned with ensuring fair competition within markets and between markets. Thus, agreements resulting from the Uruguay Round will include new rules on anti-dumping measures, new disciplines on the use of subsidies and the countervailing duties which can be used to offset their effects, a comprehensive agreement on emergency import control measures where industries are under real threat from competition, and a new code on the way in which the origin of imports are determined by customs authorities. Many other rules of the original General Agreement on Tariffs and Trade will also be clarified and improved.

The last big trade round, the Tokyo Round, resulted in a series of agreements on non-tariff measures. Most of these agreements will be expanded and improved in the Uruguay Round. In particular, the agreement on government procurement will be extended to subject billions of dollars of extra government business to international competition.

The Uruguay Round will also lead to new disciplines on national investments regulations which distort trade.

Bringing textiles and clothing trade back to the real GATT

The textiles and clothing sector has been governed by a system of quota controls - affecting the exports of developing countries to industrial countries - for more than 30 years. The Multifibre Arrangement which provides the current framework for the system has been in place since 1974. The Uruguay Round may be expected to lead to the progressive phasing out of the MFA, and other similar restrictions, over a period of probably ten years.

This does not mean that trade in textiles and clothing will be completely free. It does mean that the same rules will ultimately apply as apply to other sectors.

Fairness for farm trade

The draft agreement on trade in agriculture has four components. The first three represent a programme of commitments for reform which will lead to substantial changes in policies but very gradual changes in effective support for farmers.

The first element is a commitment to reduce domestic support for agriculture - and, in particular, to shift that support from payments related to production to direct income support for farmers. The second, will require a gradual reduction in the level of border controls on agricultural imports - with current non-tariff barriers being "tariffied" to ensure transparency and predictability. The third element sets commitments to reduce both the national budgetary expenditure on subsidized farm exports and the actual volume of such subsidized exports.

A fourth part of the agricultural deal will be an agreement on the use of regulations related to animal and plant health and safety standards. This should result in an overall improvement and some harmonization in the use of such standards while ensuring they are not used as arbitrary and unjustified barriers to trade.

Trading creativity and invention

The intellectual property protection covers matters like patents, copyright, trademarks, integrated circuit layouts, trade secrets, geographical indications and appellations of origin. The Uruguay

Round agreement on intellectual property will create or reinforce jointly agreed standards of protection in all these areas. It will apply GATT principles, like non-discrimination, equality of treatment and transparency, to that protection.

Other important aspects of the "TRIPS" deal include provisions to enhance the enforcement of intellectual property rights at the national level and the establishment of an international system of dispute settlement.

Among other things, the agreement will give governments a much be ter opportunity to combat trade in counterfeit goods.

Reforming the institution of GATT

There are three major institutional agreements in the final package. The first seeks to streamline and give more teeth to the dispute-settlement procedure. Some reforms have already been introduced during the Round, but a final package should provide even clearer timetables and deadlines, ensure more automaticity in the process (thus, preventing blockages), and improve the implementation of adopted dispute panel reports.

The Trade Policy Review Mechanism was introduced into the GATT on a provisional basis in 1989 and should be confirmed at the end of the Round. For the first time, it has permitted the GATT to undertake comprehensive, detailed reviews of the trade policies of individual members. Thirty reviews have already been completed.

Finally, a new Multilateral Trade Organization is envisaged to provide the institutional framework for the implementation of all the Uruguay Round results. Thus, it will subsume the GATT (including the various non-tariff agreements of the Tokyo Round) as well as taking under its wing the agreement on intellectual property and that on services. It is also expected to operate an integrated dispute-settlement system.

At the last meeting of the Trade Negotiations Committee, on 26 November 1992, Arthur Dunkel has proposed that governments agree that substantive negotiations in Geneva be re-activated with a view to achieving a successful political conclusion of the Uruguay Round before the end of 1992, in the light of the understanding reached between the United States and in the Commission of the European Comities and basing himself also on intensive consultations he had carried out with participants in the Uruguay Round.

The early 1992 four-track approach remains valid as to the overall strategy for concluding these negotiations: 1) negotiations on market access, (2) negotiations on initial commitments in services, (3) legal coherence of the Final Act, and (4) adjustment of the package in certain places. Two basic concepts underpin this approach: (1) the concept of globality imposing inter-linkages between each of the four tracks and parallelism among them, and (2) the concept that nothing is final until everything is settled.

A. Dunkel recognized that it would not be possible to formally conclude the process in the next weeks regarding the negotiations on market and on initial commitments in services. However, this should not prevent participants from moving rapidly to a stage where the overall shape, content and value of the trade liberalization package in goods and services could be clearly assessed.

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This paper is strictly personal and does not commit the GATT in any way.

A COMPARATIVE ANALYSIS OF GOVERNANCE COSTS FOR INFORMATION TECHNOLOGY

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1. ABSTRACT

A few countries, notably France and Singapore, pioneered in developing information technology (I.T.) policy to support their national development goals. Other countries, at many different stages of development, followed. In late 1991, the interim government of Anand Panyarachum reviewed I.T. policy in Thailand. The authors identify governance costs as a form of transaction costs, propose a dynamic model, and apply it to compare the effects of policy options in Thailand.

2. INTRODUCTION

This paper identifies an emerging need for Thailand to shift its approach to formulating its national information technology (I.T.) policies which guide the acquisition, development, and use of computers and telecommunications. This need reflects an increasingly poor fit between a traditional approach to development planning and an evolving social and economic context following its rapid development. While it is a temptation to imitate success, and Thailand can learn from the I.T. policies of nations such as Singapore [1], the authors argue that both I.T. policy and its formulation process in the two nations must reflect sharp differences between their contexts.

3. APPROACHES TO FORMULATING I.T. POLICY

This section addresses two questions. First, how do we discover which features of a specific approach to formulating I.T. policies determine its usefulness in the national context? Second, how do these approaches resolve conflicting needs for rational management of complex technology and for timely responses to unstable external events?

Technology is a dynamic resource. When national resources are scarce, the planners who shape national I.T. policy often do so with little input from stakeholders in industry. As I.T. use diffuses, public and private dependence on I.T. rises, and I.T. and other policies become tightly coupled. And as external turbulence increases, the national I.T. policy response to business and other interests accelerates [2]. These linkages are confirmed by a contingent model of I.T. policy formulation, which is derived from a substantive theory of I.T. planning grounded in field research in Asia and North America [3]. Its extension here to the policy arena follows a trend to adapt practices drawn from corporate strategy to the task of formulating national policies to gain and sustain international competitive advantage [4].

An approach to formulating I.T. policy is a system for decision making, with technical and behavioral features which (to varying degrees) fit the demands of specific contexts. The task of formulating I.T. policy reflects complexity, variety, and uncertainty in the environment [5]. Formulating technology policy demands knowledge of the forces acting on enterprises within the nation's industries. At the level of the firm, the focus is on production, the organization of inter-relationships between physical activities and information flows in its "value systems" [6].

Each approach is a unique pattern of activity designed to integrate diverse values and interests in policy choices within a specific context. Each context varies as to turbulence in the environment and stakeholder interests in I.T. policy choices.

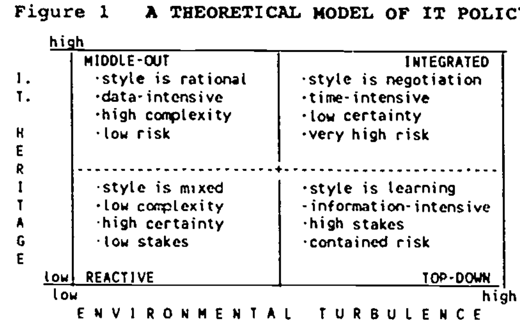
3.1. Environmental Turbulence

Environmental Turbulence [7] represents the dynamic effects of exogenous change on demands for information. Turbulence results from change in the global economic and legal context (e.g., requirements for environmentally safe products). Other sources include change in global markets (competitors, consumer preferences, or shifts in bargaining power) affecting demand for its goods, shifts in the core technology for its critical industries (in auto parts manufacturing, to EDI), or changes in industry scope and scale due to rapid exits or entries of firms into its markets. A final factor is abrupt change in the boundaries of these markets due to economic treaties (NAFTA) or the emergence of new nations (Eastern Europe).

3.2. I.T. Heritage

The "I.T. Heritage [8]" describes a nation's current ability to expand automation or redirect information flows in its industries. It includes access to technology such as computers, networks, and systems software. Human resources to plan, manage, develop, or operate I.T.-based innovations are essential. The national inventory of current types of I.T. applications is the base for further diffusion. The appropriateness of current policy governing acquisition and use of I.T. (e.g., its public tendering traditions, intellectual property and liability laws, etc.) and public support for (or opposition to) I.T. use are subtler factors.

Figure 1 A THEORETICAL MODEL OF IT POLICY



3.3. The fit between context and approach.

The model in Figure 1 defines the context for I.T. policy as a function of these two variables. It models the hypothetical relationship between the decision context and four generic approaches (Middle-out, Reactive, Top-Down, and Integrated). The model suggests that while Top-down planning may succeed in turbulent contexts, it will become ineffective as dependence on I.T. increases [9].

Technology and technical change drive the economic structure of production, generating new opportunities for trade, increasing international competitiveness, and accelerating national income growth. Economic development applies technology to efficient use of available resources, expands the available range of goods and services, and ultimately affects stakeholders in development.

4. I.T. AND TELECOMMUNICATIONS POLICIES

Computers and telecommunications are critical to international competitiveness for countries as well as firms. The development success stories of the last two decades portray building capacity to absorb modern technology and integrating it fully into production and service sectors. Successes followed policies which defined clear goals, and channeled scarce resources toward those targets.

4.1. The Dynamics of the Thai I.T. Policy Context

The need for a new approach to I.T. policy formulation stems partly from changing national aspirations geared to economic restructuring. This will rapidly lead the nation toward increased dependence on its computer and telecommunications-based I.T. services. The urgency of this need for change reflects a pattern of lagging development in I.T. capacity and capability (especially in its critical telecommunications sector), shifts in the economic development roles of the public and private sectors, and an approach to policy making which may exclude future stakeholders.

4.1.1. A new role as a regional economic hub.

For many decades, South East Asia was a leading source of agricultural products to the region and the world. However, now the role of agriculture as the leading sector in South East Asian development is in decline. The Asian NIEs succeeded by adopting economic policies to promote industry and services as leading sectors. Most countries in the region seek to transform their economies in this manner. Thailand also sees an opportunity to become a regional economic hub.

Three factors enhance its claim to this role: First, its **geographic location** in the Indochina Peninsula, surrounded by high population density countries, is suitable for a business centre. Second, Thailand's fairly large and **diversified production base** in all sectors, combined with its domestic market size (about US $ 56 million). More significant is the GNP per capita of about 1,400 US dollars, an indicator of consumer purchasing power. Third, its **open economy and society**, characterized by a free market economy, political support for the leading role of the private sector, fiscal discipline, and sound macro-economic policy. These modern management factors blend with a dynamic tradition as an assimilative and racially harmonious society.

However, Thailand faces increased competition on two fronts in international trade. Buyers in developed economies are moving to technologically sophisticated, higher value-added, higher quality, and differentiated products. Automated methods of producing labor-intensive products (now exported by Thailand) may restore the comparative advantage lost by OECD economies. Technological advances in new materials may reduce demand for Thailand's traditional natural resource-based commodity exports. Meanwhile, some less developed nations offer cheaper labor, are now more export oriented, and compete far more intensively in these markets.

4.1.2. Thailand's structural transformation.

The structural transformation of the Thai economy over the past two decades reveals four key trends: accelerating production transformation, a more diversified economic structure, reorientation from import substitution to export for production, and steady shifts in the roles of the government and the private sector in national development.

Structural shifts from agriculture to industry and services reflects **production transformation.** The agricultural share of GDP fell by half, from 25 percent in 1975 to about 12 percent by 1990. The manufacturing share of GDP rose from 20 to 26 percent [10]. The trend to globalize manufacturing operations, along with increasingly time-based competitive practices [11], will increase the dependence of this sector on I.T. capabilities.

A **more diversified economic structure** results from more varied agriculture production, enabling exports of non-traditional agricultural products (such as fruits, vegetables, and flowers) and from higher value-added products. Dramatic structural changes in industry shifted output from resource-intensive to labor-intensive activities. This demonstrated the flexibility of Thai enterprises and their ability to exploit emerging comparative advantages. In services, wide-ranging financial liberalization and deregulation measures (e.g., interest rate and exchange control liberalization, promote Thailand as a regional financial center. Establishment of the Bangkok International Banking (BIBF) offshore banking facility places Thai banking on an equal footing in terms of tax and regulation to other world financial centers. All such information-intensive business services are increasingly dependent on their I.T. capabilities.

Manufactured exports, whose share of total exports rose from 36 percent in 1981 to 74 percent in 1990, reflect a **shift from import substitution to export orientation**, and an increasingly open and international Thai economy [12]. The economic efficiency of any trading enterprise is intimately linked with its ability to acquire and disseminate information through telecommunications services.

4.1.3. Shifting national development role of the government and the private sector.

The socialist regimes are learning that market economies process and transmit more information than do their centrally planned counterparts. An efficient market minimizes information asymmetries to reduce transaction costs. Thailand's public sector was the prime mover for its development over the 25 years to 1990. During the Sixth Plan, government transformed its role from controller and regulator of economic activity to promoter and facilitator: private interests assumed the lead.

Its policies since May 1990 focus on boosting free competition in the country's economic system, on liberalizing foreign exchange, developing foreign currency markets, floating domestic interest rates and oil prices, and liberalizing trade policies.

4.1.4. Inadequate telecommunications services

Telecommunications capacity is inadequate. Public agencies monopolize delivery of most Thai telecommunication services. Constraints on public investment force these agencies to rely largely on foreign borrowing to fund new capacity. The private sector, hampered by legal constraints, rigid rules and regulations, and complicated operating procedures, cannot readily invest in service provision. The weak investment climate delays much-needed new capacity, and thus slows development of those sectors of the economy dependent on telecommunications services.

Telecommunications service quality fails to meet current needs. These needs (e.g., efficient and effective international communication systems) evolved in response to rapid economic development and technological progress. At a policy level, no central body coordinates individual networks into a national system. At a service delivery level, the Communications Authority of Thailand (CAT) and the Telephone Organization of Thailand (TOT) have poor coordination, overlapping responsibilities, and duplicated services, yet do not compete [13].

Telecommunications pricing in Thailand is neither flexible, responsive, nor economically efficient. Pricing is a political decision, unrelated to production costs. Despite rapid demand growth, certain communications services are subsidized. Also, the quantity and quality of personnel in charge of basic service delivery are inadequate, especially engineers, technicians, and administrators. This human resource shortage hinders service expansion and new development.

4.2. Development Planning in Thailand

While all six national development plans issued by the Thai Government between 1961 and today focus on different issues, each results from the central planning process administered by the National Economic and Social Development Board.

The First Plan (1961-1966) promoted private investment, emphasizing industries using domestic raw materials or substituting for imports. This plan restricted new manufacturing activities by public enterprises. The government focused public investment on infrastructure, especially to develop transportation and power capacity.

The Second Plan (1967-1971) continued the basic emphasis of the first plan. Main additions included promoting employment-generating industries, encouraging joint ventures between Thai and foreign investors, and supporting small-scale cottage industries.

The Third Plan (1972-1976) emphasized correcting the balance-of-payments difficulties. It promoted exports through duty exemptions and tax breaks. Equity issues received attention, such as "investment promotion zones" outside Bangkok. The government encouraged links between agriculture and industry and promoted its labor intensive, small scale industry in rural areas.

The Fourth Plan (1977-1981) expanded these themes. The trade regime remained protectionist, promoted inward investment, and supported exports via fiscal incentives, guarantees, and subsidized loans. The Export Service Center, which assisted exporters with marketing and disseminated product information in overseas markets, was a key Thai institutional development.

The Fifth Plan (1982-1986) focused on restructuring existing industries, and creating new industries that would be more efficient and competitive in foreign and domestic markets. The government intended to promote export industries by improving incentives and removing various obstacles to exports, and to promote small-scale industries and industrial decentralization. It presented plans to decentralize industrial development, develop basic industries, and to set up a system to develop basic industries related to domestic resources. This was also the first plan to emphasize telecommunications services.

The Sixth Plan (1987-1991) continued along the path toward modernization, emphasizing export promotion, marketing, efficiency and productivity, raising standards of quality in production, while improving industrial technology. Policies were for the first time revised in mid-plan, to address trade and current account deficits and a widening savings-investment gap. Budget for infrastructure increased as a result of this 1989-1991 review.

The Seventh Plan (1992-1996) will seek to overcome constraints to future development, by expanding basic services, capital mobilization, and rewriting obsolete rules [14]. This plan will ease constraints and restructure national tax, financial, and capital market systems for international competitiveness. The government will continue its liberalization policies to facilitate the leading role of private business operations in industrial development and foreign investment. Protection of domestic industry will decrease. The plan proposes measures to raise productivity and the quality of export products to enhance the competitiveness of Thai industries.

Policy support for technology transfer is a recent dimension of Thai development planning. The Seventh Plan hopes to lay a foundation for the basic scientific development needed to absorb, adapt and apply imported technologies. To support competition by its private sector in international markets, the plan relaxes rules and regulations for greater flexibility and to encourage inward flows of technology and capital. It encourages private sector participation on the basis of joint investment in state enterprises. Not all of these changes can be concurrent. Thus, one key task for I.T. policy planning and for the subsequent implementation process is to mediate the dialogue between the future stakeholders in these changes. This is essential for I.T. policy in general, but critical for its telecommunications element.

4.3. Role of Computers and Telecommunications

The computing and telecommunications elements of I.T. work together. However, each plays its own unique role and presents different challenges for development. The private sector meets nearly all demand for computers and software to process information. Vendors differentiate their larger computer systems (which are expensive for the work they do) to high value-added types of applications (e.g., running a manufacturing, bank, or airline database). Minicomputer systems for general use are differentiated mainly by software and are more economical. A retail commodity, microcomputers generate strong public demand for complementary products, particularly for software and training in local languages. The low cost of computing hardware, the ease of access to commodity software, and the presence of a growing computer industry in Thailand enabled a rapid increase in national computing capacity.

In contrast, only state enterprises (with few exceptions [15]) now operate communications services in Thailand. Although telecommunications infrastructure is a prerequisite to developing other sectors of the economy, Thailand finds it difficult to add services or increase capacity. Also, a lack of provider coordination leads to incompatibility and non-interoperability problems, such as the lack of a Thai language standard [16].

5. A TRANSACTION COSTS PERSPECTIVE OF GOVERNANCE

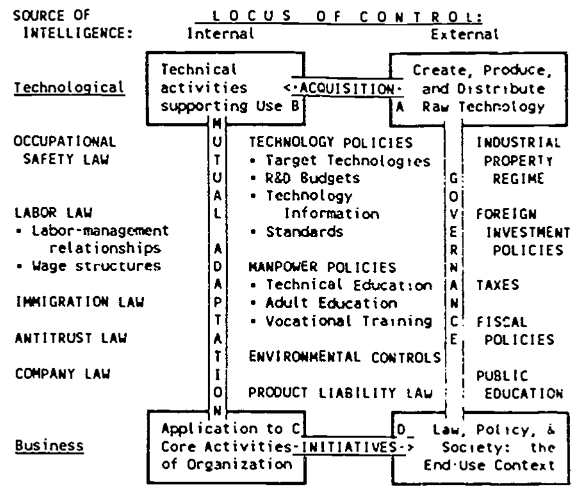
A nation's ability to compete for income and investment rests largely on the efficiency and effectiveness of private organizations operating within its borders [17]. Natural endowments or other assets which are immobile across national boundaries are not a primary source of economic advantage in a global economy. Organizations add value to location-specific resources, and their competitive advantages stem from effective use of endogenous and exogenous resources to reach goals. Policies to build sustainable national advantage must raise the long-term value of the nation's human and organizational assets, while reducing non-productive costs associated with their use.

Strategy theorists identify six sources of transaction costs: 1. Bounded Rationality (the limited organizational capacity to acquire, process, and use information); 2. Opportunism (self-seeking behavior combined with guile); 3. Complexity and Uncertainty; 4. Small Numbers Relationships (as in monopoly and oligopoly); 5. Information Impactedness (the distribution asymmetry of knowledge); and 6. Asset specificity (to the requirements of a specific transaction). The sources of transaction costs are various difficulties present in the exchange process [18].

Governments influence transaction costs for technology transfers. Well-designed institutions and organizations enhance individual capacity to process information. Government technology policy can reduce the uncertainty specific to technology transactions [19]. It may also influence the ethical and legal standards for transactions. Government agencies can improve the distribution symmetry of knowledge about the availability, performance, and terms of trade for technology.

The systems-based Control-Intelligence model [20] in Figure 2 maps transaction costs into static and dynamic activity types for an I.T. innovation cycle. Intelligence [21] refers to sources of information for technology transfer decisions, while the Locus of Control [22] identifies decision domains. The two constructs bound the four cells containing behavior affected by technology policy:

Figure 2: the Control-Intelligence Model



The C-I model differentiates between static and dynamic activities in the I.T. innovation cycle. Activity within a single cell (e.g., as computer operations in cell B, or marketing in cell C) influences system performance, but not its state. Technology transfer or other state changes are the dynamic activities on paths between cells. ACQUISITION (technology scanning, selection and transfer, between cells A and B) is a transaction between source and receiver. Design and use of information technology requires MUTUAL ADAPTATION [23] between technological (cell B) and core business (cell C) activities. INITIATIVES must alter organizational relationships with external entities such as end users or suppliers [24] to generate strategic benefits. This involves transactions between cells C and D. GOVERNANCE meditates power relationships between entities. Cross-domain activities generate transaction costs for exchanges with external entities [25], for internal integration activity [26], and for governance activities, as mapped to the model in Figure 2. The next section applies the model to analyze how I.T. policy (Governance) influences transaction costs for I.T. Acquisition, Mutual Adaptation, and Initiatives in Thailand.

5.1. ACQUISITION AND GOVERNANCE COSTS

Technology acquisition involves searching for appropriate solutions and sources, negotiating to reach terms of transfer favorable to both parties, and completing legal and financial aspects of the transaction. Government may provide or encourage services to improve the efficiency of technology transfer activities. Several governments in the Asia-Pacific region collect and offer information about available technology, and a few offer other services to assist organizations operating within their borders to acquire and use new technology.

5.1.1. Reducing Technology Acquisition Costs

As its capability to develop technology is limited, Thailand must continue to import various forms of technology. Large-scale industries and state enterprises, import equipment and materials, and rely on high technology from overseas. They have the capacity to acquire technology, but may not recognize the need to build local capability to select, acquire, and absorb new technologies. Small and medium-scale Thai enterprises (SME) often have weak capital resources, poor access to technology information, and inadequate bargaining skills. These factors raise transaction costs for acquiring new technology to unacceptable levels.

5.1.2. Reducing search and transfer costs

Thailand has several programs which provide technology information. The services include the Department of Science Services (DOSS) providing library services for public and private users, the information section of TISTR catering to researchers, the Thai-Japan Technical Promotion Association (TPA) supplying practical engineering information to the manufacturing sector, the Thailand Industrial Standards Institute (TISI) disseminating information on international standardization activities, and a few specialised information units such as the Metalworking and Machinery Industries Development Institute (MIDI) and the MOSTE Technology Transfer Center. A few private organizations, such as Siam Cement, have organized internal technology information centres.

It may be necessary to differentiate services to specific industries and to their levels of industrial development, as technology cost and performance depend largely on the context for use. The effectiveness of current Thai efforts is unclear. Few services are comprehensive, and as most sources are passive holders of information, the information may not be current. This is a serious problem, as the features of a technology and the performance of sources change over time.

5.1.3. Subsidies for consulting services

Another intervention, used in Singapore with some success, is to subsidize consulting services which offset the information asymmetries inherent in technology transfer. The Singapore Economic Development Board reimbursed SMEs for up to ninety percent of their cost to engage a consultant to assist in I.T. planning and acquisition. Thailand promotes I.T. use by small and medium enterprises through the Technology Transfer Center (TTC) of MOSTE and the University-based Unisearch. TTC provides receivers information about sources, but not about the technical or legal implications of transfer. Unisearch will act as a match maker to link the private sector with consulting firms. The parties to transfer pay all consulting fees.

5.1.4 Concessions to technology sources

A government desiring local market access to a specific technology may find the foreign source unwilling to commit the assets necessary to bring in the technology. The Singapore TradeNet case demonstrates that it may be possible to negotiate even with a powerful source (IBM) [27].

5.1.5. Supervising and monitoring sources

A government may choose to protect local firms from opportunism, or to raise the standard of the local technology market. Singapore, acting through its National Computer Board Industry Development Programme, took the latter course. Thailand relies on supervision to reduce buyer transaction costs. Its TTC and Science and Technology Development Board (STDB) support the private sector by supervising and monitoring technology sources, and by assisting local firms to acquire foreign technologies.

5.1.6. Technology planning services in context

Organizations engage external consultants to assist in planning. Consultants should develop a full range of planning methodologies, then use a diagnostic tool to ensure a good fit between methodology and the client context. In 1992, the National Science and Technology Development Agency (NSTDA) set up the industrial Consultancy and Technology Development Services program to help small and medium sized industrial enterprises improve productivity and upgrade product quality. NSTDA offers a range of services from management advice to technology research and development. The NSTDA budget absorbs the major program cost.

The STDB Diagnostic Research Design Service (DRDS) assists industrial firms in identifying production problems and serves as a mechanism to link consulting services, research organizations and other STDB activities with producers. This fundamentally important program has been delayed by start-up problems. The Support for Technology Acquisition and Mastery Program (STAMP) provides technical, managerial, information and financial support to Thai industrial firms to build their expertise and experience in the acquisition and assimilation of technologies important for their continued success and growth. This program has been praised by some external review missions [28]. However, its coverage and linkage to other programs was still limited.

5.1.7. Technology demonstrations and comparisons

Demonstrations effectively convey tacit information. Comparisons demonstrate the relative performance of alternative choices, and clarify the needs and preferences of receivers. The MOSTE CAD-CAM Centre, equipped with several sets of computers, plotters, graphics tablets and other specialized tools, is a facility designed to encourage demonstrations. Vendors may use the MOSTE centre to display their CAD-CAM software and peripheral devices, and also to train customers.

5.1.8. Renting technology for short-term trails

According to the theory, renting reduces information asymmetry and leads to a more gradual transfer of assets from source to receiver. In practice, renting or leasing is inefficient when costs for technology installation and adaptation are high, if local capability to assess, select, adapt and improve technology are weak, or when it will increase other transaction costs (e.g., where provisions for protecting the property rights of the source are inadequate). In the Thai case, the inadequacy of intellectual property laws inhibits the ability of sources to offer short-term trials.

5.1.9. Training receivers in negotiations

Receivers are able to specify the desired outcome. They may be unable to negotiate effectively with more experienced teams representing the interests of the multinational companies which are the source of information technology. Receivers can acquire fundamental negotiations theory and technique in properly designed training courses. The Technology Transfer center at the Ministry of Science, Technology and Environment offers basic training in negotiations. Few Thai universities include courses on negotiations in their curricula while even fewer Thai law schools offer in-service training to practicing members of the bar, or to managers.

5.1.10. Supporting receiver procurements

For many international technology transfers, skills gaps between technology source and receiver are wide. While a receiver may acquire foreign technology only once, sources often have extensive operating experience in overseas markets. Few of the foreign firms operating in Thailand actively transfer technology to local firms or build local supplier skills. They have been less active than expected in providing technical assistance to receivers. Language is also a barrier. A recent study of several international transfers involving South East Asian receivers and OECD sources found English to be the language for technology transfer negotiations and legal agreements in every case. This implies transaction costs may be higher (because of misunderstandings and failure to optimize negotiations) when local lawyers do not receive legal training in the English language.

5.2. INTEGRATION AND GOVERNANCE COSTS

Government can help receivers reduce cost of use in two ways: supporting increased efficiency (disseminating methods to consume fewer resources or improve the effectiveness of their use), or by assisting the reciever to allocate its use of resources to a wider set of uses or users. Also, a policy which shifts integration costs out and benefits forward may support innovation, as many costs for using technology are immediate, while the stream of benefits emerges more gradually.

5.2.1. Subsidies for training and education

Informed buyers are the basis of an efficient technology market, while trained users enable the effective use of technology following acquisition. Public subsidies for training in new technologies are justified because many of the resulting benefits are public. Thailand urgently needs foreign expertise to rapidly strengthen its S&T manpower development. Thailand is beginning to involve the private sector in strengthening higher education institutions, short courses, and in-service training programs, and to improve on-the-job training for technical employees. Current efforts to develop new technical universities receive support from the Federation of Thai Industries (FTI) and the Board of Investment (BOI). The King Mongkut Institute of Technology established specialized training programs for industry and has explored the possibility of setting up foreign-assisted training institutes. MOSTE national centers offer specialised technical training courses. These efforts will not fully meet the steadily growing demand for industrial skills, and are not focused on building the skills critical to developing the national I.T. Heritage.

5.2.2. Low interest loans for innovators

A government may reduce transaction costs for receivers by offering low-interest loans to help target firms acquire specific technologies. Most incentives in Thailand, such as the Technology Transfer Center's Revolving Fund (MOSTE) and the newly established Industrial Finance Corporation of Thailand (IFCT) program, focus on research and development. Since 1989, the Board of Investment (BOI) has allowed firms to bring in machinery and equipment tax-free for research and development use. A major problem is a lack of awareness among small and medium-sized local firms of the need for in-house technological research and development, partly due-to the current industrial structure and a lack of local competition. Usually, such firms lack the in-house capabilities needed to perform development. Therefore, efforts to raise the technological awareness of local firms and stimulate them to undertake research will not be successful without other technological upgrading efforts foreign technology assimilation, quality management and in-service training.

5.2.3. Aligning Taxes with Technology Needs

The Thai personal computer industry, hampered by tariffs on components which were higher than on complete systems, flourished only because many builders smuggled in components. In effect, the policy discouraged local firms from learning to build computer systems from a mixture of local and imported components, inhibiting the transfer of technology. The government recently reduced import duties and taxes on computers to promote computers use in business and industry.

5.2.4. Building technology management skills

The field research suggested that external advisory services which build internal capacity to implement and manage technology are superior to those which simply solve technical problems. The more successful institutions seem to be industry-focused centers which provide information on sources of technology, quality, prices, purchase conditions, and which may also provide advice and disseminate knowledge about evaluating, selecting, and negotiating for technology.

5.2.5. Adapting technology to local conditions

Technology must fit the specific environment in which it is used. As both the environment and the technology are dynamic, a developing country's technology strategy must facilitate the cheap and effective acquisition of foreign technology and its adaptation to local conditions. The enabling technology in the case of information technology is computer software. It is software that allows us to use a general purpose microcomputer for a specific task and that provides a local language interface for non-English speakers. It follows that a critical target for I.T. policy is to build up the stock of programmers and systems analysts who will adapt I.T. to the local context.

Because hardware is a commodity, the ability to produce it represents a market opportunity rather than a development goal. In Thailand, few private firms do R&D, and the R&D infrastructure consists mainly of publicly supported university and government laboratories. Given its scarcity of scientists, Thailand might focus its short-term efforts on acquiring foreign technology relevant to its conditions, then on using and diffusing it efficiently. That means giving a high priority to focus resources on acquiring, using, and diffusing foreign I.T. hardware, versus local development. As technology is dynamic and constantly changing, Thailand must also strengthen local capabilities to assess, select, adapt, and improve technology.

5.2.6. Pooling infrastructure for scale economies

To improve services offered to travel agents through their computerized passenger reservations systems, several Southeast Asian airlines formed a joint venture to share scarce management and technical skills, amortize the more than $200 billion dollar cost of developing software over a larger base, and spread the fixed costs of running the core computer system and telecommunications network. However, internal pressures forced Thai International to abandon the Abacus consortium, with negative effects on its market presence [29].

Thailand's Customs Department will soon launch a pilot Electronic Data Interchange (EDI) project to automate Customs procedures. Application level standards are a basic but critical requirement for successful EDI. Because all international trade participants are handling essentially the same data types (names, addresses, dates, places, quantities, etc.), it is mandatory to specify standards for shared data. Failure to organize a preliminary project to clarify such issues between the stakeholders will limit the long-term value of any EDI-based infrastructure project.

5.3. INITIATIVES AND GOVERNANCE COSTS

The transaction costs issues here are straightforward. The information asymmetries inherent in technology transfer deter innovation. I.T.-based initiatives include product-imbedded (a microprocessor to prevent toast from burning or the front wheel of a motorcycle from locking), and organization-imbedded I.T. (a network to link economic activities). The focus of this paper is on the latter application type, which has greater immediate relevance in the policy arena.

5.3.1. mediating industrial property rights

Receivers are often unable to determine the value of a new technology until it is in place. Ideally, local firms should be able to experiment with new technology without making a long-term commitment. However, opportunism comes into play. Much technological content is tacit in nature, and exposure to an advances technology often leads to an irreversible transfer. Sources are reluctant to lose their property rights in technology, which are the basis of their income. Sources will not enter local technology markets if the legal regime provides inadequate protection. A property rights regime in the public interest must balance the need of sources with those of receivers over time.

Intellectual property is protected through patents, trademark, copyrights, and trade secrets. Thailand is not party to any international patent convention, while the Thai intellectual property regime does not adequately protect foreign owners of technology. Patent protection is available only to nationals of Thailand or of countries with which Thailand has reciprocal agreements regarding patents. If granted a patent outside of Thailand, an invention is unpatentable, and foreign patents, inventions, and designs do not receive protection in Thailand. The Copyright Act of 1978 does not specifically protect computer software [30].

Thailand does not have special laws to protect trade secrets, the propriety, secret, often tacit information related to the way firms manufacture products, organize production, or attain quality. This reduces incentives for producers to invest in technological improvement. For Thailand, the absence of adequate legal protection for trade secrets may be more important than the absence of patent protection over the near term.

5.3.2. Public campaigns to increase acceptance

The Singapore case clearly demonstrates the potential of propaganda as a tool to accelerate the diffusion of computers and telecommunications hardware to organizations, personal computers to households, and I.T.-based skills to individuals. Although Singapore is unique in many aspects, Thailand could adapt such tactics to increase public acceptance of I.T. in their local context. This might be an effective tactic to accelerate the pattern of I.T. use in the public sector.

5.3.3. Setting (and enforcing) product and process standards

Many government organisations in Thailand engage in standards, testing, and quality control [31]. In theory, standards decrease uncertainty and minimize transaction costs, and thus help diffuse technology. However, empirical evidence also suggests that standards may either encourage or block innovation [32]. Thailand, to meet the increasing quality demanded by its international markets, must gear the national system of norms, standards testing, metrology, and quality control to its industrial policy. Establishing a well integrated system is a high priority. Although this will be expensive, Thailand can most likely receive financial and technical assistance from international donors. Thailand must develop a clear policy framework to organize the functions of this standards system to meet its industrial development needs.

Some progress is evident. The Standards, Testing and Quality Control (STQC) program of the Science and Technology Development Board upgraded existing systems. It supports development and implementation of better and more comprehensive industrial standards, and of more coordinated metrology and calibration services. It also aims to raise awareness of needs for improved quality control activities in the production sector.

5.3.4. Testing and reporting product performance

Product testing minimizes uncertainty, and if combined with a network to disseminate results, reduces buyer search costs. Thailand imports most industrial products from countries with product design standards and testing laboratories. In Thailand, the limited public and private testing services include product certification and various mandatory checks. Thai labs might cooperate with those from other markets where technology sources operate. Comparing test results from multiple sources would minimize opportunistic behavior.

5.3.5. Channeling and packaging products

Value-added networks (e.g., air travel reservations systems or TradeNet) demonstrate the use of I.T. as a channel to reach buyers. The initial economic role of the network is to reduce buyer search costs. Sellers may also use the network database to help identify buyer product design and packaging preferences. Buyers and sellers thus jointly configure products to meet specific needs. Such "non-store" electronic channels distributing differentiated Thai goods in international markets would be viable only if the government faced difficult regulatory issues and amended its laws to support value-added networks.

5.3.6. Sharing complementary development costs

Local development is efficient when technology from international sources is inappropriate, too expensive, or when the nation has strong research capability. Thailand's allocations of resources to R&D are still relatively weak compared to NIEs at comparable levels of development. A first step toward capacity building should be to establish specific targets, then to rationalize the existing research structure for effective use of current resources. The goal should be to combine economy of scope for development costs with learning by individuals and organizations. Transaction costs can be minimized by networks composed of producers of complementary goods, with access to markets for joint products. The resulting flow of economic benefits could provide the resources required for development and innovation of new products.

6.0. CONCLUSION

A transaction costs analysis of technology transfer and use illuminates the policies needed to enable information technology-led development. The confluence between digital telecommunications and computers, by reducing interorganizational transaction costs, will create new opportunities for trade, enable new production structures, and accelerate the growth of national income. The benefits of information technology-led development will follow policies which minimize transaction costs associated with acquisition and use of I.T., and which also minimize governance costs. These are the economic, social, and political costs of the organizational and institutional evolution required to fully integrate this dynamic technology into the national context.

Technology-led development requires not only the effective use of I.T. as a resource, but the evolution of an institutional framework to guide applications of the technology toward development goals. Thailand's lack of effective I.T. policy is a barrier not only to the immediate diffusion and use of technology, but to acquisition of the related technical and management know-how required to use technology to keep pace with development in other nations. Developing a set of policies to address these issues will require input from a broad range of stakeholders. These include local commerce and industry, education, public agencies, and labor, and international trading partners.

Charles Perrow notes that systems which are both complex and tightly coupled are prone to fail [33]. One solution is to reduce coupling between actions on the technical (closed system) and institutional (open system) levels. An integrated approach to formulating I.T. policy will reduce coupling and facilitate adaptive change.

The paper identifies gaps in the present national I.T. Heritage. However, rapid diffusion of all-digital and radio-based communications technologies may create a window of opportunity for Thailand to upgrade its networks and develop new, high-quality services. In formulating an I.T. policy to seize this emerging opportunity, Thailand must act both wisely and well. Its traditional Middle-Out approach to development policy (supplemented by Top-Down intervention) should yield to an Integrated approach, one which is both negotiations-based and results-oriented.

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STANDARDS AND CONVERGENCE: NEW REALITIES

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1. ABSTRACT

The convergence of telecommunications, IT and broadcasting around multimedia applications adds complexity to the essential participation of users in the evolution of standards for telecommunications and related IT products and services. This paper outlines the role of innovation and user influence in an ideal standardization process. Recent activities of international standards organizations to streamline activities and encourage participation in standards activities are described. A future scenario outlines the nature of the growing complexity and motivations for user interest are ascribed. Theoretical mechanisms for encouraging greater user participation are suggested for both the industrialized and the developing worlds.

2. INTRODUCTION

The importance of standards in telecommunications, information technology and broadcasting has become increasingly recognized in recent years. Standards are now being viewed strategically and their economic and trade implications are gaining increased attention. Several papers have recently dealt with the process, structure and implications of national and international information technology standards enabling policy makers and strategic planners to gain a deeper appreciation of the issues surrounding standards. (1,2)

Traditionally restricted to those in the engineering and scientific professions, interest in information technology and telecommunications standards has now extended outside of international and national standards structures and involves economists, political scientists and business experts. The OECD, for example, has undertaken work though an Expert Group on the Economic Implications of Information Technologies and forecasts possible significant changes in the standards setting process. In addition concerns have been expressed as to the role of small firms in evolving information network developments raising the fear that only large firms may be able to bear the learning and fixed costs associated with IT networks.(3)

Among the miriad of complex issues surrounding the standards process, this paper addresses two of particular concern to the telecommunications and information technology sector. These are the influence of standards on the emerging open market place and the involvement of users in that market place in the standards making process. These are particularly important issues as the convergence of traditional telecommunications, computers and broadcasting products and services begins to appear in the workplace and the home in the guise of new digital multimedia applications.

The paper will describe the market place and the role played by standards in an open market environment. It will provide an overview of recent developments in the international standards setting process with emphasis on existing opportunities for user participation in the process. It will then outline the challenge posed by multimedia communications and will offer theoretical mechanisms to encourage greater involvement from users affected by products and services in the open market place.

3. THE MARKET PLACE - THE OPEN ENVIRONMENT

An appreciation of the strategic, economic and trade implications of standards requires an understanding of the market place and the influence of standards on the introduction of new IT products. This raises questions as to the timing of standards; whether and when standards are necessary.

Experience in the telecommunications field has been mixed.

For example, the enormous international effort, extending over a decade, to develop ISDN standards has only recently produced results in the market place. On the other hand, voice messaging emerged as a viable and competitive product in the market place without the benefit of international standards. The dramatic public acceptance of facsimile was in part influenced by standards but other factors may have played a greater role including mass user recognition of a product that ideally met a real need.

3.1 THE IDEAL STANDARDIZATION PROCESS

Now, let's draw a brief picture of the ideal standardization process. Ideal from whose view? Optimized, ideally, to bring innovation into a network - and into society, for its users - on the quickest feasible basis. Network innovations that improve people's lives are one important basis for increasing productivity, so that we can enjoy better standards of living. (Here we will use "network" as a shorthand for the mix of telecommunications, computer and broadcast technologies that are emerging). We will find ourselves coming back to this question of what we mean by "ideal"; with the dynamic complexities of innovation and standardization, the answer is not as straightforward as we might like.

3.2 THE OUTLINES OF THE STANDARDIZATION PROCESS

What are the outlines of the standardization process? It begins with an *innovation*, in a company laboratory or in an inventor's garage perhaps. As the new idea begins to take form, it may have the potential to unfold along several different paths. Facsimile transmission, actually a fairly old idea, took a variety of guises. During this part in the process *experimentation* with various possible forms of the new idea is crucial for development of the possibilities. The emerging new technology is also likely to build together new ideas from several different *building block* capabilities. Facsimile, again as an example, is built from transmission schemes, image coding schemes, as well as mechanical paper handling abilities, to tell only a part of that story. Development of the composite - in our example, facsimile - may depend on the development of a component - such as lasers.

At some point for this innovation, the experimentation has been adequate to bring forth the main possibilities. Now it is time to pick and choose among the ideas floated. Particularly if this is a networked technology, *standardization* begins. Standards are essential to make the interconnection which underpins a network's function. Even non-networked, standalone computer users benefit when software developers are drawn to a standardized platform; this is an outgrowth of the interdependencies among components and the composite.

What can we expect from this point in the process? There are several possibilities, and each one complicates the story further.

Typically the new technology, still young in its life cycle, will be in a fairly rudamentary form. Wider adoption and use should help refine the new tool, to give it a better fit with its users. We may think of this continuing evolution in the technology as producing successive *generations* (while we may see the initial breakthrough as more fundamental). The G-series of fax standards is an obvious case of generational evolution. Extensibility is a term being used to describe the more predictable features of this path.

There may be another development however, perhaps even in parallel. The standard may serve as a sort of window that enables significant *diversity*, it may become a key interface that allows numerous unique applications to be created. To switch for a moment to the Apple Macintosh world for an example. Apple's QuickDraw standard for graphics allowed the development of different graphics packages, each with its own special strengths. By allowing interface at a key point, the standard catalyzes its opposite: diversity. Scalability refers to a particular kind of this diversity.

Perhaps more than anything else, the balance between the commonalities of a standard versus the diversity that users may need does make the question of what is an optimum process especially ticklish. So far we have seen - after the standard is first put forward - diversity across time (in generational evolution, but here early generations are discarded in favor of later) as well as diversity for a given moment (in separate applications, where the diversity serves differing user needs). We have not found the homogenous commodity that is the economist's ideal (except perhaps if there is a truly standard product).

There is a third line of development - one that is essentially orthogonal to these two - which we must take care not to confuse with them. Along with universal interconnection as the hallmark of a network's function, groups of subscribers will also want *private* sub-networks. This mix of the public and private is surely one fundamental of network architecture. But though there is some tendency to associate privacy with diversity, and the public with standard, we can carefully distinguish the phenomena.

Have we now sketched the end of the process? Not if we want continuing innovation in the network. After exhausting the generation and/or the unique possibilities, each flowing from the standard, we look to another, more basic round of innovation. So in fact our subject, overall, turns out to be a round, an iteration - a *cycle between innovation and standardization.*

3.3 THE USER IN THE IDEAL PROCESS

Where is the *user* in this ideal process? Clearly, the technical innovation is useful only if it becomes a social innovation. In rough terms there are two phases to a given cycle: the *experimentation* prior to the standard and the *consensus* after. Where is the user, ideally, in each phase?

Conventional wisdom holds that innovative ideas are the product of a creative mind, with little or no role for the consumer. In fact, there is important evidence that demand does play a surprising role, even in the early stages of creation (4,5). Despite this, during the period of experimentation with possible versions of the new technology, users may play a lesser part, though increasing as the time for a standard nears.

In our ideal scenario, in fact, the user plays a crucial part in the runup to selecting a standard. Only user demand can make a standard commercially viable, or lucrative. When the applications have a mass market, which are often the case with networked technologies, the challenge is especially clear. The tradeoffs endemic to standards-making will ramify through to the user in a variety of ways. To get adequate feedback from a very large group of potential users, on the utility of alternative configurations as they would affect the user, is a daunting task.

Then, after the standard issues? The user needs to take a co-equal role, alongside the suppliers of the systems. Development, after the standard, is in fact a *co-evolution* - of the technology to fit the user, and of the user practices to take advantage of newly created possibilities. The user and his/her tool evolve together, and the user's role in the process becomes equal in importance to that of the technologist. In the best outcome, people evolve more productive and better satisfying lives, using increasingly well-refined new tools. (6)

The point of the *shift* from experimentation to consensus is of course a key in the overall process. The move to end experiments and head toward a standard is not ordinarily seen as a discrete decision, but the picture we have drawn here suggests that "gathering such a storm" of opinions is in fact pivotal. User response to the experimental trials is essential input to that kind of "decision".

3.4 CONSENSUS

In general, assembly of the consensus necessary for a standard is the principal - and intricate - task of the transition between the two main phases of the cycle. To encourage adequate experiments in the first phase requires freedom of action and separate paths for those involved. But consensus, by direct contrast, will necessitate forming some bonds across the fragmented groups. While fragmentation is essential for the experiments, those fragments must also hold the potential for bonds of *community* that consensus will eventually require. Users come lately to this gathering, and many may not join until later in the generational evolutions. But user participation must have the potential to be realized, even at adoption of the standard.

3.5 THE OPEN ENVIRONMENT

What is the "open environment" which is now a commonplace across the industry? That is what we have called the consensus phase. (Since the notion of open is meant to connote access, the word might have been used for the earlier experimentation phase, when the competition of ideas requires access for creative input. But convention has instead assigned "open" to the constrasting access that standards afford, in the later phase).

What does an open environment require? Principally that consensus be complete. However, firms often prefer to continue the monopoly rents that they have rightly enjoyed during the experimentation phase, when the technology was still divided into proprietary, non-interoperating trials. Whether full consensus is implemented and interoperation is really "open" depends in some large part on how the firms involved may define their targets. Do they prefer the higher per unit profits that accrue from the proprietary, non-consensus market? Or, do they see themselves as part of a process that evolves systems which interoperate - so that they find satisfaction in a transition to larger volumes during a consensus phase, though the profits may be less per unit (but probably not as low as a strict commodity would imply)?

Ultimately, an open environment depends for its success on being part of a dynamic process. In time that will mean foregoing the standard that has enabled the current round of openness, to make way for a future round of more basic innovation. Here again the user plays a pivotal role. Only by being interested in moving beyond today's non-routine technology does the user encourage a spirit of continuing change, and a next round of innovation.

Now, let's turn to some particulars of the standards process. Let's look at the process closer up - particularly as standards making is practiced today...

4. STANDARDS, INTERNATIONAL ORGANIZATIONS AND THE USER

The international organizations most directly concerned with standards in the converging technical fields of telecommunications, information technology and broadcasting are the ITU, the ISO and the IEC. All three are making considerable efforts to accelerate their processes and to allow for a more open process of participation in the setting of standards.

4.1 ACCELERATING THE ADOPTION OF STANDARDS

Efforts are being made, on various fronts, to make the standards process more dynamic, rapid and responsive and to reduce duplication of effort.

ITU's Resolution 2 (Melbourne, 1988), "Approval of new and revised Recommendations (7) between Plenary Assemblies", which concerns the work of the CCITT, allows for an accelerated process, subject to certain conditions being satisfied. Both the ISO and the IEC are committed to speeding up the standards process with IEC having reduced the time for standards approvals down from three years to 14 months (8). All three bodies are encouraging the adoption, where possible, of international rather than separate national standards. For example, IEC has an agreement with CENELEC that no new European work will be started on a standard if an IEC standard exists or if work has already started in the IEC.

In addition, arising from the work of the ITU'S High Level Committee, an Electronic Information Exchange (Teledoc) offers new methods for electronic access to CCITT-related documents and information including faster electronic handling and output of CCITT documents. It has been developed by ITU headquarters for the exchange of information and documents between the CCITT and its members. Now under development, it offers, among other things, circulars, lists and summaries.

4.2 THE ITU'S HIGH LEVEL COMMITTEE (HLC)

Perhaps the most significant effort, on behalf of the ITU, to come to grips with the changing nature of telecommunication, information technology and standards is to be found in the report of the ITU's High Level Committee (9) The Report states that the ITU's roles in standardization, regulation and development must be streamlined to keep up with the pace of change. It proposes an "invigoration of the Union's standardization function". Among other suggestions, the Committee suggests that telecommunications manufacturers, service providers and *users* should play a larger role in the decision-making and strategic planning processes of the ITU. The HLC recommends the creation of a new Standardization Sector, standardization conferences and work programs which would reflect the rapidly changing needs for standardization in the telecommunication market-place. The HLC encourages greater private sector and business user participation in the standards process. Finally, they make specific mention of the practice of ITU Administrations to consult users and other interests in developing national positions and encourage this practice, particularly in respect of the interests of small end users, including individual customers. They see a role for users in contributing views on what standards need to be developed and in what time-frame.

4.3 USER INVOLVEMENT - MEMBERSHIP

The term "member" has a specific, legal definition in international organizations. For example, "member" is defined in the Convention of the ITU and includes, as far as the CCITT is concerned, member Administrations of the ITU, recognized private operating agencies, scientific or industrial organizations and international organizations participating in the work of the study group in question. One of these international organizations is INTUG - a user group.

The International Organization for Standardization (ISO) is a worldwide federation of national standards bodies with 90 members, one in each country. Correspondent members are normally organizations in a developing country which does not yet have its own national standards body. Correspondent members do not take an active part in the technical work but are entitled to be kept informed about the work of interest to them. There were 18 correspondent members as of January 1992.(10) The IEC's members are national committees, which are required to be as representative as possible of all electrical interests in the country concerned.

While user participation may be limited in international bodies to members, the possibility for users to participate exists in national bodies. It is possible for even small companies to participate directly in their national standards organizations or, more likely, through membership in associations who partipate in national standards bodies. Large companies, such as the telecommunications companies and computer firms, may have an excellent understanding of the potential needs of certain user groups since they may also represent a large potential future market for the company's products. Finally, government representatives attend many international standards meetings and may have accumulated a knowledge of user needs.

The ITU has taken many steps to encourage developing country participation in standards work but this issue remains a major challenge. The High Level Committee report identifies the need to increase developing country participation as a matter of concern.

5. COOPERATION IN INTERNATIONAL STANDARDS SETTING

There is close cooperation among the ITU, ISO and IEC and between each of them and other international, regional and national standards bodies. Several significant steps have been taken which made it potentially easier for users to understand the standards process. These are:

5.1 TSAG

The ITU is currently studying the creation of a Technical Standardization Advisory Group (TSAG) which would, among other things, foster cooperation and coordination and provide advice to assist the harmonization of work with other relevant bodies inside and outside the ITU.

5.2 COMMON TEXT

ISO and ITU (CCITT) now follow common procedures and produce a common text which, to the benefit of the user, is identical word for word.

5.3 RATIONALIZATION

There has been a rationalization of work in the field of information technology as exemplified by the joint ISO/IEC technical committee ISO/IEC JTC1, set up in 1987-88. It is interesting, since our focus on the future uses digital multimedia as an example, to summarize those sub-committees (SCs) concerned with multimedia under JTC1. These are:

SC 6 : Telecommunications and information exchange between systems;

SC 18: Document processing and related communication (includes multimedia and hypermedia model/framework);

SC 24: Computer graphics and image processing (Standardization of interfaces, in windowed and non-windowed environments for:
- computer graphics;
- image processing;
- interaction with and visual presentation of information.)

SC 29: Coded representation of audio, picture, multimedia and hypermedia information. (Multimedia is defined in SC29 as the property of anything to handle several media - synchronization).

The work of this last SC covers the rapidly expanding areas of information and entertainment. Typical of , other sub-committees, there has been intense ir .rnational involvement in SC 29 including technical experts from 15 countries.To further indicate the wide area of cooperation, it should be noted that SC29 draws on the coding work of JPEG, JBIG, MPEG and MHEG. (11)

6. NEW REALITIES

The international organizations have made considerable progress in improving both the speed and accessibility to standards making and are increasingly offering new opportunities for user participation. What, then is the motivation for users to participate, and who might the users represent?

6.1 NEW STAKEHOLDERS IN STANDARDS AND IT PRODUCTS

Users of information technology products and services are increasingly to be found in the government and social sectors where budgets are declining and capital budgets are under constant scrutiny. IT products and telecommunications services are becoming a proportionally higher percentage of these budgets. Even in the private home, IT products are becoming a more significant proportion of an individual's personal property. However, business, social service, government or individual users are unlikely to have set aside funds to participate in standards making. Those that would wish to do so will find that the standards process is both highly specialized and costly. With the growing stress on the adoption of international standards, the ability to afford the high cost of international travel and living has been added to the need for a sophisticated technical knowledge as the price of admission to meetings of standard setting bodies. Many standards meetings are long and protracted, take place over a period of years, and are held in highly expensive cities such as Geneva. In reality, while there has been a growing participation in standards bodies by users, these have, for the most part, been highly sophisticated large users.

6.2 INCREASING COMPLEXITY

To further compound the challenge of user participation, the standards setting process, already complex in the telecommunications, information technology and broadcast and entertainment fields will become even more complex as the three areas converge. Since the late 1980s, there has been a growing number of interactive multimedia projects and new products appearing in the marketplace. Many are aimed at the educational market. These were initially concerned with the convergence at the personal computer of three major communications technologies - print, audio and video. Standards in these "desk-top" applications deal with things such as data representation and user interfaces. (12). However, the recent decline in the costs to use high speed networks, and the offering of ISDN tariffed services, has introduced lower cost telecommunications and the potential for multimedia "at a distance". The emergence now of multimedia communications applications combining images, sound and data, promises to create a new set of standards questions. The end user, the individual, will be offered a plethora of options to chose from, and the ability to create a unique information environment to fit his or her needs. All of this will take place in a multi-vendor environment complete with its mix of international and proprietary standards. Applications at the desk-top and in the home entertainment field will place the onus for choice as much on the individual as on the service provider.

7. A 1998 SCENARIO

Standards making, as mentioned earlier is essentially a "pre-market" process. To be able to understand where we are today in this process, we need to look sufficiently far into the future to be able to hypothesize a reasonable scenario of future products and services, and yet not far enough to lose the thread of the potential influence of user participation in the standards process. Let's chose a scenario which will affect us all - multimedia in the home circa 1998. (13)

Now in 1998, digital interactive, multimedia applications, linked by intelligent telecommunications networks have entered the North American home. (14) The drivers for these applications emerged from transmission sytems (ISDN, cable, standard telephone) coupled with compression, a shift to digital from analogue and a dramatic improvement in storage devices. Using 1992 industry structure definitions we now have access to :

Bandwidth on demand from the telecommunications suppliers providing voice, image, fax, data and almost real time video through an intelligent, interactive network;

A highly sophisticated home entertainment center featuring CD-ROMs with interactive programming;

An interactive broadcasting/cable user controlled program delivery system offering a multiplicity of digital television, sound, image and data services;

A powerful home computer system offering informational, educational, work and entertainment applications linked to other computers via user defined telecommunications networks. The list of functions is endless...text, video, image, digital photography, audio, database access, paperless facsimile, desk-top videoconferencing, multimedia information retrieval.

7.1 NOT YET THE PERFECT WORLD

Traditional defininitions and boundaries are blurring. Telecommunications, the computer, broadcasting and home entertainment have almost become a hybrid - but not quite. The flat panel display on my computer offers a much better display for the type of text and graphics and the exciting multimedia presentations delivered to me by the broadcaster than the lower quality I get from my NTSC television screen. My new read/write optical disk drive could be useful for all of my multimedia applications, but I'm still looking for the right black box to make some of the connections. The interfaces to some of the interactive services and applications still needs work. I get lost retrieving information from some of the services.

The scenario, and the problems, may be hypothetical but the possible conclusions are all too real. User applications and user interfaces will need a lot of attention if the full potential of the multimedia word is to be realized. Definitions and boundaries become blurred and responsibilities compounded. Our short scenario involves all of the standards bodies mentioned earlier working in cooperation and at speed. How can the user, even our hypothetical home user, play in this game?

8. THEORETICAL MECHANISMS FOR GREATER USER INVOLVEMENT

There is obviously no single answer, but some theoretical mechanisms for ensuring a greater involvement into the standards setting process can be postulated. Two characteristics emerge from the above discussion. First, the scale of the introduction of information technology (including telecommunications and broadcasting) products and services into the market is large enough to be viewed as a mass market issue. Second, the leap from today to the mass market, open information world of the late 90's requires bridging mechanisms. We can probably postulate further that although the issue affects the mass market, the number of people who will in practice wish to participate are relatively few even if the constraints of cost and expert knowledge could be removed. The following then are early suggestions for bridging mechanisms which would begin to see a wider public appreciation and, hopefully, bring the mass market user into the standards development process.

8.1 A LAYMAN'S VIEW

The highly technical and complex nature of specific standards can mask the essential simplicity of the actual application of a product or service. The engineer might struggle with the difference in decibels of a clear or unclear signal. The layman will simply say that it is audible or it is not. The layman's conclusion is a useful input to standardization and is, of course, already obtained through user trials of emerging products. Layman's conclusions could be obtained through other fora such as, for example, user "focus groups". Further, a number of science writers do an excellent job of explaining complex technical matters in popular terms. Perhaps they could be encouraged to help "demystify" the complex world of standards and technical innovation.

8.2 INDUSTRY FUNDED INFORMATION SEMINARS

Large companies could fund information seminars dealing with standards - this could be done under the auspices of the ITU/ISO and IEC to avoid the implication that companies are influencing the standards process. User representatives could be invited to attend these seminars;

8.3 INDUSTRY FUNDED, ELECTRONICALLY ACCESSIBLE BACKGROUND PAPERS

Companies could fund the preparation of background papers on standards issues. These papers could be published or made available electronically through the information systems now being set up by international and national standards bodies;

8.4 A WINDOW INTO THE STANDARDS COMMITTEES

Standards committees and working groups could open up their meetings for a session. User groups could be encouraged to meet with them to exchange views on the standards under discussion and their user implications

9. DEVELOPING COUNTRIES

Developing countries will undoubtedly need to consider the implications of convergence and multimedia applications in their plans. Convincing arguments have already been put forward in papers by experts from developing countries which stress the importance of standardization in meeting the hopes and aspirations of the developing countries. (15) Each of the suggestions above could be applied to the developing world, and, perhaps under the auspices of the ITU, given particular attention. In particular, holding meetings in developing countries, and offering short seminars on the subject under discussion, could focus on particular problems facing the developing world in the area under discussion. The High Level Committee has already recommended that the Standardization Bureau of the ITU extract and group matters under active study which may be of particular interest to developing countries.

10. CONCLUSIONS

User participation, an essential element in the process of standardization and innovation, will become more important as telecommunications, information technology and broadcasting converge around digital, interactive, communications linked multimedia applications. Informed users will be motivated to participate as a reflection of the growing business and personal embedded investment in telecommunications and IT products. International standards organizations have already shown their intention to streamline standards activities, to permit greater access and to encourage user participation although the role of developing countries remains a challenge. Users and standards bodies now enter a period of experimentation as they explore the parameters of this new spirit of cooperation. Technologists need to create a more open and informed environment while users need to develop ways of expressing their interests and concerns. A new consensus can be developed by adopting bridging mechanisms which allow both communities to work together and engage in a more open, needs based process for the evolution of new standards. The end result could be a more harmonious integration of new products with user needs and requirements to the benefit of both users and industry.

11. ENDNOTES/REFERENCES

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EUROPEAN TELECOMMUNICATIONS - NEW DIMENSIONS

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Abstract

The re-definition of European Telecommunications services in the context of the European Community gives rise to the use of new methods of regulation which incorporate extensively consensus-driven mechanisms of standards generation and use. The context of this regulatory environment and the part played by the standards upon which it relies is set out.

THE ENVIRONMENT

"Europe is very European": this statement sums up in a few words the reality of telecommunications provision and infrastructure throughout that continent. All recognise that the PTT monopoly-monopsony environment originated from that region (and was subsequently exported to European colonies world-wide); the stimulus of economic and social necessity within Europe subsequently created other related institutions, some now with a global context. It is no accident of geography that the ITU is based in Geneva.

Europe has undergone in a very general sense an economic and social evolution during the last half-century not experienced elsewhere; since mid 1940, its commerce and industry has been rebuilt, and its social rules re-defined. Telecommunications has been a major component of this post-war reconstruction plan. Since the late 1950's, the embryo of pan-European economic harmony has grown; today, the European Economic Community as an integrated macro-National market force in our world-wide community is a reality. Its telecommunications goods and services penetrate to greater or lesser extent the markets of the world including the Pacific region, and thereby expose internationally all regions to European technology and to European policies which to a significant extent define and determine that technology.

The fundamental constitutional structure of the European Economic Community is based upon a vast collection of multilateral agreements of treaty status, collectively referred to (somewhat loosely) as "The Treaty of Rome". The glue of economic interdependence holds member States together: There is no pan-European militia to enforce the sustained Community membership of any member State. Enforcement of Community-wide policies, regulations, or other rules rests ultimately with a member State itself following agreement with its partners to adopt and hence (according to its national political and legal strictures) to implement such rules on a national basis.

This environment, of course, sets the context and determines the methodology of telecommunications resource management as it does for every other commercial or industrial activity. In pursuing this principle of government by agreement and of consensus (defined as the absence of formal opposition), particular methods to support the development of pan-European commonality and to ensure sustained compliance with that commonality must be identified, promulgated, and operated. This process takes time. Given the time spent, the result of such pervasive deliberations produces a highly stable compromise with few, if any, national variations from a common theme. Given the diverse nature and sheer quantity of interested parties and the need to recognise the particular concerns of each in the generation of such an agreed compromise, the administrative and bureaucratic structures which result have a complexity in a number of dimensions.

As the Community begins to mature, its further evolution clearly exposes visibly an emphasis upon the need to provide Community-wide equivalence in the access to and use of telecommunications infrastructure for free and unrestricted information flow. It is perhaps right that in the formative years of the Community,

telecommunications was left as a national matter; it is undoubtedly right that the Community as a whole now should place some focused initiative on the methods of supporting change from nationally idiosyncratic to Community common telecommunications services and a telecommunications infrastructure to support those services.
It is this goal which has fostered a number of Community initiatives in the telecommunications field during the last decade. Many of these initiatives are widely known: the formation of a European-wide telecommunications standards-writing machine (ETSI) is but one of these.

THE ROLE OF REGULATION

There are, of course, many ways to crack a nut. The particular method one chooses is indeed, somewhat determined by the nut in question. The telecommunications resource of any nation-state is made up of many components, and in order to redefine its method of management, a number of linked procedures and institutions to support and to implement those procedures must be established. The underlying requirement that consensus be a common theme provides no simplification.

Moreover, the telecommunications environment presents a special challenge: the efficacy of symmetric resource management across national borders depends extensively upon national technology. It is difficult (some say impossible) to uncouple the provision and use of telecommunications services from the electronics, physics, and integrated circuits which are the rule-makers of its infrastructure architecture. A single technical parameter can render a regulatory objective achievable only at grossly uneconomic cost or indeed not at all; a straight forward regulatory principle can be frustrated or rendered impossible to achieve by one or more technical parameters or by the technical implications of such parameters. This interrelationship of the legal and economic world of the regulator and the hardware-software world of the telecomms technologist provides an endless feast for those with a debating appetite, and these two worlds do not of themselves proscribe a convergent path for such debates.

It is perhaps worth noting that this disparity tends to be less significant within a given nation-state which has grown up with its telecommunications infrastructure than it is between countries which have different historical evolution. Hence the re-definition of North American telecomms regulation involved setting out rules for using differently a given technology; this is in stark contrast to European re-regulation, which requires technical definition of significantly different infrastructures and subsequent *ab initio* regulatory rules for that service delivery and use which the different technologies in various member States might permit. A second regulatory step, of defining a migration path towards greater technical commonality between countries and choosing that path to be consistent with regulatory objectives for re-defined network access and service delivery, must clearly follow.

It has already been mentioned that the articulation and implementation of 'Federal regulations' within the European Community is in large measure in contradistinction to its constitutional position; regulatory dimensions exist within the Community at large and within each of its member States, and these regulatory positions may well be different in kind or in the extent or nature of their development. In consequence, two discrete regulatory roles - those of the Community and those of its member States - are found. Much effort has been spent and no doubt will continue to be spent in identifying the machinery needed to forge effective and working links between these interests.

A further consideration is that of the dissimilarity across nation-states. The national regulatory constraints and targets in France, for example, are unlikely to be similar to those found in, say, Italy. And neither could be expected to relate closely to the regulatory environment in, say, Greece.

It seems clear that the re-definition of European telecommunications must involve the Community itself (by way of the European Commission) and of each member state (by way of its particular approach to the telecomms aspect). These aspects of Community regulation are set out below.

The Community Dimension

Telecommunications as a consolidated community resource is seen by the European Commission and by the Council of Europe as a significant component of further economic and social evolution and, indeed, integration throughout the European Economic Space. Emphasis upon its re-alignment better to serve those objectives has developed during the last decade, and the Commission has implemented a number of supporting initiatives.

These centre about the overall consideration of the telecommunications resource as, in the main, a basket of information transfer or transport services. From this aspect, the secondary issues of technical infrastructure and terminal equipment naturally follow. This is not to say that networks and terminals are forgotten; much Community resource has been expended and continues to be dedicated to these particular areas of concern (the formation of ETSI is but one example). Yet, the general consideration remains service based.

There are clearly both historical variations and inconsistencies and future developments to be considered in this light: Community policy has concentrated upon both. The policy thrust includes programmes to extend universally service provision to areas within member States and their neighbours not well-served with infrastructure, to set out mechanisms to develop equitable service and service accessibility in areas where existing infrastructure is able to support demand, and to identify leading-edge technological approaches to the telecommunications needs of the future. In parallel, the pan-European consistency of user parameters is of concern; numbering strategies and equitable tariff structures are high on the priority list of re-definition.

Community legislation is (and must be) short on regulation and very long indeed on direction; that is to say, given the imposed restrictions upon regulatory methodology arising from a non-Federal structure and hence the (predominant) role of the member State and its legislative framework the essence of the Community-wide role a regulator must pragmatically assume is one of consultation, consensus (or at worst qualified majority voting), and direction to member States. This direction is articulated by means of Directives agreed in the normal way by the Council (composed of members of Government from all member States), and then addressed to member States for the purpose of their approximation of the content of the Directive to their national laws.

This process maintains the distance between National sovereignty and Community policy and at the same time permits the spirit of a Directive to be applied throughout its member States. It should be noted that so long as national law is the principal vehicle for implementing Community policy, using a procedure such as this is often the only way to proceed: legal structures in the member States differ widely in their method of statute generation and application.

Nonetheless, the system seems to work: any number of Directives on issues ranging from telecommunications to agriculture have been introduced into member States' legislative fabric and have largely achieved Community-wide implementation to a considerable degree of uniformity. The nature of this process delimits the role of the Community Regulator to one of direction to member States following extensive consultation with member States and with other interests, and passes to the National Regulator a central role in implementing this direction.

The National Dimension

The Community Green Paper on telecommunications, published in 1987, proposed fundamental structural changes to the traditional European PTT. Aimed at supporting the development of certain types of competition in the telecommunications market the separation of the regulation and type approval powers from each other and from the network development and operation sectors precipitated this development. This separation is now largely complete throughout the Community. The effect of such a step has been the creation of a new regulatory dimension.

The PTT model of monopoly supply of infrastructure, services, and terminals (and, by implication, all regulation thereof) has been recast into independent sectors; the new regulation function, as a separate activity, becomes more visible to supplier and to user and includes to a large extent opportunities for debate and public (rational) decision-making in the areas of terminal market entry and supply of services. The national dimension of this restructuring has created certain structural irregularities from member State to member State, but this is consistent with the concepts within the Community Constitution. National differences, related to the historical dimension of the part each PTT played in provision of telecommunications will diminish as Community-wide markets, led by Community-wide standards to define and to harmonise those markets, evolve.

Perhaps the central point is simply that the telecommunications environment throughout the Community is changing in a single direction but at the pace and to the extent appropriate to each member State's particular needs and concerns. Said another way, Europe is re-regulating its telecomms resource by consensus rather than by dictum.

THE PLACE FOR STANDARDS

The partition of the telecommunications resource into marketable elements is an activity which cannot begin without deterministic definitions of those elements. This, then, is in part the role which standards must adopt. It is, to considerable extent, a role which (for telecommunications) is new. The (traditional) PTT model uses specifications which set out the nature of goods and services the monopoly might supply; the free market relies upon technical recommendations as guidelines for innovative design to a cohesive and normative core. The standard is perhaps a half-way house; it plays a key role in implementing and sustaining the re-regulated telecommunications resource of Europe.

Control of market entry which is in the hands of the market place itself creates a dynamic yet ordered environment. European Standards contribute in principal measure to that control. Generated by all with equal voice using consensus, they set out a deterministic measure of market entry targets able to be independently and objectively assessed. Used by the regulator, they set the legal basis for entering the market and for complying with market parameters.

European Telecommunications Standards are written by members of recognised European Standardisation Bodies and coordinated and managed by the European Telecommunications Standards Institute (ETSI); those specific to telecommunications matters (as contrasted with, for example, electrical safety or matters of electrical interference) are wholly the responsibility of ETSI. It is instructive to note how and by whom they are used, and how and by whom they are written.

Standards and Regulation

European Telecommunication resource management derives its Regulations from the text of standards written from the outset to be used as Regulations. Requested by the European Commission or by the marketplace itself, these documents have a deterministic form which allows for their application either technically or legally without equivocation. Generated from the outset by the Members of ETSI, the content represents a consensus view of those members' interests. The effectiveness of their use, particularly in conjunction with general (or 'umbrella') legislation, is linked absolutely to the interests represented during the drafting phase.

It is principally for this reason that the constitution of ETSI is open to all who have an interest in telecommunications *per se*; it is also for this reason that each member of ETSI has one vote, irrespective of the size or character of the organisation he might represent. ETSI is truly an open and equitable forum in which those representing the concerns of Government, supplier, user, researcher, network or service provider and any other entity with a market interest sit, side by side, as peers with a common technical expertise. Generating text by consensus, the diversity of market interests is checked each by the other; a standard generated by such a method sets out agreed 'basics' (often determined by the physics of the topic which are known to all) and intentionally omits the details (often functions of product specificity and hence of commercial value only if not revealed).

This is cooperative competition at work.

The result, when applied by the regulator as a market Regulation, represents when applied the agreed position of the marketplace. Disagreement can only arise from those whose interests during the generation of the Regulation were ignored, and hence (since all may take part in that generation) from those who choose not to participate. Clearly, their case for redress (should it be put) is feeble.

Thus the National Regulator, in realty the manager of a national telecomms resource, is presented with two focused constructive tools with which to effect his task: a Community-wide agreed direction setting out the context of his rule-making, and a Community-wide market-sensitive and agreed Regulation addressing the specifics of the point at hand. These are, in concert, formidable tools indeed.

Standards Generation

It could be said that telecommunications standards (as opposed to specifications or recommendations) perhaps come in two flavours. The aspects of a Regulation which is (or was) a standard have been discussed above. A second might be considered, to be exactly similar to the first but not adapted by a regulator for resource management purposes. Such cases arise when regulation is not intended to extend to technical specificity beyond a particular level; an example might be a standard concerned with the sensitivity of a dial tone detector.

There are many standards of this kind; they typically cover technical aspects of terminal equipment (or services) considered to be over and above those aspects by which successful interworking with the network (or with the service which the network provides) is achieved. Such standards may take on a Regulation role in countries which choose to regulate to that extent; in others, they may well assume a legal role under a civil or commercial code. This in fact generates what might be called "second order" regulation: regulation within the market by itself, or self-regulation. The regulatory locus does not directly include the Regulator but rather two (or perhaps more than two) parties in an agreement to provide and to use a service or network port.

Other regulatory levels can be identified: these could be said to extend to, for example, the very general area of consumer protection. The point at issue is simply that the prior existence of a standard generated by and for the market to which it relates sets apart legally the market dynamics from market definition and control. With rapid technological evolution, this becomes an important factor in market development.

The generation of standards, then, can be seen as a key component of the re-regulation methodology used within the Community; there are, of course, side-effects of this approach outside the Community as well. Moreover, the Community regulatory model, which clearly relies not only upon standards but also upon a particular method of their generation, can be seen to offer positive benefits in the ordered development of a new telecommunications environment able to foster and to benefit from competition and to integrate a multitude of disparate national market segments.

TODAY'S REALITY

Telecommunications in Europe is changing. PTTs are re-aligning their activities, commercial interests, and political allegiances; competition is developing, services are improving. But problem areas remain.

Perhaps one of the most pronounced is that of today's telecommunications infrastructure. Community-wide access on a technically common basis remains a distant goal; normalisation of charges for attachment and for use within and between member states has yet to be achieved. The provision of leased lines, the rules for attachment and tariffs of use (particularly in the international dimension) remain to be harmonised. Standards - particularly of a regulatory nature - evolve slowly.

Yet a number of initiatives are under way which address many of these problem areas. Community Directives on streamlining market Regulation, on providing Community-wide "open networks" to support new services and leased-line needs, on the availability of satellite services and on the harmonisation of licensing are all in train. ISDN development is encouraging; GSM is a world-leader, with other wireless services not far behind.

Telecomms in Europe is well, very much alive, and certainly kicking. In its very European way.

Finding Common Ground--The Global Virtual Network Services Forum

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BACKGROUND

Businesses that are planning to compete in a rapidly expanding global environment are making an escalating series of demands of service providers. They are asking for the communications security and power offered by dedicated private networks -- coupled with the reliability, flexibility and reduced costs that the Public Switched Telephone Network (PSTN) provides.

Customers are looking for off-the-shelf global networks they can use to efficiently link all their business locations, and to provide customized solutions to their needs. They want to be able to build individualized network applications specific to their businesses, instead of creating and maintaining a complex global infrastructure of cables, switches and control centers.

In short, global business is pushing hard for carriers to rapidly develop and offer Global Virtual Network Services (GVNS) -- software-defined service offerings with enhanced feature sets that equal or surpass dedicated private networks while using PSTN or ISDN facilities.

AT&T is a leading provider of advanced software-defined network services both within the U.S. and on a global scale, and we partner with telecomm administrations for these services. Customer demands were for a transparent global communications environment that would give them the ability to intelligently evaluate their options before choosing service suppliers for their GVNS.

Customer concerns fell into three general areas. The first was a need for international carriers to provide global support for sales, provisioning and maintenance that was oriented to customer requirements -- clear, consistent and comprehensive.

The second call was for services providers to create truly global networks by agreeing on standardized interconnections between different carrier systems. Customers wanted the ability to specify flexibly, point-to-any-point meshed networks instead of being limited to centrally hubbed star configurations determined by individual carrier capabilities.

They also asked for at least a basic minimum palette of feature ubiquity. Customers want to be able to plan GVNS implementations that join far-flung business locations together with the assurance that they and their chosen carriers share a common, clearly-defined language of technical capability and service expectation.

Along with this, multi-national businesses want network management capabilities that are clearly defined and effective even when they had to reach across a GVNS that included facilities from different Telecommunication Administrations.

Finally, though far from least important on the customer agenda, was the third specification -- global end-to-end reliability from GVNS providers that was at least as good as that supplied by existing International Long Distance service. And they wanted that reliability at a price tag that offered a compelling reason to switch from dedicated private network set-ups.

That is a substantial body of customer expectations, and it is growing rapidly in complexity and insistence.

In December, 1991, AT&T set up the Global Virtual Network Services Forum, open to all carriers. Its overall goal was the resolution of those customer imperatives, and its immediate objective was setting the stage for the rapid deployment of the seamless global communications environment of GVNS that customers around the world are demanding.

Currently, 37 carriers representing 23 countries are active Forum participants -- collectively carrying 95% of the world's international long-distance business calls. There is no other grouping in the world that begins to approach it in both the scope and understanding of direct customer business requirements.

After the first six months, the other two major carriers in the U.S. joined the Forum--companies that are major, fiercely competitive rivals for market share. Finding common ground was clearly going to demand cooperation that went beyond simple technical agreement on interconnection guidelines.

At first, there was some wariness and uncertainty at the Forum. Different carriers, some of which competed with each other in the same country, had questions about the true purpose driving the Forum and its real agenda. That tension dissipated with remarkable speed, as the GVNS Forum took on an identity and momentum clearly driven by customer requirements. The GVNS Forum also pointedly refrained from trying to set itself up as a standards body that dictated competitive strategies for participants.

What I'm going to report on now are some of the key proposals that were considered for adoption at the fifth meeting of the GVNS Forum last month at Sydney, Australia. That meeting occurred after the deadline for submission of this writing and any significant changes or developments that occurred will be updated during my oral presentation at PTC'93.

At this point, the basic definitions and vocabulary of GVNS have been agreed to. While that may seem elementary, the process of building consensus between a truly global association of carriers is not. The enabling factor has been our common positions as stakeholders with immediate, bottom-line interests in supplying solutions for international business customers.

SERVICE DEFINITION

Global Virtual Network Service is a multi-network international service which provides private network functions to users at geographically dispersed international locations while minimizing the need for dedicated network resources. This is accomplished using a closed user group over the PSTN or ISDN.

As used in this paper, GVNS is a term used to describe a feature-rich, international virtual network service. It has functions typically associated with private networks, but utilizes the public switched network.

The customer's network configuration is defined by the customer, using the customer-specific service information resident in multiple networks. The network configurations may be administered by the customer directly or by the GVNS Service Provider.

GVNS provides customers with global services as a result of internetworking between the GVNS Service Providers in different countries. GVNS may accommodate this local interconnection using ISDN and non-ISDN facilities.

THE BASIC GVNS FEATURE SET

The GVNS Forum considered the adoption of a basic minimum feature set which all carriers agreed should be the foundation of any GVN service offering made to customers. There are six essential components:

1) Basic Private Numbering Plan

   This allows GVN customers to define flexible dialing plans, which use abbreviated dialing (fewer digits) to call different locations within the network.

2) Basic Closed User Group

   This consists of the customer-defined locations in different countries which use GVNS features and functions to communicate with each other. Operating within the public switched network, the GVNS closed user group takes advantage of the redundancy and reliability of the service provider's systems while enjoying security and value comparable to dedicated private networks.

3) Basic Call Screening

   This elemental GVNS feature lets the customer set limits and determine authorization levels from calls between different locations, groups or individuals within its virtual network. Customers can define permissible GVNS calls by employing different levels of screens, such as on-net, off-net, domestic-only, international-only, or specific location or workgroup identification.

4) Basic Billing Report

All GVNS billing appears on a common bill, separate from other telecommunications charges. Total GVNS usage, access and miscellaneous charges are specified. Volume or other discounts are clearly detailed.

5) Basic Network Management Reports

Bare-bones traffic surveys must be available to customers showing, at a minimum, numbers of calls, minutes and costs; configuration reports of on-net locations and levels of access for different locations and authorization codes; and network outage reports detailing numbers of outages, duration of individual events, and total down-time.

6) Voice and Voiceband Data

GVNS communications between any two on-net locations must be supported by the service provider at a rate equal to, or less than, International Long Distance calls between the same two locations.

Going Beyond the Basics...

In order to expand that listing of basic GVNS requirements, the Forum looked at all of the features existing or planned by its members today, and compiled a preliminary catalogue of enhanced GVNS service offerings. There has been no attempt by the GVNS forum to tell individual carriers what enhanced features they have to develop or offer to their customers, since that is central to each carrier's individual competitive strategy.

These include the following key features, among others:

Digital Data Transmission -- rapidly becoming an integral part of standard business communications planning as PTT's rapidly push through major modernizations and expansions to existing infrastructures. During the next ten years, the world is expected to spend some $50-to-$70 billion a year on network infrastructure, and that growth is particularly robust in the Pacific region.

By the mid-1990's, for example, AT&T and the whole industry will have committed $4 to $5 billion into the Pacific part of its fiber optic Worldwide Intelligent Network, going beyond the point-to-point systems now deployed. The next generation Pacific network now being rolled out is built with ring structure and spokes, which will greatly enhance both reliability and flexibility for customers.

Digital data transmission is becoming essential for competitive global business. High speed fax is a compelling example. Studies have shown that between 4 P.M. and 5 P.M. in Hong Kong, for instance, more than 50 percent of the telecommunications traffic to the U.S. is fax traffic.

"Forced on-net routing" is another enhanced feature which is available from some carriers today but doesn't fall under the basic feature set the Forum has evolved. When a customer dials a public telephone network in a foreign country, software intelligence residing in the GVNS provider's network will automatically determine if the call is to a location included in the company's virtual network. With the AT&T GVNS service, for example, the call will be automatically placed over Global Software Defined Network Service, and optimally routed, and billed as a GSDN call.

"Remote access" is a third widely used enhanced feature that Forum members have identified. When a carrier makes this option available to customers, they are able to access their GVNS when they are physically at an off-net location, by dialing a toll-free number.

During the Sydney GVNS Forum meeting additional work was planned to further define key enhanced GVNS features.

STREAMLINING THE PROCESS FOR CUSTOMERS

Today, the process of setting up a GVNS still involves some unknowns -- for both customers and service providers. For many carriers, it is a brand new territory without any experiential guidelines.

At AT&T, we've seen that first hand -- getting requests for GVNS set-ups from PTT salespeople that came on the backs of envelopes, because there was no standardized form for inter-carrier ordering, or procedures in place to make the process rational and efficient.

What the GVNS Forum has been working hard at is reaching consensus on the basic guidelines for customer/service provider relationships, and allow greatly improved service response and service quality.

Operations, Delivery and Maintenance (OA&M) issues have received particular attention.

Improving Service Quality and Reliability...

One factor limiting the growth of GVNS has been the need for consistent standards of reliability and quality. These are critical requirements for a offering that is being described as the wave of the future for corporate communications. Since GVNS performance varies greatly from country to country, the Forum saw no practical way to reach consensus on uniform performance levels; but there is on-going discussion on the possible establishment of a certification process that will endorse qualified GVNS providers. We did agree on a need to establish minimum standards of service performance that would meet customers' end-to-end expectations.

The Forum has identified and created a quality framework of key factors that influence customer perceptions of GVNS quality. It drew on the collective experience of its participants, an unequaled repository of customer research. Particularly involved in this work were AT&T, NTT, Italcable, Telecom Canada and Telecom Finland. Further work is being actively pursued by MCI, Sprint, BT and Mercury.

The following chart gives the results of that finding:

GVNS Quality of Service Framework

GVNS Process:	Quality Criteria:						Key Indicators	
	SPEED	ACCURACY	AVAILABILITY	RELIABILITY	SECURITY	SIMPLICITY	FLEXIBILITY	OTHER
Presales	Response Time	% Correct Information	Hours of Operation	% Optimal Information	Confidentiality	Ease of Contact	Options	Helpfulness
Service Delivery	Time to Deliver	Complete as Ordered	Hours of Operation	% On Time	Confidentiality	Ease of Contact	Options	Customer Informed As Per M&P's
Service Maintenance: -User change request mgmt.	Time to Respond							
-Repair	% ≤5 hrs. Mean Time to Repair	% Correct % Repeats	Hours of Operation			Ease of Contact	Options	Customer Informed As Per M&P's
Network Performance: -Connection establishment	Post Dial Delay	% Wrong #	% Call Compl. % Blocking	% Lost Calls		# Digits Dialed	Alternate Routes	
-User information transfer	Throughput	Loss/Gain, Noise, Echo, BER, BLER	% Availability	Cutoff	Crosstalk		Range of Equipment Supported	
-Connection release	Time to Disconnect			Cutoff				
Billing/Mgmt Reports: -Delivery	% Late	% Correct	Frequency		Fraud			
-Inquiry	Response Time	% Correct		% Optimal Information				

Operations, encompassing the sale, provisioning and cutover of service with the customer, has also been examined with an eye to providing simplified, consistent response to customer needs.

Knowing Who to Contact...

The establishment of Single-Point-Of-Contacts (SPOCs) within each carrier for key functions is a goal that Forum members have adopted. This is a readily identifiable group of people within each carrier's control center, who are the designated interface for all OA&M interactions between carriers and customers. Updated listings of SPOCs --with their phone, fax and e-mail contact numbers and responsibilities--are being developed in hard form and may evolve into an on-line inter-carrier database of information that can be consulted whenever needed.

Cooperation and education in the way that other carriers operate in OA&M procedures is also underway. AT&T has had representatives from Mercury, France Telecom and Telecom Canada down to its Virtual Network Service control center, for example, to get first hand experience and understanding on how we handle provisioning and maintenance. Similar invitations have been extended to all PTT's that we do business with and have cross-agreements with.

REACHING CONSENSUS ON INTERCONNECTION ISSUES

The GVNS Forum also investigated and discussed the three GVNS technical configurations currently implemented or planned by GVNS carriers. It tried to create a baseline starting point for the development of a common technical interconnection specification for all carriers, as well as set guidelines for service providers planning to offer GVNS service to customers. KDD provided strong technical input on Pacific Region technical issues.

The first configuration, currently in use by some carriers, makes GVNS connections by passing a unique Service ID along with each call. In every case, each distinct customer has to have a unique Terminating Network Routing Number, since duplication by different service providers would result in total confusion if calls were sent over shared network facilities.

The second configuration, also in use today and recommended for service providers starting up GVNS offerings in the near-term, depends on the assignment of Customer ID's which give carriers customer-specific access to each communication. It also allows greater responsiveness without the numbering restraints existing under the Service ID arrangement in Configuration #1.

The third Interconnection Option, not currently fully developed, uses the ISUP (ISDN User Part) signaling message to carry the Service ID and Customer ID separately from the address digits of the call. This method of information transmission has the potential to carry more detailed customer-specific information, which will be used to provide enhanced GVNS features.

CONTINUING ISSUES

Establishing common ground between carriers that lets them respond to customer GVNS requests with speed, accuracy and reliability is the GVNS Forum's ongoing focus. At this point, many of the basic foundation definitions and goals have been agreed to by all parties -- no small feat considering the extraordinary span encompassed within the Forum. Future Forum efforts will focus ever more closely on the specifics of technical GVNS establishment and maintenance.

GSM,
INTELLIGENT NETWORKS
& PERSONAL COMMUNICATIONS

by

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The following paper discusses the current and future standards in Asia/Pacific, North America and Europe and focuses on the relationship between GSM and Intelligent Networks.

The rapid evolution of personal communications, the wireless options of cellular and recent advances in network intelligence and digital network services, have armed the telecommunications industry with some very powerful building blocks for an exciting, innovative and potentially highly prosperous future.

The rapid advances in mobile telecommunications technology taking place throughout the world are, however, too often slowed, if not actually hampered, by the need to take existing infrastructures and regulatory requirements into account. In some of the more liberal regulatory environments, keen new operators, without the multiple vintages of long-standing infrastructures to impede them, press enthusiastically on, but still face tremendous barriers trying to establish a critical mass of investment and expertise to make the right choices.

Creating the "communications services of the future" requires the right investment, mixture and timing of resources for a specific market environment to succeed. A brief look at the "step-by-step" advancement currently taking place in the cellular world reveals a few pointers for suppliers and operators trying to steer a course towards these correct choices.

In the US, the single AMPS (Advanced Mobile Phone System) analogue standard brought nationwide system uniformity and associated cost benefits. An unfortunate result of increased subscriber demand however, has been increased pressure on the radio frequency spectrum, and an immediate need to concentrate on the solution to that problem.

Different digital radio solutions, such as TDMA, ETDMA and CDMA (both narrowband and wideband) are being proposed to balance subscriber density requirements with efficient spectrum usage. A more efficient version of the AMPS radio standard (NAMPS) has also been put forward as a short term solution to capacity shortfalls. The 1990's sees these major strands battling for acceptance and several field trials are under way to show the merits of each technology. Because of this movement to several standards (see figure 1), the economies of scale associated with a homogeneous infrastructure may now be more difficult for US operators to achieve. In addition, multiple regional standards would severely limit the usefulness of digital cellular networks to the end user. This trend is also expected in Latin America.

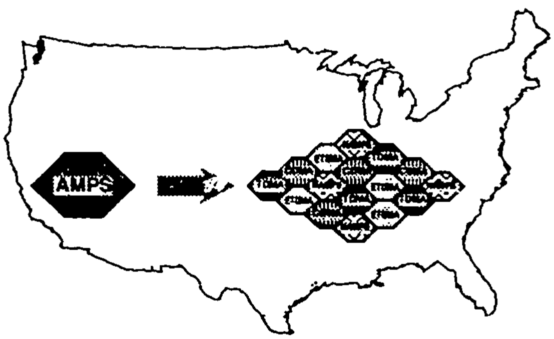

Figure 1 : MIGRATION OF RADIO STANDARDS IN THE UNITED STATES

A similar effect can be seen in Hong Kong where NAMTS, TACS, AMPS, TDMA and GSM systems are being used by the operators.

Japan has decided to go its own way with a cross between the North American TDMA standard and some facets of GSM.

In contrast, cellular services in Europe are rapidly converging on a unified standard (figure 2), and countries worldwide are beginning to follow their lead. After much fragmentation surrounding a plethora of analogue systems, a new digital system, now known as the Global System for Mobility (GSM), is being deployed universally across the European Community and in many other major countries throughout the world. It is the European GSM initiative, and its relationship to Intelligent Networks that is the focus of our attention here.

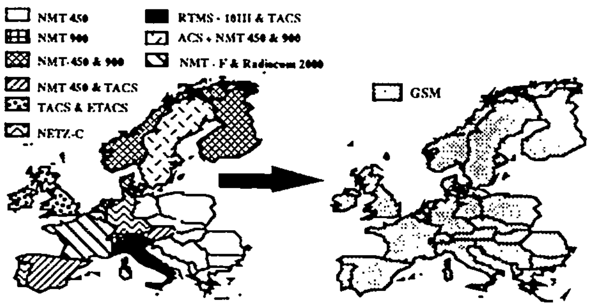

Figure 2 : CELLULAR SERVICES IN EUROPE ARE MIGRATING TOWARDS GSM

Significantly, in terms of its global acceptance, GSM has already been adopted by all of Europe, as well as Australia, New Zealand, Singapore, Hong Kong, India, Thailand, Pakistan and the major Middle Eastern countries. In addition, it serves as the basis for future digital and Intelligent Network services. It is being considered in many other countries which have not yet officially committed to a standard, such as China and Eastern Europe (Eastern Bloc), despite proposals for GSM systems being made. The population coverage of GSM is now just short of 2 billion (POPs).

The GSM standard model for mobile networks and the CCITT model for a fixed Intelligent Network have reached several points of intersection:

- the evolution of both technologies is maturing rapidly and in parallel
- in both cases, common central network intelligence and out-of-band SS7 signalling standards will deliver high speed, high capacity networks with a high degree of service flexibility. Non-channel associated signalling is a key similarity of the two network architectures
- the emergence of Intelligent Network and mobility services beyond the traditional switched-based services, is starting to converge into advanced areas such as universal numbering, location tracking, unified billing and virtual private networking.

The GSM service will provide worldwide roaming through those countries adopting the standard, high security, quality and high capacity. It will deliver the improved voice clarity associated with digital transmission, plus far greater reliability and consistency compared with analogue cellular. Data services, being inherent, are faster and more reliable - offering instant connection with no need for modems at either end of a link.

Significantly, GSM is a more comprehensive technology than is generally realised. GSM comprises a total network specification (figure 3). It defines every pertinent interface between nodes, the functionality of those nodes, from billing to network administration

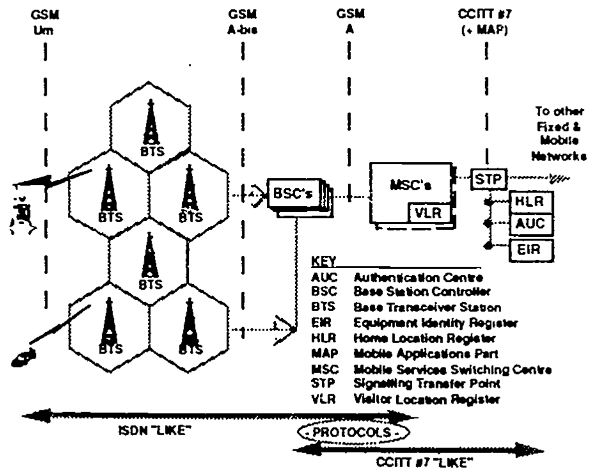

Figure 3 : GSM AS A TOTAL NETWORK SPECIFICATION

GSM is both ISDN (Integrated Services Digital Network) and AIN (Advanced Intelligent Network) compatible. In examining the components of a GSM network, it becomes clear that the GSM architecture has not been designed and specified in isolation. The experts responsible for defining GSM have both ISDN and Intelligent Networks firmly in mind. For example, some features within the specification have no direct relevance to mobile communications but are included as a recognition and expectation of future integrated mobile and fixed network solutions.

For anyone unfamiliar with digital mobile networks, GSM largely mirrors the fixed network model. GSM, however, includes radio paths for access. Subscribers communicate by radio frequencies to the Base Transceiver Stations (BTS). These are linked to Base Station Controllers (BSC's), rather like remote concentrators, which trunk their traffic to Mobile Switching Centres (MSC's). Functionality-wise, handsets will take responsibility for the man-machine interface and signal power, for example, while the Base Station Controller and other radio equipment (BTS's) perform functions such as handoff operations, radio resource management and maintenance. The switches have the intelligence to handle call processing, mobility and act as network gateways, while the central database attunes these functions to individual subscriber requirements. The whole architecture and the resulting function set have their roots in an ISDN and Intelligent Network infrastructure.

The network itself is 100% traffic carrying with no subscriber unique equipment. Subscriber identity and location are established on a per call basis. A

Mobile Switching Centre is basically a public central office switch with the additional features to accommodate this subscriber mobility. One MSC communicates with other MSC's and the fixed network, acting as an Intelligent Network Service Switching Point (SSP).

Looking briefly at the central intelligence of a GSM network:

- the VLR (Visitor Location Register) is a a temporary database for roaming subscribers who are for the moment within the associated MSC area.

- the HLR (Home Location Register) holds the subscriber's service profile (i.e. the list of services to which he is entitled) and his current status and location. The HLR is the GSM version of the Signalling Control Point (SCP) found in an Intelligent Network model.

- an EIR (Equipment Identification Register) and AUC (Authentication Centre) ensure that a mobile call is not activated by a non-authorised user or equipment.

- the STP (Signal Transfer Point) concentrates several SS7 signalling links and is connected to an HLR, the GSM version of the Signalling Control Point (SCP) found in an Intelligent Network model.

Each GSM switch is intelligent enough to understand and perform certain network functions, such as call forwarding, call barring, billing, etc. Like an Intelligent Network, the central database carries specific intelligence relating to individual subscribers profiles and instructs the switches how the inherent IN functions should be applied to meet specific subscriber needs.

Whilst GSM signalling between the central database, the mobile switching centres and other fixed parts of the infrastructure conforms to SS7 standards is parallel to that found in the Intelligent Network, it also uses the Mobile Applications Part (MAP) protocol. The signalling is independent of the path taken by the call itself. There is also a deliberate adherence to ISDN in the GSM interfaces at the access and subscriber terminal end.

A fixed Intelligent Network can, via GSM's HLR and VLR, confer virtual mobility to the fixed network customer, as well as the services associated with Intelligent Networking mentioned above.

A mobile network, with GSM at its heart, can be a natural extension of the fixed Intelligent Network - both in terms of architecture and services. In particular:

- the traffic load of fixed and mobile subscribers could be combined on the same Intelligent Switching Platform (SSP).
- both GSM and fixed Intelligent Networks depend upon parallel availability of a logically separated, digitally switched, CCITT No 7 (SS7) signalling-based infrastructure. SS7 networks for the first time segregate signalling from customer traffic, thus providing far higher information delivery speeds, service flexibility, differentiation and ubiquity.
- calls that need handling by an Intelligent Network distinguish themselves within the structure of signalling messages generated during call set-up and during the call itself. Whether the call is generated within the mobile or fixed network, call processing "triggers" provide access to the HLR or SCP via the IN infrastructure.
- GSM and the Intelligent Network have in common a database serving the whole network.
- In Europe PCN (Personal Communications Network) development is proceeding in parallel with GSM, and uses the exact same network architecture and standards. In the right regulatory environment, a true "intelligent" PCN could evolve from *either* a mobile or a fixed network operation.

GSM can therefore be looked upon as a *complete network specification* not just for digital mobile services, but for a type of Intelligent Network that can integrate successfully the mobile and fixed Intelligent Network infrastructures (figure 4).

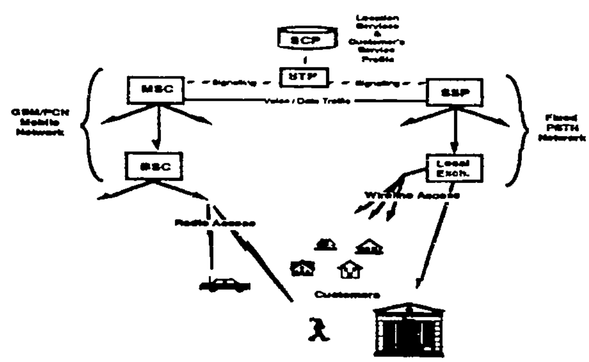

Figure 4 : GSM NETWORKS CAN SUCCESSFULLY INTEGRATE MOBILE AND FIXED INTELLIGENT NETWORK INFRASTRUCTURES

As GSM emerges and expands, both geographically and in the services it offers, the complementary nature of its architecture and administration with that of Intelligent Networks will enable such Intelligent Networks to evolve faster and more efficiently by moving to provide Personal Communications Services.

Personal Communications Services are services users demand as part of the current drive for enhanced functionality from their communications provider. In turn, such customer demands will drive the evolution of the services provided on the Intelligent Network, as is already the case in the fixed networks. In these fixed networks, both private and public, large end-user organisations have traditionally provided the investment that funds, indirectly, technological development of advanced telecommunications features.

For example, take existing PBX's with several hundred features. Major commercial organisations had the power and money to determine their development. It has undoubtedly been to the benefit of smaller businesses and of residential users that, in some markets over the last few years, these features have been made available from the public network telephone exchange.

In North America, the range of centrally provided public network business services is extensive. In fact, it is on a par with high-end PBXs in terms of functionality. Moreover, network operators have been able to offer advanced network functionality, such as Virtual Private Network features.

The vast investment in PBX-based services has been migrated smoothly into public networks. In that competitive environment, network operators have used these services to prevent the loss of their customer base which in Europe was largely protected and guaranteed to monopoly PTT operators.

In the last two or three years, some features originally developed for business customers have been repackaged and offered to residential consumers by public network operators.

North American operators now offer a host of network-based features to public users. These include basic virtual services - better known in Europe as star services - tone dialling, calling party identity, voice messaging and other innovative extensions of fixed-line functionality.

In these markets, the Plain Old Telephone Service is no longer plain.

Although still within the confines of the fixed network, the advances continue and individual users now have the opportunity to take particular sets of packaged services according to their own personal profile.

A personal profile of communications services is built up by an end user and will be remembered by the network. Instead of attaching service to a particular phone number, the network responds to the individual needs and wants of the user of that phone, flexibly and dynamically.

The fixed-line examples of advanced services highlight attempts to improve a customer's mobility and their control of availability. In assessing the likely impact of offering network-based and value-added services, figures from the North American experience suggest that uptake has been five times more than originally forecast - in some cases uptake is by 20% of all subscribers in just a few years.

Therefore, imagine the impact that true mobility, with its inherent flexibility over and above any fixed services, will have with its far greater utility. Taking that 20% as a guideline, it is not difficult to justify the forecast of subscribers for GSM and PCN.

We must not forget, though, that functionality is the key to their uptake and a lot of attention is focussed on the Intelligent Network to make this happen. A mobile network, especially a GSM network, starts with an immediate advantage; users can themselves be on the move and, as demonstrated before, it is already an IN.

It may be useful to examine the GSM network as part of the three-tier infrastructure for an Intelligent Network, in which mobility is simply one facet, sitting on top of a service-independent platform of hardware and software. The building blocks for the future services mentioned earlier are already in existence, although some are more mature than others. These blocks are service-independent and therefore will enable network operators to differentiate their offerings from each other.

Fixed network users on such an Intelligent Network can take on virtual mobility with, for example, SSP functionality in the fixed and mobile parts. Roaming subscribers can be tracked by either part.

Intelligent Network technology, applied in the mobile environment. coupled with the GSM specification and future developments such as PCN, could enable the fixed network to offer virtually everything a mobile network operator can supply.

GSM has already been developed to operate at two frequencies (900MHz and 1800MHz) and could be deployed at others. While the initial investment in an Intelligent Network may appear large, it has already been justified throughout Europe and in other parts of the world through the introduction of GSM.

Furthermore, movement towards commercial as well as technical mechanisms for inter-country GSM services has already received the blessing of the European Commission and Gulf Co-operation Council and is being embraced across the GSM community. Independent billing and services clearing houses are being formed. As new services appear, the associated administration mechanisms, such as billing across borders, will already be in place and can be carried through from the fixed to the mobile worlds and back again with no practical separation.

As the distinction between fixed and mobile networks becomes increasingly blurred into the single concept of an Intelligent Network, GSM, on a multi-national scale, with its Intelligent Network architecture becomes the key to the goal of personal mobility.

Application Of GIS Technology To Wireless

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ABSTRACT

Some of the key factors differentiating one cellular service provider from another are quality of cellular service within the coverage area, quality of customer care operations, responsiveness to customer problems, timely & accurate billing, competitive pricing, enhanced services, network reliability and reduced fraud. Applications based on the Geographic Information System (GIS) technology can assist in the areas of Customer Care, Engineering, Marketing and Network Operations. This paper will discuss benefits of the GIS technology and some key applications based on this technology.

INTRODUCTION:

During the past several years, the Cellular industry has experienced a tremendous growth. Some of the key factors differentiating one cellular service provider from another are quality of cellular service within the coverage area, quality of customer care operations, responsiveness to customer problems, timely & accurate billing, competitive pricing, enhanced services, network reliability and reduced fraud. Applications based on the Geographic Information System (GIS) technology can assist in the areas of Customer Care, Engineering, Marketing and Network Operations.

CURRENT METHODS:

Currently most of the following operations are manually performed:

- **Map look-ups:** Coverage area maps are pasted on the wall in the Engineering and in Customer Care departments. Cell-site locations and coverage areas are manually drawn on this map. Any trouble calls, for example drop calls or calls related to poor service quality, are manually plotted on this map by using colored push pins. Also, when Customer Care agents receive coverage area related inquiries, they have to manually look through the maps to determine this information which may be inaccurate or out of date.

- **Subscriber Trouble Report:** Trouble calls reported by subscribers are manually logged on a form by Customer Care agents. These are periodically transmitted to Engineering using manual methods like FAX, Voice Mail or Electronic mail. Sometimes these are hand carried to Engineering. This leads to poor communication between the two departments. Also, this makes reporting a labor intensive task.

- **Network Trouble Report:** Any scheduled outages or problems within the coverage area reported by a Network Monitoring System are either not reported to Customer Care or are reported using manual methods like FAX, Voice Mail or Electronic Mail. This makes Customer Care less pro-active at handling trouble calls in the affected geographies.

All of the above reasons lead to poor Customer Service to the subscribers and could contribute to **churn**.

GIS TECHNOLOGY:

The Geographic Information System (GIS) technology has been in existence for several years. It has been widely used in other industries like utilities, government and wireline phone companies. An ideal GIS consists of three key components. These are:

- **Map Databases:** Also known as vector databases. They include information about street addresses, highway intersections and important landmarks. When displayed on a computer terminal the streets and associated geography are represented by vectors (straight lines and curves) and are difficult for an end-user to understand (please refer to Figure-1.)

- **Raster Image:** Since the vector display is difficult to understand by an end user, it is overlaid with a scanned image (also known as a raster image) derived from an aerial photo or a printed area map (for

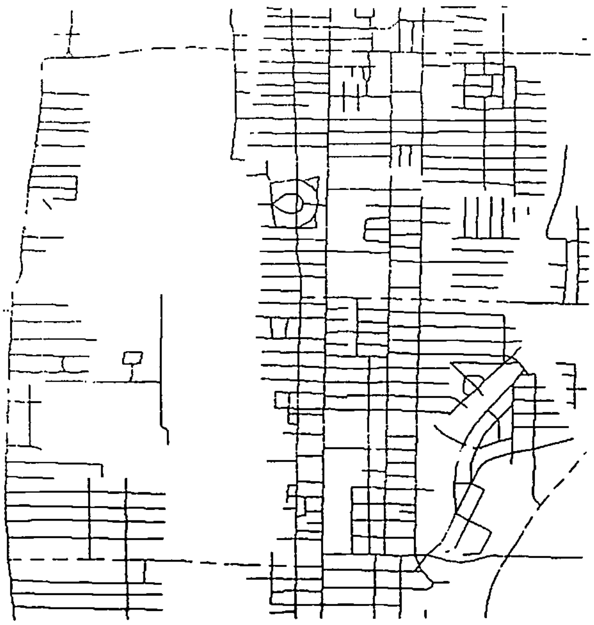

FIGURE-1: Vector Data as displayed on a computer terminal.

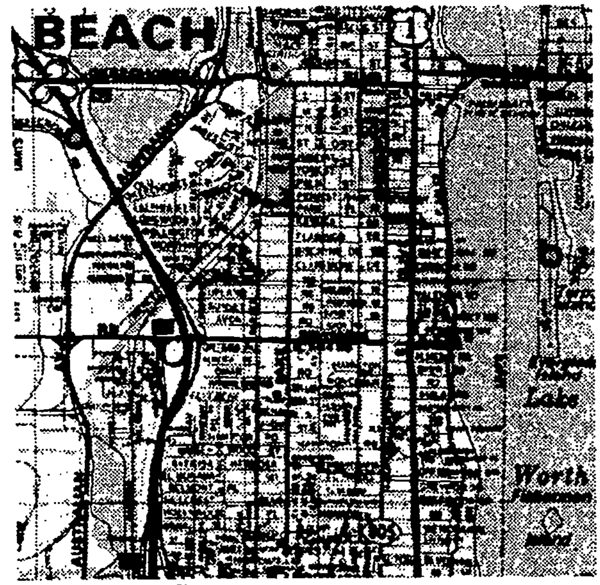

FIGURE-2: Vector Data with a Raster Overlay using a scanned area map.

example a Rand McNally map or maps available from other cartographers.) The scanned image includes detailed information like airports, parks, waterways and railroads. This allows for a friendly user interface (please refer to Figure-2.)

An alternate method of obtaining the friendly user interface is to have the software perform the area fills when the vector data is displayed. For example, when a lake is displayed in the vector form, the software could paint it blue or when a major highway is displayed, the software could draw the appropriate symbol (please refer to Figure-3.) When this technique is used the display appears very similar to that obtained from a scanned image. Also, this technique saves the cost associated with scanning an image and normalizing it with the vector data.

The raster information can further be overlaid with information about cell-sites, cell boundaries, coverage areas, MTSO's, demographic information and commercial information like restaurants, hotels, hospitals, police stations and gas stations.

- **The software**: The software to access the database and the image. It should also have the following:

  - Flexible data structures to accommodate the integration of vectors, raster, co-ordinate geometry and a powerful database.

  - A programming language or an industry standard query language interface (for example SQL).

The above features combined with a powerful CAD capability provide an excellent tool for the entire organization. The CAD function could be used to create engineering drawings, ZOOM, PAN and BOX into specific areas of the drawing and/or the map.

FIGURE-3: User friendly Raster like display using area fills. Photo: Courtesy of ETAK Inc.

G.I.S. BASED APPLICATIONS

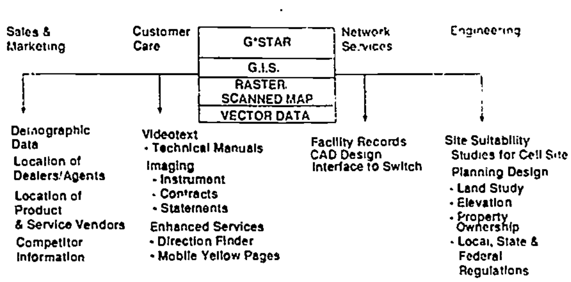

FIGURE-4: GIS based Applications in various departments of a Service Provider.

GIS BASED APPLICATIONS:

Several applications can be developed to take advantage of the GIS technology (Please refer to Figure-4). These can help improve efficiency leading to an improved customer response.

The **G*STAR** application shown in Figure-4 has been developed by Digital Equipment Corp. It consists of two modules namely the Trouble Tracking module and the Direction Finder module. When cellular subscribers report Trouble calls like a dropped call or a poor service call, special actions have to be taken. These include billing credit to the customer, inform engineering so that they can investigate the problem, post a notice if similar problems are occurring in other parts of the coverage area. As indicated earlier, manual methods are currently used to locate, log and track trouble calls. These are very time consuming and subject to error. Also, these cannot provide an information base for engineering and operations. Based on discussions with leaders in the cellular industry, Digital has structured the Trouble Tracking module within G*STAR to perform the following functions:

- Graphically display (on an electronic map) all active trouble call locations, cell boundaries, towers and MTSOs. The different types of trouble calls are displayed by using distinct symbols (for example a DROP call is represented by a square, a POOR quality call by a triangle.) The status of each trouble call is represented by a unique color (for example a call in the OPEN status has RED color, the one that has been started by engineering has a VIOLET color.) Please refer to Figure 5.

  All reports have graphic representation like Pie-Charts and Bar Graphs.

- Provide an automated, structured approach in the capture of trouble call information.

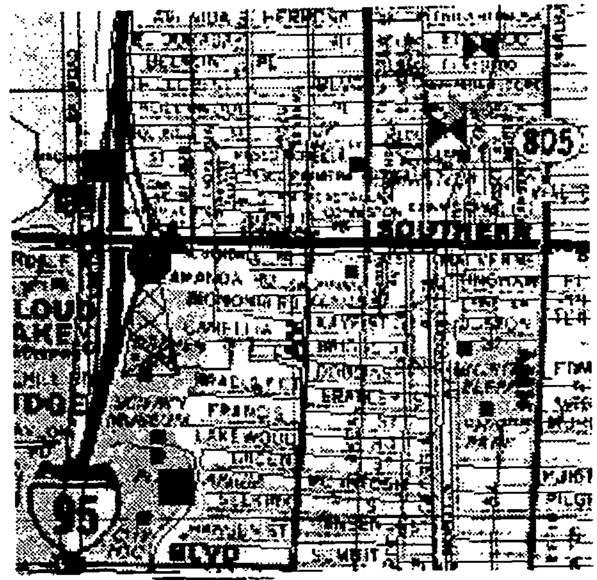

*FIGURE-5: In G*STAR symbols denote type of Trouble Call. Note the SQUARE, TRIANGLE & BOW-TIE Symbols. When seen in COLOR, the color denotes status of each call.*

- Automatically assign a real world geographical location for each trouble event. Also, automatically assign the cell-site(s) that the call can be associated to.

- Provide electronic access to all trouble call information.

- Provide adhoc inquiry capability including real-time analysis, trouble call tracking and management reporting.

- Maintain a historical file of all trouble call information.

- Provide non-graphic data entry capability to enter and update trouble tickets.

To demonstrate additional uses of the GIS technology, Digital developed the Direction Finder module for G*STAR. This module allows a service provider to give directions from one place to another to their subscribers. It has been viewed, by industry leaders, as a capability to offer an enhanced service for competitive advantages. Also, it has the potential to be a revenue generator for the following reasons:

- Encourage increased air-time usage.

- A subscriber may be charged a fixed fee for using this service.

- The Mobile Yellow Pages application (described below) may be interfaced with the Direction Finder for enhanced functionality to provide a competitive advantage and additional revenue both from advertisers and users of the system.

The Direction Finder has the following functions:

- Provide a customer with directions from one place to another.

- Enter starting point and destination by using an Address, a Landmark or by locating it on the map.

- Output can be displayed on the Screen (please refer to Figure-6), printed on a printer or saved in a file for future access.

- Integration capability to VOICE and FAX interfaces is also available.

The benefits of the G*STAR application are given below:

- Provide an accurate and timely status of each trouble call.

- Use trouble call information to pro actively enhance customer care.

- Use trouble call information for improved operations management.

- Reduce the clerical cost of the current system.

- Use trouble call information while planning for additional cell-sites.

- Use trouble call information to determine the amount of credit issued by each cell-site. The ones with the maximum amount of credit issued may be further investigated by accessing history information.

- Identify subscriber equipment problems.

- Identify subscribers that may be abusing the system of getting credits for short duration calls. This is a form of FRAUD.

- Provide engineering an opportunity to be part of customer satisfaction process by improving communications between customer care and engineering

- Improve communications between Customer Care and Engineering departments.

- The Direction Finder may be used to offer a revenue generating enhanced service.

- When geographic locations of Dealers/Agents, Product/Service Vendors are stored in the database the Direction Finder may be used to provide prospective or existing clients with directions to these vendors.

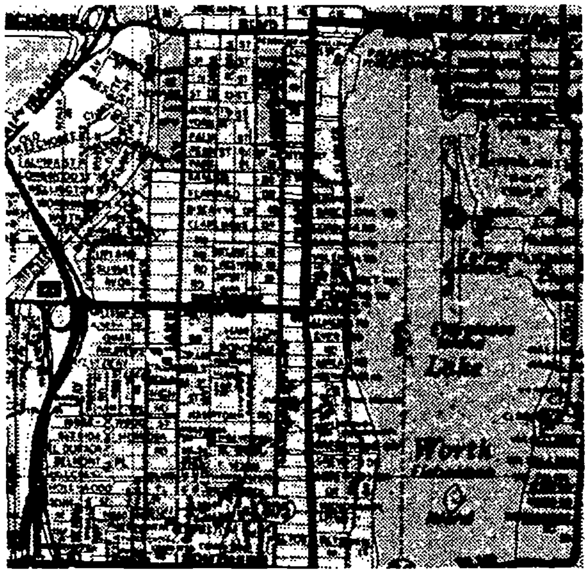

FIGURE-6: Direction Finder output on the Screen. Note the line on Belvedere, S.Olive, Royal Palm Bridge, Royal Palm Way into the Golf Course. This is a solid RED line when seen in Color.

As shown in Figure-4, other applications that may be developed by using the GIS technology are:

- **NETWORK INTERFACE:**

  Log and diagnose network related problems resulting into improved network reliability and availability.

  An interface between G*STAR and a Network Monitoring System will provide this functionality. When alarms of a certain severity level are detected by the network monitoring system, these can be passed to G*STAR for displaying on the screen. This enables a Customer Care agent to be pro-active in responding to calls from subscribers.

  When an excessive number of Trouble Calls are logged by a Customer Care agent in a given time frame, an alarm could be sent to the Network Monitoring System for an engineer to take action. This allows an engineer to be pro-active at diagnosing potential network related problems or even identifying new ones.

  This interface will also provide the capability to compare the problems reported by subscribers to those logged by the Switch.

- **REVENUE GENERATING APPLICATIONS:**

The Direction Finder is already a part of the G*STAR application.

This combined with a GPS locator may be used to provide vehicle security service over the cellular network. If a car is being stolen, the system in the car would call the nearest police station and the owner of the car.

Additional applications like the Mobile Yellow Pages may be developed to compliment the functionality of the Direction Finder and provide a competitive edge.

Using the Mobile Yellow Pages application, those businesses that wish to advertise will have their ads scanned or created using the CAD facility. The ad will be displayed at the appropriate geographic location on the map. Also, the relevant information like Category, Price, Hours of operation, Credit Cards accepted, Dress code, Service rating etc will be stored in the database. In addition to the geographic location, these ads would be organized by category for example Shopping Malls, Restaurants, Gas Stations, Hotels, Rental Car Companies, Attorneys, Hardware Stores, Car Mechanics etc. The advertising will provide an additional source of revenue to the service provider.

When a subscriber is new in town or is not familiar with a given area, (s)he could call the service provider and ask questions similar to the ones listed below:

- List of Hardware Stores that open before 8:00 A.M. or remain open until after 6:00 P.M. and are on the way to work.
- List of Restaurants closest to a given location that serve meals in a given price range and are open until midnight.
- List of Gas Stations that are located in a given part of town or those that are located on the way to the airport.

The applications mentioned above not only provide a competitive edge but also a basis for additional revenue.

- **IMAGING APPLICATIONS:**

Store and retrieve document images like those of a customer bill or a contract. Lost and misplaced contracts is a common occurrence. One of the legal requirements is to produce the original contract in order for it to be enforced. The current method could lead to loss of revenue because a contract cannot be enforced.

Also, when a subscriber calls with a billing question, they reference the bills by page numbers. Most billing systems do not have information stored in that order. In addition to the frustration, this leads to increased time on the phone and reduced agent productivity.

Currently the Customer Care agents store Technical Manuals on their desk. When a subscriber calls with a question, these are manually searched for the relevant information. Also, when these are updated, the update pages have to be manually inserted. This could lead to the information being misplaced or lost. An ideal method is to scan the Technical Manual and be able to search it electronically based on key words or be able to look at the picture of the instrument in question. This will speed the search and allow for easy and accurate updates.

- **SALES & MARKETING APPLICATIONS:**

Store and retrieve demographic information for target marketing to receive maximum benefit from advertising dollars. This would include information like the annual family income range, income range for a given area, percentage of residents in a high income area that are customers. This helps in targeting advertising to specific areas.

Store and retrieve locations of Dealers, Agents, Product Vendors and Service Vendors etc. This combined with the demographic information helps ascertain need for additional dealers, agents etc. Also, it would help identify non-performers. Information about the competition may also be stored for analysis purposes.

CONCLUSION:

Some studies indicate that a 30% reduction in **churn** can lead to as much as 15% increase in revenue. Having an efficient and well trained customer care staff armed with the right tools, a pro-active engineering department, a variety of enhanced services and a strong Sales and Marketing department are keys for success in the 90's and beyond.

In conclusion I would like to say that the GIS technology is not a new technology. It has been used and proven successful in other industries. Installing a GIS based system is like installing a platform that a user can build on. In the wireless industry, the implementation of a GIS based application will provide a 2-3 Year competitive edge and help generate additional revenue.

Computers and Telecommunications for Distance Education

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1. ABSTRACT

Network-based distance learning systems offer significant advantages over dial-up, mainframe, or host-based platforms for instruction, communication, and student interaction. This paper examines the new network-based computer and telecommunication technologies and presents strategies for their application in distance education.

2. INTRODUCTION

The computer is an educational tool valued for its ability to integrate a variety of media in interactive presentations. Computer-mediated communication has become an integral component of current distance education technologies. Online educational 'communities' and 'virtual' classrooms enable learners to interact with information which is fluid, constantly evolving, and continuously expanding.

Today, dial-up or modem-based learning systems using a central computing resource are the predominate means of providing computer-based distance education. However, new telecommunications technologies enable distance education systems to capitalize on embedded network, internet, and infrastructure services to provide comprehensive learning systems. Dynamic information from remote resources can be integrated into training and academic programs. This paper will discuss strategies for developing distance education programs using the new network and infrastructure technologies including an analysis of some new telecommunications technologies and public online resources.

3. COMMUNICATION STRATEGY

Computer communications can assist teachers to reach learners in a variety of settings and thereby bridge the gap between formal, institutional education and non-traditional education (Brookfield, 1986). Many of the concepts associated with traditional classroom learning, but absent when using conventional distance learning technologies, can be accommodated with computer communications. Teacher-student counseling and student-student collaboration can be an integral part of an electronically delivered instructional program. In addition, users may access the resources at their convenience to download exercises, respond to questions, or customize their learning to meet individual needs (Long, 1983; Gooler, 1987; Hayes, 1989; Duning, 1990; Moore, 1990; Hopper, 1991).

3.1 CLASSROOM APPLICATIONS

Computer-mediated learning uses personal computers as the main medium of communication between instructors and students. Communication is not with the computer, but with the teacher through the computer (Hayes, 1989), with the objective an improved teacher-student communication process (Hiltz, 1990). Thus, networking is not only a technology, but a sociology--a means to communicate and share ideas (Edelhart; 1987; Thachenkary, 1987). Applications may range from simple classroom support using electronic mail and bulletin boards; to elaborate conferencing systems featuring pictorial displays of class members and real-time information transfer (RTZ, 1992); to online universities which use computer communications as a primary means of information delivery (Berlfein, 1991). Communication may be immediate (teleconferencing), delayed (correspondence), or simulated (computer-tutorial) (Garrison, 1987; Wells, 1992).

3.2 IMPLEMENTATION SCENARIOS

Computer-mediated distance learning systems are generally based on proprietary information platforms and services. In a typical application, a student calls into a remote computer system to exchange mail, participate in a conference, or complete an assignment (Lauzon & Moore, 1989). The host computer may be at the institution offering the program or be part of a contracted service. These systems may be referred to as 'modem-based, host' systems.

The advent of desktop workstations, and network computing, has expanded systems capabilities to enable students to connect to national networks and receive a full range of online information services. Instructors may use the Internet to develop curriculums which regularly feature input from dynamic resources (Maule, 1991b, 1992a). These services may be referred to as 'network-based, infrastructure' systems.

Next-generation distance education technologies will integrate public and private telecommunication services, incorporate industrial laboratory simulations, and support the real-time monitoring and control of the network and all of its resources. 'Virtual-network, cooperative' services will feature on-demand multimedia, video conferencing, collaborative computing, and Internet information access.

3.3 INTERACTION

Historically, computer communications have been hindered by inconsistent user-interfaces and irregular patterns of human-computer discourse (Ridgeway, 1989; Straub & Wetherbe, 1989). However, new graphical computing software enables user-interfaces to be designed with standardized screen displays using machine commands which function identically across multiple platforms, networks, and operating systems (Molich & Nielsen, 1990). Thus, a heightened capacity for student interaction and collaboration across networks is possible, making the medium a truly remarkable and unique resource for education (Davie & Wells, 1991).

Software now enables intelligence to be programmed into interfaces to create learning systems which maintain and apply information about users to further enhance communications (Jacob, 1986; Higgins, 1989). Increasingly, the network will seem transparent as intelligent interfaces, search, and retrieval mechanisms manipulate, process, and present data in formats appropriate for the user (Rockart & Short, 1989). Of course, such communication functions are dependent on the capability of the underlying telecommunications infrastructure.

4. TELECOMMUNICATIONS STRATEGY

The goal of telecommunication planners is to create a global digital highway, open to all users, with universal access into totally open networks (Pelton, 1990). The Government Open Systems Interconnection Profile (GOSIP), and the High-Performance Computing Act of 1991, accomplish these objectives by establishing open networks as a national priority with standards for network interoperability (U.S., 1988; U.S., 1991). The next step is the extension of high-performance networks into homes and the development of information partnerships among government, industry, and education (Roberts, 1990; Johnson, 1992). Distance education providers will need to be prepared for an era of ubiquitous computer networking and systems which support voice, data, and images, in any combination, anywhere, at any time--and with convenience and economy (Mayo, 1992).

4.1 INTEROPERABLE SYSTEMS

Voice and data operations began merging in the late 1980s. Simultaneously, applications for centralized mainframe computing lessened as organizations adapted to desktop workstations, networks, and distributed computing. A new generation of information managers emerged as network technologies empowered end-users to improve organizational communications (Opper & Weiss, 1992). However, the proliferation of independent development platforms caused network compatibility problems and a movement to control distributed systems from central operations (von Simson, 1990).

In the 1990s, standards for open systems promise to shift information responsibilities back to end-users, but without the interoperability problems prevalent in the 1980s. The computing environment of the 1990s will be characterized by client-server models supplanting hierarchical master-slave systems, and peer-to-peer associations among participants on the networks (Madron, 1991). Hybrid public-private computer networks and information systems will be part of a new information order featuring global interconnectivity and cooperative information services (Elbert, 1992; Heldman, 1992). In addition, the infrastructure, rather than being a system that supports other services, will become a programmable intelligence that can be distributed, managed and reconfigured by the user (Mulgan, 1991).

4.2 INTERNETWORK COMMUNICATIONS

Today's local-area network technologies such as ethernet and token-ring, and wide-area network technologies such as X.25 and dial-up (modem-based technologies), are too slow to meet the needs of tomorrow's distance education programs. The new generation of services solve LAN interconnection bottlenecks by offering high speed communications and bandwidth on-demand (Lippis & Herman, 1991).

At the local level, the fiber distributed data interface (FDDI) operates at 100Mbps and is an upgrade to existing ethernet or token-ring LANs. FDDI is presently used as a backbone technology in campus environments to interconnect LANs, but is also a viable desktop technology for media intensive applications such as network or workgroup-based simulations.

FDDI-II operates at 600Mbps+ and is competing with Switched Multimegabit Data Service (SMDS) (1.5Mbps to 34Mbps+) as a technology/service to interconnect LANs within a metropolitan-area. SMDS is also being tested as a national service. FDDI-II and SMDS will enable interconnected LANs to perform as one large LAN--an ideal situation for distance education networks within the same city. However, wide-area communications are needed for most distance education applications and for access to remote information services.

Frame Relay is the immediate heir to X.25 for wide-area network (WAN) communications. It is a fast-packet technology and operates at speeds up to 1.54Mbps. It has been demonstrated transmitting full motion video. However, interactive video, complex multimedia, and instructional applications featuring intensive multi-user interaction, (i.e., computer supported collaborative work across a distance), will require both powerful local and wide-area network technologies and a means to integrate a variety media. Asynchronous transfer mode (ATM) offers a solution.

ATM is one of the most talked about new technologies. It operates between 45Mbps and

1.26Gbps and is a solution for local-area network communications, LAN-WAN integration, and wide-area multimedia internetworking (Cerf, 1991; Pentland, 1992; Williamson & Titch, 1992). ATM is both a computer and telecommunications technology. Computer networking enthusiasts view ATM as a high-speed network switch. Telecommunications carriers use ATM in wide-area telephony for central office and inter-exchange switching of video, voice, and data (via synchronous optical networks). ATM will accommodate both hardware and software-based multimedia and is programmable to enable users to define personalized, intuitive services (Dunning, 1992; Sekimoto, 1992; Smyth, 1992). Thus, educators can integrate onto ATM all of the various media technologies comprising a state-of-the-art distance learning system.

The Integrated Services Digital Network (ISDN) is a solution for student access into the local laboratory LAN. It is a hardware-based voice-data-image telecommunications technology which as a residential service offers medium speed data (64Kbps to 128Kbps) with simultaneous voice (McQuillan, 1992). ISDN will enable students to connect to campus LANs from home for multimedia and internet communications. National ISDN will link interexchange carriers to provide access to multiple switched services over a single circuit including digital dial-up, X.25, and Frame Relay (Lippis & Herman, 1991; Aloia, Fitzgerald, & Kaufman, 1992). While the data speeds are rather slow in comparison to other technologies, several companies are selling ISDN boards which support desktop videoconferencing making ISDN an interesting alternative for those desiring a turn-key solution or wishing to provide students with advanced telecommunications capabilities from home (Bajarin, 1992). Residential ISDN services are priced comparable to existing telephone rates.

Multimedia into the home at higher data rates such as 1.5Mbps can also be accommodated through high-bit-rate digital subscriber line (HDSL) or asymmetrical digital subscriber line (ADSL) services on twisted-pair, copper plant (Sutherland & Litteral, 1992; Stewart, 1992). HDSL and ADSL have yet to be publicly priced for residential applications. In the long term, broadband multimedia communications via fiber-optics are inevitable simply because the maintenance costs are so much lower than for copper plant (Negroponte, 1991). The full potential of distributed multimedia applications will be achieved through broadband ISDN, the Synchronous Optical Network (SONET), and software which supports collaborative work (Doll, 1992; Hoshi, Takahashi, & Mori, 1992).

A final problem confronting distance learning providers and also solved by the new telecommunications technologies involves bandwidth allocation. New network applications can be programmed to provide only the bandwidth or media capacity needed at any given point in time. Bandwidth can be changed automatically and instantaneously even for simultaneous sessions in multiple locations making network management nearly 'transparent' (Bessey, 1992). For educators, such capabilities mean that information and telecommunications budgets and services can be established for sessions, groups, or projects. The cumulative effect is that network managers may soon be able to treat bandwidth the way a utility treats energy sources, converting back and forth between sources and supplies depending on what is cheapest at the time (Anderson, 1992).

4.3 NETWORK COSTS

A cost-benefit analysis of the new telecommunications technologies for applications in distance education is somewhat difficult to establish using traditional measures. Distance education technologies have generally been deployed as independent applications specific to a predefined audience, and as such, costs are distinct and measurable. Network-based, infrastructure technologies are pervasive, upgrading organization-wide communications and providing benefits to an entire population. In addition, infrastructure development costs are offset by reduced operating expenses and amortized across participants including education, industry, business, and government.

Infrastructure costs are also difficult to budget because networks may be established as voice-data public telephony services, as data communications technologies, or as a mix of public and private services (Casner & Deering, 1992; Heldman, 1992). For example, improvements in compression technology have cut the bandwidth needed to transmit acceptable images for videoconferencing to 1/75th of that required in the late 1970s (Doll, 1992) making even the most complex media transfers within the domain of both computer network and telecommunications carriers.

At the local level, costs for FDDI have fallen dramatically and are available for $1200 to $2000 per node (Van-Mierop, 1992). For wide-area communications, frame relay services are expected to fall to less than existing 56Kbps or T1 service to bring network access under $100 per month. Savings will be pronounced as multiple remote sites access the public network eliminating the need for expensive, dedicated lines. Transparent LAN-MAN interoperability for metropolitan and wide-area communications can be achieved using SMDS at $550-$750 per month (Travis, 1992). Private ATM long distance offerings, and the introduction of PC-based ATM cards, have expanded the potential of the technology to include true LAN-WAN integration at gigabit speeds. ATM is presently expensive at $9000 per node, but costs are expected to fall to $1000 per node by 1995 (Johnson, A., 1992). ATM WAN switches will also process consumer and commercial ISDN traffic.

5. NETWORK CURRICULUMS

Active learning, peer learning, integrated subject learning, and real-world learning are important when designing distance or technology delivered education (Knapper, 1988; Winkler, 1992). Online, collaborative environments support interactive learning. Within shared environments, participants may experience a variety of information and perceptions as users share resources and experiences. The cumulative effect may be to produce not only new and different information, but new and different approaches to learning, as participants serve as both teachers and learners in partnership with other learners (Duning, 1990; Riel & Levin, 1990).

A strong communications infrastructure is a strong ally for education, enabling students to interact with rich intellectual resources, including distant teachers, libraries, and museums (Kay, 1991). Combining text, images, sound, color animation, and full-motion video, multimedia will transform networks of desktop machines into distributed workspaces ideally suited to collaborative projects (McQuillan, 1992). Networks may provide educational services to students at school, work, or home--complete with laboratory simulations, online conferencing, and collaborative computing. Building network capabilities into the curriculum requires a strategic or phased approach.

5.1 PHASE 1: LABORATORIES

Interactive multimedia documents, self-contained hypermedia instructional programs, and computer-generated simulations enable students to engage in exploratory learning and master difficult concepts on their own terms and at their own pace. Simulations require a supportive media environment built around the simulation (van Joolingen & de Jong, 1992) and multimedia communications provide this support. People learn more, and more rapidly, when they can simultaneously see and hear while practicing new concepts (Hamilton, Smith, McWilliams, Schwartz, & Carey, 1992).

Multimedia or hypermedia instructional systems can be implemented as stand-alone applications for use in remote sites, or as network-based resources integrated into computer-mediated communications (Maule, 1991a, 1992b). Distance learning systems which integrate voice and image conferences, laboratory simulations, and online collaborative projects require sophisticated network management tools.

5.2 PHASE 2: NETWORK MANAGEMENT

Infrastructure-based services, wherein control and responsibility is diffused and embedded throughout the network, may be used to build curriculums which reflect the dynamic nature of today's workplace. Instructional processes can readily be adapted to reflect changes in the global economy. Network tools enable users to create collaboratively, and to rapidly disseminate shared learning experiences.

Future distance learning systems will use advanced telecommunications switching systems, a variety of interoperable networking technologies, and a mix of public and private telephony, network, and information services (Heldman, 1992). Fortunately, new tools place network control in the hands of instructors. Software-based applications allow instructors to program telecommunications and wide-area network services (Jackman & Lee, 1992). Programmable, on-demand bandwidth will dramatically reduce costs for video conferencing and multimedia communications. Wide-area networks will be fully configurable to accommodate a wide variety of simultaneous communications (Lippis, 1992).

Network management tools enable instructors to monitor data hubs, information servers, bridges, routers, and clients--all from their desktop (McBride & Brown, 1991). The software features X-Window technology, graphical interfaces, network maps, point-and-shoot commands, and color-coded icons for ease-of-operation. These management tools enable instructors to monitor laboratory simulations, oversee network resources, and use simulations which span networks and operating systems while retaining full collaborative and conference capabilities. Thus, instructors can dynamically initiate and guide student projects as groupware applications internetwork students on distributed LANs allowing them to work, share information, conduct conferences, and dynamically access information from distributed data bases, electronic bulletin boards, and other network resources (Edwards, 1992).

ISDN will prove attractive as a service to interconnect residential and small business sites into educational networks and public information services. A typical network-based application may involve a shared workspace with participants simultaneously annotating and altering memos, diagrams, spreadsheets, graphs, and other documents--all while conducting a conference featuring audio and short video segments sent interactively or through electronic mail (McQuillan, 1992). Student attendance at the lab may be optional as home telecommunications services enable students to access network resources from local calls into the laboratory LAN for simultaneous, multi-party videoconferencing, cooperative computing, and groupware applications.

5.3 PHASE 3: INFORMATION SERVICES

Network-based services use a variety of different information search, retrieve, and dissemination mechanisms. Bitnet (or CREN), Internet, and Usenet are the major public networks and host several interesting resources and network software applications. The services provide comments and articles posted on electronic bulletin boards and newsgroups, process messages to multiparty mailing lists, and provide files and programs for free and public file transfer (Johnson, J., 1992). Instructors can use infrastructure resources to supplement reading assignments, to initiate student-student conferences with peers around the world, and to serve as a platform for network-based collaborative projects.

Network applications can be programmed as research aids for information access from distributed resources (Tennant, Ober & Lipow, 1992; Johnson, J., 1992). For example, 'Archie' is a program which helps users locate Internet sites and media appropriate for anonymous downloads. 'Hytelnet' is a hypermedia utility for locating Internet libraries and information services for remote login. 'xLibrary' is a multi-tasking hypermedia application which allows multiple, simultaneous network services. 'Wide-Area Information Servers' (WAIS) retrieve information from distributed databases, through a common interface, and are useful for keyword searching across large library collections.

A new and popular application is the Internet 'Gopher' for searching modular, distributed databases. It features a browsing tool and subject-oriented menus to search, retrieve, and display documents. Gopher servers have links to other Gopher servers enabling users to move seamlessly from network to network, resource to resource. An even more sophisticated application is the 'World-Wide Web' which uses hypertext to organize and access resources from across the Internet. It goes beyond Gopher and WAIS by providing pointers and chains within the text. These resources, when combined with online, interactive, multiuser communications, enable users to conduct a conference while interactively retrieving information from around the world. The Internet Relay Chat (IRC) is a multi-user, distributed, multi-platform, client/server software system which supports such conferencing.

Electronic distribution lists enable instructors to gather and distribute information across the networks. National mailing lists or 'listservs' also archive information for access through electronic mail commands making them useful for research. Comserve (vm.ecs.rpi.edu) is a comprehensive online resource offering mailing list services, electronic professional journals, bibliographic reference databases, and academic courseware. The Coalition for Networked Information (cni.org) stores information on national policy concerning infrastructure development. PACS-L (unmvm.bitnet) distributes the latest information about public online access services. As the name implies, NetTrain (ubvm.ccbuff.edu) distributes network training information.

Electronic newsletters may be distributed through prescribed mailing lists, or through the listserv utilities described above. The National Science Foundation Network newsletter (merit.edu) keeps readers abreast of NSF sponsored Internet activities. The wide-area information servers newsletter (think.com) addresses the impact of programmed intelligence for automated network information searching (WAIS). There is also a growing trend toward the electronic distribution of trade and academic journals. Indexing and archival features eliminate tedious legwork for researchers and students.

As public domain journals become an established and accepted means of professional publishing, and the journals are archived in databases compatible with wide-area searching systems, it is conceivable that researchers and students will enter search commands to scan journals throughout the world, locate needed sources, and retrieve appropriate data. Prominent electronic journals include 'The Online Journal of Distance Education and Communications' (uwavm.u.washington.edu), 'EJournal' (vacsc2.albany.edu), and the 'Electronic Journal of Communication' (comserve@vm.ecs.rpi.edu).

Library services and bulletin boards are some of the most popular online resources. There are presently over 150 domestic and 120 international online library catalogs with access by subject, title, author, and in some cases, key word and full text searching. European catalogs can be accessed through the National Science Foundation relay server (sun.nsfnet-relay.ac.uk) which provides access to the JANET information system of the Open University.

U.S. Government services include the National Science Foundation (nis.nsf.net), the NSF Science & Technology Information System (stis.nsf.gov), the National Technical Information Service (osi.ncsi.nist.gov), NASA (spacelink.msfc.nasa.gov), and the Library of Congress (dra.com). The National Public Telecommunications Network has established 'free-nets' as comprehensive bulletin boards organized to resemble electronic cities--complete with a city hall, library, post office, hospital, and town hall. Free-nets provide public data communications services to compliment the services of National Public Radio and National Public Television. Two of the more popular free-nets are at Cleveland (cleveland.freenet.edu) and Case-Western (freenet-in-a.cwru.edu). Free-nets are a popular method for organizing information and should be considered for university-wide information services--including distance education.

6. DISCUSSION

The evolution to network-based information delivery seems a certainty. Success will be measured by the quality of the information and the efficiency of the communication--as evidenced by the degree to which resources are readily available to instructors and students through institutional information systems. Successful implementation may require that users learn new ways of performing intellectual tasks and new ways of thinking about communications (Mulgan, 1991).

High capacity, wide-area communication networks are expensive and necessitate shared and common services. Educators may take advantage of cooperative networks and public information services to initiate partnerships with industry and government. Such partnerships might help alleviate current training problems facing employers. Infrastructure-based services also afford institutions the opportunity to strengthen interorganizational communications between universities, local schools, and the community.

The implementation of infrastructure-based services is timely as educational institutions become increasingly aware of the need to integrate their centralized and decentralized information architectures, seek to determine whether media transfer should be based on voice-data technology or high-speed internets, and recognize the need for organization-wide training and education to support information management within distributed and heterogeneous environments.

Instructors using networked communications and infrastructure resources benefit from the convenience of desktop communications, from the application of an easily assimilated mechanism for increasing interaction among students, and from the implementation of network resources which serve to keep students abreast of the latest information in their field while simultaneously aiding them in their efforts to establish ties with peers in industry, business, and government. Students appreciate the convenience of being able to communicate from home into laboratory LANs and for exposure to the wealth of knowledge available to them through the global information networks. One of the more interesting aspects of the new information technologies is that they enable users to shape their personal learning programs and learning environments.

Additional research is needed to determine the proper mix of the various communication technologies; to ascertain the impact of network-based communications on traditional information structures; to determine information and design processes for the distribution of information to various home, work, and social environments; and to determine application designs to achieve specific learning outcomes.

7. CONCLUSION

Available network-based distance learning technologies support multimedia communications, on-demand conferencing, and distributed workgroup applications. However, the systems integration necessary to fulfill the promise of such technologies has been slow to evolve due to the unusual nature of developing infrastructure services. Eventually, the issues will be addressed as institutions evolve into distributed information management, adopt inter-organizational communications, evaluate alternative carriers for wide-area and multimedia communications, and discover the need for cooperative infrastructures to accomplish their learning objectives.

The high cost of switching technology necessitates shared equipment and partnerships among business, industry, government, and education. Given the need for workforce retraining, and the impartial nature of education, distance learning providers may be uniquely qualified to prototype society-wide information applications and be instrumental in infrastructure design and development.

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THE CONTRIBUTION OF DISTANCE HIGHER EDUCATION TO NATIONAL DEVELOPMENT IN PACIFIC ISLAND COUNTRIES

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1. ABSTRACT

One of the major purposes of this paper is to present some of the preliminary results of research initiated by the National Institute of Multimedia Education (NIME) in Japan, in cooperation with the University of the South Pacific (USP), on the impact of distance higher education in the South Pacific. Specifically, this paper will discuss the results of attitudinal surveys and extensive interviews conducted with students from almost every Pacific Island member country of USP and from a wide range of backgrounds. The implications of these results will be discussed against the background of national development aspirations, the role, function and effectiveness of satellite based tutorial instruction for higher education, and the potential socio-economic effects of the provision of extension program services on the respective Pacific Islands societies. Finally, issues will be raised to highlight possible directions of future study and application and what role Japan, or other rim countries, could play.

2. INTRODUCTION

The countries of the Pacific Islands region are spread across an area of ocean three times the size of Europe and far larger than the continental United States, yet possess an aggregate land area of less than 63 thousand square kilometers—an area no larger than Denmark. And, excluding Papua New Guinea, there are little more than 1.5 million people living on the more than one thousand islands that make up more than a dozen separate countries scattered across this vast ocean area.

Likewise, all of these Pacific Island countries, with the exception of Nauru, have aid-dependent, or at least aid-augmented, economies with total per capita aid flows ranging from US$62 in Fiji to US$2,800 in Niue. Likewise, the per capita gross national product (GNP) also varies widely, ranging from US$430 in Tuvalu to US$1,770 in Fiji and US$1,958 in the Cook Islands (*Pacific Economic Bulletin* 1992, June).

English is used in both conventional and distance education and is a reflection of the Pacific Islands collective colonial heritage. For the majority of university students, English is their second language or, at least, not their mother-tongue as there are approximately 265 languages in the region (UNESCO 1992). Although English is everywhere taught in schools, standards vary widely and are often quite low.

The education systems in the Pacific Island countries are generally separate, different and autonomous; reflecting colonial and/or missionary history using a British derived educational model with the exception of the Marshall Islands which follows a North American model, and Vanuatu which uses a combination of both British and French models.

In tertiary education, there are some 13,000 full-time students throughout the region. Almost a third of them at the University of the South Pacific (USP), the only significant regional institution teaching at the university level. The other two-thirds are at some forty institutions throughout the region, half of which have fewer than 100 students each. There are, in addition, nearly 3,000 students studying at universities outside the region, mostly in the rim countries. This distribution of students is in many ways uneconomical. For example, at the university level the cost of a student at a rim university is three or four times the cost at USP for a comparable course. It was recently estimated that the total overall annual cost of all 16,000 students is some US$85 million, of which about 70 percent is spent on the one-fifth who study outside the region, and only 30 percent on the four-fifths studying in the region (Caston 1992).

Thus, if there is a region of the world that could benefit from an educational network, it is the Pacific Islands region. If there is a group of academics who need to link with each other and with colleagues elsewhere, the answer is also those working in the tertiary institutions of the Pacific Islands (Wah 1992).

With the founding of USP in 1970, it was envisioned that significant alteration in the provision of higher education in the Pacific Islands region would be realized and, through cooperative efforts, the tyranny of distance might be overcome. USP is a regional university, as apposed to a national university, established to serve the higher education needs of 11 Pacific Island member countries: Cook Islands, Fiji, Kiribati, Nauru, Niue, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu and Western Samoa. In 1991 the Marshall Islands joined USP as the 12th member of the consortium and the first to be added since its founding. The main campus is located at Laucala Bay in Suva, the capital of the Republic of Fiji, with an Agricultural campus located at Alafua in Western Samoa. There are also two other instructional and/or research complexes, located in Vanuatu and Tonga, as well as the research oriented Atoll Development Project in Kiribati. For students studying through the USP Extension Program, regional centers have been established near the capital cities of ten of the member countries (Tokelau is served from Western Samoa and the Marshall Islands have yet to establish a regional center).

This paper focuses on research conducted by the National Institute of Multimedia Education (NIME) with financial support from the Ministry of Education in Japan and in collaboration with the University of the South Pacific. From mid-1991 through early-1992 survey and interview teams visited each of the extension sites as well as several rim country locations to collect information on the life-styles and attitudes of students learning through the distance education programs provided by the Extension Services of USP and/or graduates of such programs. Such research was initiated because, despite its functional importance, research on the actual operation and dynamics of USP's regional study centers, the role and impact of satellite based tutorials, as well as the impact of distance higher education on students' social mobility and their attitudes toward development, was basically non-existent.

3. OBJECTIVES AND METHOD OF NIME RESEARCH ACTIVITIES IN THE PACIFIC

Since 1989 NIME has been conducting research to clarify the state of distance higher education institutions in Asian and Pacific countries, financially supported by the Ministry of Education in Japan. During 1989, Sukhothai Thammathirat Open University in Thailand and the Universitas Terbuka in Indonesia were selected as the research sites. In 1990, the Indira Gandhi Open University in India and the Allama Iqbal Open University in Pakistan were also studied by the research team. For 1991, USP's Extension Services was selected. Each research project attempted to clarify the *real* state of distance higher education for each institution. The overall research project is expected to continue through 1993 and will include the sending two research teams to Korea and Malaysia (initiated in 1992) as well as China, which will be studied as the last and largest research site. When completed, this rather ambitious project should provide educators with an overall image of distance higher education in Asia and the Pacific region.

3.1 PACIFIC ISLANDS RESEARCH OBJECTIVES

The 1991-92 research project in the Pacific Islands region had the following two objectives:

1. To examine the current state, role and effect of USP Extension Services and its various regional centers. Also, the function of each regional center was to be evaluated in relation to the respective geographic, socio-economic and cultural conditions present in each island society in which the Extension Program is operated. Special focus was placed on this aspect of the study in order to determine how regional centers perform in relation to the reciprocal process between internal and external factors of socio-economic development present in the island societies.

2. To see how the USP Extension Program affects national development in each island society; especially human resource development. Focusing on both the social and regional mobility of students and graduates of the distance education program, the role and function of distance education were to be examined in terms of the human resource development aims and goals within the respective island society. In addition, this research tried to clarify the unique characteristics of human resource training through USP distance education in comparison with those individuals who received their training in the metropolitan universities of the Pacific Rim; countries such as Australia, New Zealand, Hawaii and the West Coast of the United States.

3.2 METHODOLOGY

This study placed a great deal of emphasis on field interviews with students and graduates. Needless to say, the examination of each learners' behavior is one of several important factors to be assessed in any research concerned with education's impact. However, many research programs on distance education conducted in the past have tended to depend largely on data collected through the central administration of the distance education institutions, rather than through visits and observations of the "realities" of the learners themselves. This tendency might be due to the difficulties and inconveniences of visiting remotely located study centers, especially those in Asian and Pacific countries.

In view of the principles of educational research, however, it is nearly impossible to grasp the *real* state of distance education without field interviews. In this study, we endeavored to persevere in the application of interview techniques as the principle method of our research in order to compensate for weakness we saw in previous studies of this type.

The responses obtained through these surveys and interviews were compared among the six different student and graduates categories. The six categories are as follows:

1. Students resident at USP's Suva Campus.

2. Island students learning through the Extension Program and resident in their home country.

3. Islanders studying in metropolitan universities on the Pacific Rim; including, rather non-geographically, Hawaii.

4. Island residents who completed the Extension Program in their home country.

5. Islanders who graduated from USP Suva Campus and were resident in any of the island locations of the study.

6. Islanders remaining in Pacific Rim countries after their graduation from metropolitan universities in these countries.

Interviews covered a wide range of subjects relating to the individual's learning behavior and motivation, life-style, life-history of their education, social mobility, social status and expectation, ethnic identity, and their motivation to participate in nation building (self-defined by the respondent). We selected approximately 150 samples of students and graduates from the main campus and each regional center. In addition to these, we also selected about 50 samples from students and/or graduates from universities in metropolitan cities outside of the South Pacific Region; such as Honolulu, San Francisco and Berkeley in the United States, Auckland, Palmerston North and Wellington in New Zealand, and Brisbane in Australia.

By adopting such a research methodology, we could obtain significant and interesting findings on the students and graduates of higher education institutions in the greater Pacific Region.

4. OVERVIEW OF DISTANCE HIGHER EDUCATION IN THE PACIFIC ISLANDS

As was mentioned earlier, distance education in the Pacific Islands region has one major provider, the University of the South Pacific. Consequently, the overview of distance education in the Pacific Islands covers mostly the activities of USP's Extension Services. However, it should be noted that in the early 1970s, there was much activity conducted over the PeaceSat satellite network on which USP and other institutions in the Pacific region experimented with the use of satellite tutorials and teleconferencing to support distance education as well as other educational activities (1).

Extramural Studies began in 1970 and were initially operated by the School of Education (later renamed the School of Humanities). Later, in 1971, Extramural Studies was reorganized as Extension Services with its own director and facilities. The first distance education courses were offered primarily in education and were oriented toward a Diploma in primary and/or secondary education with in-service primary and secondary school teachers as the principle clientele. Today, Extension Services offer approximately 175 courses leading to a Certificate, Diploma or Degree in 30 different programs along with vocational and continuing education programs. In 1990, there were approximately 6,451 enrollments in Extension Services (mostly in-service teachers or public servants) and about 7 full-time staff—academic and non-academic—as well as many part-time local lecturers and staff (2).

The distance courses are primarily print based. Satellite tutorials—experimentally implemented in 1973 on PeaceSat and, since 1986, conducted via USPNET using the INTELSAT VI satellite—are used to supplement learning packages with attendance being optional. Students principally study from the core materials, developed by the centrally located curriculum development team. These learning packages usually consist of at least two printed texts; the *Introduction and Assignments* booklet, and the *Course book*. Ancillary components might include a *Reader*, textbook(s), audio tapes and/or video tapes. USP's traditional commitment to its distance students is to provide them with the home-based teaching packages containing all that they need for learning and mastery of the Extension course subject matter (UNESCO 1992).

Other centrally provided instructional support services for the region include satellite tutorials on USPNET, visits to the regional Extension Centers from course tutors based on the main campus in Suva, and personal correspondence with students as well as teaching through assessment. The need for such interaction between the students and the instructors is great, but is in some cases poor to non-existent, except for comment on assignments (which can occasionally arrive to students after the final examination!). The feelings of isolation experienced by many distance education students is multiplied by the meager postal system in some countries or exacerbated by the inefficient, expensive or inadequate telecommunications systems both in-country and internationally (Wah 1992).

For the above reasons, the in-country educational support provided by the national USP Extension Centers is very important. The Extension Centers in each member country of USP serve as the clearinghouse for all materials and assignments as well as functioning as the liaison between local students and remote teachers. In many locations, these centers provide, on a regular basis, continuing education radio programs along with occasional television programs and public lectures. Also, face-to-face tutorials with part-time local tutors and/or peer group tutorials provide additional support to the distance education materials. The Extension Centers are also the site of the teleconferencing facilities for satellite tutorials, library services, computer facilities, classrooms and study space. Many centers also circulate bulletins or newsletters for their students, offer training in study skills, course counseling, practical laboratory sessions (were possible and required), and "bridging" courses. For many Pacific Island students, the national Extension Center **is** USP.

5. HUMAN RESOURCE DEVELOPMENT AND USP

Following this somewhat lengthy, but necessary, introduction to the form and nature of distance education in the Pacific Islands region, we turn our attention to the outcome of our study. What did the results of our research reveal about the impact of distance higher education on development in the Pacific Islands? The nature of the data precludes an easy answer, however, our findings did reveal some interesting results which are presented in summary below (3).

First of all, what did our study reveal about the relationship between human resource development and USP distance education? In part, it was found that USP Extension students and/or graduates seemed to be more motivated to work or study abroad than there counterparts who were students and/or graduates of USP's residential campus, or even those who attended metropolitan universities in the rim countries (Table 1). For many Extension students, the distance education programs provided by USP seemed to whet their appetite to move further afield. It appears that while participating the Extension program they became more inclined to want to move abroad desiring to seek out better educational or economic opportunities than those available at home.

This situation seems unlikely to change, at least in the near future, and would lead one to expect a continuing and severe shortage of qualified man power in the Pacific Island countries. However, this would only be a superficial conclusion. In reality, many Extension students are participating in distance education as a way of gaining university level credits towards their desired degree while marking time until they qualify for a government scholarship to study either at USP's main residential campus in Suva, or overseas at a metropolitan institution. Indeed, for such countries as Kiribati or Tuvalu, the USP Extension program functions as a means of providing an opportunity for those who completed their secondary education but failed to receive a government scholarship, to once again re-apply for a university level education rather than enter the job market or seek vocational training. Furthermore, many Extension students are older than average university freshmen and are already employed and/or have families and are unwilling to commit to full-time studies until their future financial situation as a student is more secure. Also, Pacific Islanders, as with anyone else, want for themselves and for their children the expansion of personal capabilities that higher education brings. For many Extension students who live in very small communities, this also involved a desire to travel, to experience living elsewhere, or even to emigrate.

For those who choose to migrate—and there are some who do (4)—it results less from their exposure to Extension studies and more from the almost complete integration of the island labor markets (at least for the professionally and technically qualified) into the wider Pacific labor markets of Australia, New Zealand and even the United States and Canada. For such individuals who maintain strong family linkages to their home communities, there is also the likely sending back of remittances. In Western Samoa and Tonga for instance, such remittances are the largest source of foreign exchange (Ogden 1989). From this point of view, people can be seen as a valuable export, as long as traditional and extended family loyalties continue to operate in ways that ensure they go on sending home a part of what they earn overseas.

Another interesting result of our research—having impact on human resource development in the islands—is shown in Table 2, which describes the degree of job satisfaction among the six different categories of respondents and was used as an indicator of an individuals motivation to seek change. Of these categories, according to the data, USP Extension graduates showed the greatest levels of discontent with their present jobs and, likewise, the largest gap concerning job satisfaction before and after the enrollment. In other words, by enrolling in the Extension program, the student's level of discontent seems to be magnified further. The trend seems to be even more striking when the economy of the country is weak, job opportunities are slim, and the desire to migrate greater.

Perhaps this is to be expected, after all, if an individual is dissatisfied with their present employment they are likely to seek change. However, in a constricted job market such as that found in most Pacific Islands, such aspirations result in frustration. If such frustration becomes perceived as insurmountable, an individual either gives-up or goes elsewhere; except in the Pacific Islands.

For most Pacific Islanders, the government is the largest employer and the employer of choice offering slightly better salaries, better job tenure, and a certain level of social status. Unfortunately, there is also little opportunity for career advancement, and subsequently higher salaries, without obtaining a higher level of training and education. Many Extension students already experiencing some level of job discontent, and frustration at seeing recent university graduates promoted above them, see participation in Extension studies as a means of job mobility. Island governments promote this by re-embursing tuition to public servants who pass their courses and pay increment raises to those who obtain certificates, diplomas and degrees. However, other factors begin to come in to play—perhaps an individual's desire to travel to other places to obtain a higher degree, to gain a higher salary overseas, or study in a field not offered via Extension studies—and frustration and discontent build.

From these findings it may be inferred that the more education islanders gain through USP Extension programs, the more they become inclined to move abroad; or at least the more likely they are to contemplate migration as an option to their present circumstances. Ironically, however, when we conducted the same survey in the rim countries, we found very few Islander students among the interviewees who had previously been enrolled in the Extension program in their home islands. This seems to indicate that, in reality, the number of those trained through the Extension program flowing out of their home islands is much lower than was to be expected—despite the likelihood expressed by many of the interviewees of this category. An alternative assessment of this situation could also indicated that they are going to one place, USP's main campus in Fiji, where worries of gaining credit for their extension courses is moot and the possibility of gaining alternative employment in one of the many regional organizations located there is equally attractive.

Thus far, from the preliminary findings of our research, it may be stated that USP Extension Services contribute to island countries in promoting the expansion of professional knowledge and skills necessary for social and national development. At the same time, it also contributes to a possible increase in Islanders educated or trained through the Extension programs feeling frustrated because of a general lack of job mobility or scarce employment opportunities commensurate with their educational background. This may in turn result in some leaving to seek better opportunities in the rim countries and taking their education and skills overseas for application in a higher-wage job market.

6. EVALUATION OF USP AS A REGIONAL DISTANCE HIGHER EDUCATION INSTITUTION

In the assessment of USP's Extension Services as an effective institution for the delivery of tertiary education at a distance, we asked respondents to indicate how beneficial they thought USP Extension courses were in obtaining employment or promotions in their home countries (Table 3). Our preliminary results imply that students attending metropolitan universities evaluated the program least favorably followed by those currently attending USP's Suva campus. Extension students, as would be expected, gave the program the most positive evaluation with the advantage of being able to continue full-time employment while attending Extension courses (and the encouragement to use practical application of their course work in their employment; and conversely, application of work related experiences in course assignments) as its primary strength. From this it may be inferred that the formation of a mild form of social stratification may be emerging in the island societies based upon the "prestige" attributed to metropolitan university graduates, USP Suva Campus graduates, and those completing the Extension Programs (in that order). This was also mentioned in the interviews with islanders now playing important roles in the local, regional and/or international scene.

6.1 THE EXTENSION CENTERS

The USP Extension Centers, which form a unique and vital part of the USP system, appear to be under strong influences determined by the socio-economic circumstances of their respective island country. Therefore, the facilities and services provided vary from one center to another. Table 4 shows how regional services vary among the member countries.

It also appears that these centers have the potential to develop in ways that excel anything most USP member country governments could conceive (Ogden 1992). It would therefore seem important that USP's Extension Centers be seen not only as a viable means of providing higher education at a distance, but also that they foster a strong sense of belonging to the communities to which they serve; since for many, the Extension Centers **are** USP.

Of these Extension Centers, some have large enrollments and excellent facilities and equipment similar to those in Fiji. Whereas there are countries such as Tokelau that do not have their own facilities and are thus further disadvantaged by having to be served by a center in an adjacent country. Also, in the utilization of the communication satellite, it was found that there was a great gap between and among the member countries. Many of the Extension Centers are provided with free or very low cost access to the USPNET by their local telecommunications provider and therefore capable of communicating via INTELSAT. Alternately, there are some countries, such as Nauru or Niue, that have to substitute HF radio contact for their tutorials and therefore suffer from bad audio quality and generally inadequate capabilities. Finally, there is the case of Kiribati which has thus far been refused other than commercial rate access to satellite facilities by the local telecommunications company whch it cannot afford and is thus cut off from participating in USPNET. In all cases, much technical (and political) difficulty is experienced with "last mile" connections and some locations are forced to use break-down prone equipment that is some twenty plus years old.

6.2 SATELLITE TUTORIALS

USP, in many ways, pioneered the use of communication satellites for distance tutorials in the Pacific region. Today, the combined satellite/HF system which makes up USPNET is used heavily for administration and teaching. Administration includes weekly staff meetings on distance education matters, the continuing education program, materials dispatch monitoring and directorate-to-center business, and point-to-point sessions. Whereas instructional use of the satellite/HF system still continues, it has diminished in importance due to technical difficulties (Wah 1992). However, when questioned about the possible effectiveness of satellite based tutorials, we obtained predominately positive responses, as shown in Table 5. This seems to indicate that many consider satellite based teleconferencing for educational purposes to be an appropriate technology vital to the promotion of higher education in the Pacific Islands.

Rather disappointing, however, was the evaluation of satellite teleconferencing by students who actually *participated* in tutorial sessions. This data also showed a high degree of variation from one country to another. In the analysis of the evaluation research conducted by the USP Extension Services in 1991 (and collaborated by our data), the appraisal of the practical effect of satellite based tutorials was relatively low, as indicated in Table 6. Interestingly, the evaluation was relatively high in Fiji, Solomon Islands and Western Samoa, while it was very low in Nauru and Vanuatu. Positive responses tended to stress the importance of gaining feedback from the instructors who mark the exams and learning from fellow satellite tutorial participants' questions. Negative responses tended to concentrate on the poor audio, complexity of discussion, and/or the time such tutorial sessions were held. It should be noted that this gap in evaluation among islands may be due not only to the technical aspects of the satellite tutorial sessions (audio interference) but perhaps also to extenuating socio-linguistic factors.

Although seeing the virtues to satellite based instruction, USP still has much difficulty in maintaining its distance education system, utilizing in some places technology that is at least twenty years old. To this end, the university has also been actively seeking to improve the system. A high powered committee of the vice-chancellor was recently formed to spearhead this endeavor and has recently developed a document outlining the requirements for a proposed upgraded system, which was approved by USP's Council in October 1992 (Wah 1992). USP remains committed to providing distance education to its member countries and is seeking the means to do so with relevant communications technology.

7. CONCLUSIONS

Today, institutions of higher learning in both the developing and developed countries of the Pacific are increasingly being asked to adapt more quickly to the changing technological and educational needs of the societies they serve. As such, universities are now not only the agents of change, but are having to undergo radical change themselves as they adjust to meet the educational needs of the 21st Century (Ogden 1992). USP is busy attempting to build the necessary telecommunications infrastructure that will guarantee their students and faculty equitable access to information regardless of geographic location. The goals are to make the equipment of distance training as transparent as possible, to improve the delivery of educational materials, and to promote the financial, socio-cultural, and political resources to bring this about. Many see such efforts as defining the core of the respective Pacific Island country's national goals for human resource development; both through the innovative organization and delivery of institutionalized learning as well as non-traditional forms of distance and continuing education. The results of our study indicate that there is still much to be done.

Toward realizing this, a network of "human development centers" has been established in Okinawa, Fiji, and Hawaii for Pacific economic and technical cooperation by creating a flexible technical transfer system in which one can choose a place for study in accordance with the technical level and content desired and needed by his/her home country.

Also, the "human development network" structure will most likely be the basis for any progress of individual projects anticipated hereafter. As such a project, the National Institute of Multimedia Education has been promoting a project called the *Partners Project*, to establishing an international educational network beginning some time in 1993 using various innovative communication technologies available on the ETS-V satellite. However, this is still at the experimental stage and yet to be implemented fully.

8. NOTES

(1) For more information on the early use of PeaceSat see, M. Ogden, D. Teoh & V. Young (1984). *The satellite that would not die: A case study of the PeaceSat Project.* (unpublished manuscript) Background Paper for Working Group #15 *Learning Networks*, **PTC'85**, Honolulu, HI.

(2) Most faculty members are full-time employees and divide their work duties between non-distance education and distance education instruction. Almost all of the part-time staff are employed by the Extension Centers and work only in support of distance education; their numbers fluctuate from semester to semester and are employed at local discretion.

(3) The authors wish to thank fellow research team member Dr. Fumihiko Yoshida, Associate Professor of international relations at Tokai University, for processing the original raw data and providing the initial statistical reports which were used in the tabulation of the data presented in this report.

(4) According to a public lecture given by former USP Vice-Chancellor Geoffrey Caston, a World Bank funded tracer study of 1985 and 1988 cohort graduates from four Pacific Island countries (Fiji, Kiribati, Solomon Islands, and Western Samoa) revealed that a very high proportion of these graduates emigrate to the rim countries. Of the 1985 and 1988 cohort graduates, about one-third are now working overseas. Moreover, large numbers of those who had not yet emigrated said they were likely to do so in the future (Caston 1992).

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Table 1 Expectation for Immigration

Is there any country/city in which you want to work or study in the future?

	Yes	No	Total
1. Students at USP Suva Campus	6 24.0%	19 76.0%	25
2. Island students learning through the Extension Program	16 41.0%	23 59.0%	39
3. Island students in metropolitan universities in the Pacific Rim	9 25.7%	26 74.3%	35
4. Island residents graduated from USP Suva Campus and others	5 29.4%	12 70.6%	17
5. Island residents completed the Extension Program	8 53.3%	7 46.7%	15
6. Islanders remaining in the Pacific Rim countries	8 42.1%	11 57.9%	19
Combined categories	20 55.6%	16 44.4%	36
Total	72 38.7%	114 61.3%	186

Table 2 Job Satisfaction

Are you satisfied with your present job? Were you satisfied with the job that you had before you entered your University/USP Program?

	Yes, definitely	Yes, to some extent	Not quite	Definitely not	Total
1. Students at USP Suva Campus	3 42.9%	3 42.9%	1 14.3%	0 0.0%	7
2. Island students learning through the Extension Program	14 46.7%	10 33.3%	4 13.3%	2 6.7%	30
3. Island students in metropolitan universities in the Pacific Rim	8 61.5%	3 23.1%	2 15.4%	0 0.0%	13
4. Island residents graduated from USP Suva Campus and others	11 64.7%	3 17.6%	2 11.8%	1 5.9%	17
5. Island residents completed the Extension Program	5 35.7%	4 28.6%	4 28.6%	1 7.1%	14
6. Islanders remaining in the Pacific Rim countries	10 55.6%	4 22.2%	2 11.1%	2 11.1%	18
Combined categories	21 63.6%	11 33.3%	1 3.0%	0 0.0%	33
Total	72 54.5%	38 28.8%	16 12.1%	6	132

Table 3 Evaluation of USP Extention Programs

In general, do you think graduates from USP Extension Program are benefited from the aspect of obtaining a job or promoting to a better position?

	Yes, definitely	Yes, to some extent	Not quite	Definitely not	Total
1. Students at USP Suva Campus	12 52.2%	10 43.5%	1 4.3%	0 0.0%	23
2. Island students learning through the Extension Program	25 64.1%	12 30.8%	2 5.1%	0 0.0%	39
3. Island students in metropolitan universities in the Pacific Rim	15 50.0%	13 43.3%	2 6.7%	0 0.0%	30
4. Island residents graduated from USP Suva Campus and others	11 61.1%	5 27.8%	2 11.1%	0 0.0%	18
5. Island residents completed the Extension Program	9 60.0%	5 33.3%	1 6.7%	0 0.0%	15
6. Islanders remaining in the Pacific Rim countries	12 75.0%	3 18.8%	0 0.0%	1 6.3%	16
Combined categories	24 68.6%	9 25.7%	1 2.9%	1 2.9%	35
Total	108 61.4%	57 32.4%	9 5.1%	2 1.1%	176

Table 4 Conditions of Regional Centers

Country	Regional Center	Independent Facility	Participation in USPNET	Access to INTELSAT
Cook Islands	x	x	x	x
Fiji	x	x	x	x
Kiribati	x	x	Disconected in 1988	-
Nauru	x	-	x	HB radio
Niue	x	-	x	HB radio
Solomon Islands	x	x	x	x
Tokelau	-	-	x	x
Tonga	x	x	x	x
Tuvalu	x	-	x	HB radio
Vanuatu	x	-	x	x
Western Samoa	x	-	x	HB radio

Table 5 Evaluation on the Satellite Tutorials

Do you think satellite-used tutorial is effective for the advancement of learning activities in Pacific island countries?

	Yes, definitely	Yes, to some extent	Not quite	Definitely not	Total
Fiji	12	15	2	0	29
	41.4%	51.7%	6.9%	0.0%	
Polynesia	32	13	7	1	53
	60.4%	24.5%	13.2%	1.9%	
Micronesia	10	3	4	0	17
	58.8%	17.6%	23.5%	0.0%	
Melanesia	13	6	2	0	21
	61.9%	48.6%	9.5%	0.0%	
The Pacific Rim Countries	22	6	2	0	30
	73.3%	20.0%	6.7%	0.0%	
Total	89	43	17	1	150
	59.3%	28.7%	11.3%	0.7%	

Table 6 Evaluation of Satellite Tutorials

How helpful were any satellite tutorials you attended?

	Cook Is.	Fiji	Kiribati	Niue	Nauru	Solomon Is.	Tonga	Tuvalu	Vanuatu	W. Samoa	Total
Very helpful	1	39	2	0	0	8	0	2	0	2	54
	3.7%	22.4%	20.0%		0.0%	13.1%	0.0%	14.3%	0.0%	16.7%	
Of some help	0	12	3	0	0	6	0	1	0	3	25
	0.0%	6.9%	30.0%		0.0%	9.8%	0.0%	7.1%	0.0%	25.0%	
Of hardly any help	0	3	1	0	0	0	1	1	0	0	6
	0.0%	1.7%	10.0%		0.0%	0.0%	16.7%	7.1%	0.0%	0.0%	
Did not attend any	26	120	4	0	5	47	5	10	14	7	238
	96.3%	69.0%	40.0%		100.0%	77.1%	83 3%	71.4%	100.0%	58 3%	
Total	27	174	10	0	5	61	6	14	14	12	323

The Georgia Vocational Education Network:
Training, Econoric, and Technical Implications

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1. ABSTRACT

The Georgia Tech Communications Laboratory, working through the Georgia Center for Advanced Telecommunication Technology (GCATT) is pursuing the development of the Georgia Vocational Education Network (GaVEN). The proposed network is focused on the goal of reaching a vital group with new technology and educational resources: the 180,000 students in Georgia's Vocational Training and Adult Education System. The long-term vision is to migrate to SMDS and eventually B-ISDN services, providing network capacity that can be utilized by not only the education centers, but businesses, government and other entities.

2. INTRODUCTION

It has been widely recognized that the link between workforce education and economic development is strong. In recognition of that link, a Vocational Education Network is proposed for Georgia (GaVEN).

This paper discusses the proposed approach to network development, desired services and benefits, expected payoff, and the unique partnership pursuing the project to bridge the gap between the growing economy of metro-Atlanta and the rest of the state. Providing connectivity to the State's adult education centers will put unprecedented network capacity within thirty miles of more than 95 percent of Georgia's population.

Since 1988, enrollment in the state's technical schools has jumped 38 percent. Many education and economics experts have questioned whether the state's vocational schools are up to the task of educating workers to compete in the Global information economy. "Information education" of rural Georgians is critical: outside metro Atlanta, only 16 percent of the population over age 25 have a college degree.

The GaVEN initiative seeks to meet challenges on four fronts:

- to capitalize on existing momentum in several key telecommunications and related information industries;
- to develop (through a leveraging of technology and educational infrastructure) a well-trained and ready workforce;
- to catalyze growth in information intensive industries through development of telecommunications infrastructure in the form of "information highways" in all of Georgia;
- to focus limited resources on fulfilling the promise through industry, university, and government partnerships and initiatives.

A functional GaVEN will be pursued through the Georgia Center for Advanced Telecommunications Technology (GCATT). GCATT is a telecommunications-focused element of the Georgia Research Alliance. The Research Alliance fosters cooperation between the business community, government and six key research universities in Georgia.

GCATT is currently emphasizing many programs in basic and applied research, service programs in distance learning and telemedicine, economic development and public policy issues. Several key industry players have expressed interest in participating in the network development in a university/ government/industry partnership.

3. ONGOING INITIATIVES

A key step in the development of the GaVEN will be to play off existing initiatives and the existing communications infrastructure for education. For example, the ongoing Georgia ClassConnect Distance Learning trial was initiated by BellSouth, NEC America and Georgia Tech in 1991. The trial is based on two-way video and audio using DS-1 circuits. Currently involved in the trial are four high schools in metro Atlanta and Columbus, as well as Georgia Tech, the University of Georgia, Morris Brown College and Columbus College.

This trial and others like it provide an opportunity to utilize "advanced" telecommunications technology in readying the workforce of tomorrow with skills that will be necessary in the information-based economy. It also provides a stimulus for the extension of key telecommunications networks and services to parts of the state and region that have not been traditionally served as well as the larger metropolitan areas.

Another example of combined educational outreach and infrastructure development activity in Georgia is the Georgia Tech Satellite Literacy Project. Initiated in 1989 with two remote sites, the program has grown rapidly and now serves more than 60 sites in Georgia. Programming on the educational network originates at Georgia Tech, and offers people with poor reading and writing skills a chance to improve their skills. Students have ranged in age from 17 to 79 years old and hail from all parts of the state--this is a program which truly embraces all of the people of Georgia. Recent site additions to the network include Warm Springs in conjunction with the Roosevelt Institute. Some other sites include Albany State College, Georgia Southern University and Athens Area Tech.

These trials and others utilize a communications framework consisting of about 350 satellite communications terminals, several hundred modems and less than one hundred CATV connections. Given that there are over 1700 primary and secondary schools and more than thirty adult and vocational educations centers in Georgia, the current communications capability to support delivery of educational services is clearly inadequate.

4. PROPOSED APPROACH

To improve the communications infrastructure to support delivery of educational services and programming in Georgia's adult and vocational education centers, the goal is to leverage from existing distance learning initiatives in Georgia and the region. This will be done by defining the information transport requirements to and from the 32 units of the state vocational school system.

Additionally, information flows to allow distance learning and other data transport applications to be applied in and around the vocational education centers will be characterized. This is a key point, because the proposed intent for GaVEN is not only to allow delivery of educational programming and real-time, two-way interaction and multicasting. A second motivation is to put in place transmission and networking capacity in the state to spur the development of "information intensive" businesses which are replacing traditional low-wage manufacturing enterprises in many regions of the rural south.

Thus, the goal is not only to provide educational mechanisms to train and re-train the workforce in "information-age skills" using an integrated services network, the goal is also to catalyze economic development in rural and semi-rural areas by providing infrastructure to allow business which require varying levels of telecommunications connectivity to locate in these regions.

A few statistics will underscore the need for this secondary benefit: First, the median household income in the Atlanta Metropolitan Statistical in 1990 was $34,595 (in 1990 dollars). In the rest of Georgia, the median income in 1990 was $21,920. Second, twenty-one counties in Georgia exceed the state average for the percentage of the population with a high-school diploma--71 percent. Ten of the 21 were in metro-Atlanta. Clearly, there are two Georgias, and there is a real need to deliver now-unavailable educational services to rural Georgia and to spur economic development there as well.

Once the necessary information flows have been characterized, needlines and other connectivity issues will be overlaid on to a proposed, broadly-based network planning effort for the State. The State Department of Administrative Services and the Public Services Commission, in cooperation with GCATT, are developing plans for this effort, which will examine the networking needs of the state for administrative functions, the University System and the State School Superintendent (K through 12), as well as the Department of Technical and Adult Education.

The current concept for the State network to meet all of these needs is an ATM ring of ten to twelve nodes located primarily in the larger cities. Radiating from these major switching centers would be DS-3 and DS-1 sub-networks carrying traffic to less populous and lower communications traffic density areas. The overall goal for the state network is to migrate current and future traffic to a new platform and new transmission technology.

Analysis completed to date is encouraging: the cost tradeoffs between DS-1 and DS-3 services given current tariffs should allow cost savings when currently separate leased services are bundled in many locations. Furthermore, when these services are trunked onto the broadband ATM ring, additional efficiencies are expected.

An ambitious goal with target date of the year 2002 is to allow any classroom in the state to be connected to any other. While switching facilities may ultimately provide this capability cost-effectively, it is not likely that premises equipment (including workstations, monitors and cameras allowing two-way video and multimedia connection between any two rooms in the state) will be affordable. Nonetheless, this goal is presented here to frame the complexity of the switching fabric envisioned for Georgia.

If the overall state network technology migration and the more focused GaVEN is to be successfully implemented, several factors must be addressed. First, a phased approach to implementation must be utilized because the state cannot absorb the capital costs of the conversion/ implementation over a short period. Second, early break-even on lease costs must be achieved. Otherwise, the recurring costs in bringing up the new network in phases will cripple the effort financially.

Third, a migration path to ATM/SONET allowing the offering of broadband services must be accommodated. Without broadband services, the "new" network would simply be a recasting of existing capability. Fourth, centralized network management must be accommodated. Without it, efficiencies in combining the many state network users on a single broadband transport infrastructure may never be realized. Finally, the network must accommodate new users and services, including potential use by third parties not affiliated with the state such as new information-based industries.

5. EXPECTED PAYOFF

The number of service jobs surpassed the number of manufacturing jobs in the United States in 1988. In the South, displacement of low-wage manufacturing workers is especially acute because of the heavy concentration of these jobs in the region. Technology advances in telecommunications can "soften the impact" of this transition.

Not only will the implementation of GaVEN facilitate growth in service and information-intensive industries, we must also strive to retain and create new manufacturing jobs which will also be driven by telecommunications technology in supplier/manufacturer/vendor/consumer networks.

A bonus benefit of a focus on development of an information infrastructure for regional use and economic development is that the technologies and techniques applied here are also extendable to almost any region of the Globe. This provides an unprecedented opportunity for industry in the region to benefit from direct improvements in regional information infrastructure, but also from connections with the global infrastructure and from the business base derived from infrastructure development elsewhere.

These benefits are in addition to the direct yet difficult-to-measure benefits of making educational services more widely available.

6. ELEMENTS OF THE PARTNERSHIP

GCATT, the State Department of Administrative Services and the telecommunications, CATV, and media industries form the partnership that can make GaVEN a reality. Atlanta and Georgia have great momentum in key telecommunications and related information industries which will contribute greatly to fulfilling this promise. BellSouth, with its headquarters in Atlanta and its focus on the Southeast region, is historically the most significant factor in the development of the region as a telecommunications hub.

Additionally, the Atlanta region enjoys a position as a key network center for broadband corporate networks for multinational companies. A key factor in the development of this capability is the city's stature as an international fiber hub, with more than 29 separate fiber paths in and out of the city versus, for example, less than a third that number for New York.

Also key to the Georgia region's leadership in moving toward an integrated information infrastructure are high-profile information service, programming, and content origination organizations such as Atlanta-based Turner Broadcasting System and Cox Enterprises.

7. SUMMARY

The Georgia Center for Advanced Telecommunication Technology (GCATT), in partnership with the Georgia State agencies and industry in the region, is pursuing the development of the Georgia Vocational Education Network (GaVEN). The proposed network is focused on the goal of reaching a vital group with new technology and educational resources: the 180,000 students in Georgia's Vocational Training and Adult Education System. The long-term vision is to migrate to SMDS and eventually B-ISDN services, providing network capacity that can be utilized by not only the education centers, but businesses, government and other entities.

This paper has reviewed ongoing initiatives in the application of telecommunications technology to education in the state, and demonstrated the need for the network as a catalyst for educational enhancement and economic development, particularly in rural Georgia. The proposed approach to development of the network has been reviewed, as have the expected direct and indirect payoffs of implementation, and the elements of the partnership pursuing the network.

In addition to this initiative, GCATT is currently emphasizing many programs in basic and applied research, service programs in distance learning and telemedicine, economic development and public policy issues.

First Steps in Multimedia Telecommunications: Using ISDN for Educational Delivery

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1. Abstract:

This paper analyzes the ISDN Distance Learning Trial held in Vancouver, BC, Canada, which delivered high school credit courses to adult learners. Data collected through interviews, observation. and video analysis are presented and analyzed to assess whether the ISDN project fulfilled its goal of promoting educational interactivity (i.e., collaborative learning, active student participation) and of enhancing student accessibility (geographic as well as technical), as well as to assess the relative benefits and overall utility of using such a system for distance instruction in adult learning centers.

2. Introduction and Background:

The use of computer-mediated communication systems for educational delivery is having a major effect in expanding educational delivery and enhancing the quality of educational interaction, especially with regard to encouraging active learner participation and collaborative learning (Harasim, 1990; Harasim et al, 1993; Hiltz, 1993; Mason & Kaye, 1989). Most online educational activities to date use electronic mail or computer conferencing: asynchronous, text-based message systems. The introduction to North America of ISDN (Integrated Services Digital Network) communications technology enables the creation and use of multimedia educational environments, made feasible with ISDN's increased transmission speeds for voice, image, and data signals.

The Electronic Classroom:

The project created an "electronic" or "online classroom" in Vancouver, Canada, by linking four Adult Learning Centers using an ISDN network and four interactive multimedia workstations (MDLWs), one at each center, to enable image, audio, and data conferencing. Each workstation included a microcomputer, microphone, preamp, speakers, writing tablet, and light pen. The project used BC Tel's ISDN technology and the MDLWs, which offered image, audio and data conferencing to the students and teachers, were developed by MPR Teltech, a research and development subsidiary of BC Tel. The students and teacher could talk to one another using the microphone and to input, share and alter images using the screen, scanner, light pen, mouse and/or keyboard.

The multimedia workstation provided a many-to-many synchronous communication environment, a space that could be employed to support collaboration and interaction that simulates and possibly enhances a conventional classroom. There were many new challenges to mediated educational collaboration, such as the need to reformulate the curriculum design and teaching methods used, training teachers and students, and determining the viability and suitability of ISDN technologies for such tasks.

Timeline:

The project covered two phases: Phase 1 (February to June, 1992 and Phase 2: October, 1992 to January, 1993). Two courses, Introduction to Math 11 and Western Civilization 12, were offered to students enrolled in the online program. Math 11 was dropped shortly after implementation in the 1st Phase, due to technical problems and the lack of computer tools appropriate to this subject., but reintroduced in Phase 2, when changes such as the introduction of a light pen were implemented. In Phase 2 both courses are being offered.

Characteristics of the Users:

Students ranged in age from 18 to 25 years of age, returning to complete their high school program. Approximately 20% of all the students in the project were immigrants to Canada and spoke English as a second language. Besides the ISDN course, students also registered in one or two traditional classroom courses. Few had previous computer experience. Students were all given instruction in the use of the equipment.

The two teachers involved in the project were experienced adult educators who had taught their subjects in the adult learning centers in past, using traditional face-to-face approaches. Neither teacher had ever used a computer for communication or as a primary educational tool for teaching and learning and one had never before used a computer at all. An MPR technician was present throughout the class sessions to provide technical support. Teachers also received training in the use of the new computer technology. Some training in curricular design issues and approaches for new media was provided.

Description of Activities:

The ISDN classroom consisted of four sites. One, referred to here as the local site or center 1, included the teacher and several students in a regular classroom; at the three remote sites (centers 2-4), the students had ISDN access to the teacher and to the other sites. At the local site, students sat in groups of

2-3 to a table while the teacher, monitor and microphone were located at the front of the room. There were about 4 empty rows of seats (approximately 30') between the monitor and the back tables where the students sat. The teacher spent most of her time directly in front of the monitor. At the remote sites, the students also sat at a significant distance from the equipment. The monitor was about 10' away and the microphone was about 4' away from the students. The computer monitor and equipment were about 15' from students.

The teacher, located at center 1, presented lectures and interacted with students at the remote sites using audio conferencing and image conferencing to show images that had been scanned and distributed among all four sites prior to class. Students at the local site had access to all the conferencing equipment. Students in the remote sites used the audio channel to communicate with the teacher and peers at other sites, and had access to other input devices such as the light pen, keyboard, and mouse.

Technical problems beset course delivery throughout Phases 1 and 2 such as problems with the functioning of the ISDN line and the MDLW, the fact that the high quality audio linkup was not available, and a host of other computer related difficulties. At various points, the project team considered removing the technology and reverting the course to a traditional face-to-face format but did not do so because both the teacher and the students requested to continue with the ISDN mode of delivery.

3. Research Methodology:

Data were collected using interviews, observation, and analysis of video records. The interview data was generated at the conclusion of the Western Civilization class in Phase 1. There were 16 student respondents and 2 teacher respondents. This data is presented in section 4. User Perspectives.

Video tape recordings were made of the Western Civilization class in Phase 2, over three different days. Class proceedings were videotaped from two locations [one in which the teacher and 25 students are located and a remote center with 6 students]. Segments of 30 minutes (15 min. from the local center and 15 from the remote center) were selected and analyzed for their representative value. In addition video outputs of the computer activities were recorded and analyzed. Thus, 120 minutes of activity were studied. The tapes were analyzed according to the nature of teacher activity, the nature of student interaction, and the nature of the user-technology interaction. Video analysis is presented in section 5. Usage Interaction Patterns.

4. User Perspectives:

4.1 Student Perspectives:

Phase 1 students were interviewed regarding three main issues of ISDN delivered classes: stability and effectiveness of the network; the degree of student interaction and class participation; and other course issues. Sixteen students [who had all completed the course] responded (see Table 1). It should be noted that these comments came from those who were able to successfully complete the course under difficult conditions and that they tended to be highly motivated and committed to making the project work. Overall, student evaluation was favorable, and most said that the ISDN course was as good as or better than other (face-to-face) courses that they had taken at the learning centers.

Course Completion Rates:

Phase 1 of the project had a somewhat higher dropout rate than previous (traditional) offerings of this course and course completion rates should be tracked over subsequent offerings of ISDN courses to have a higher sample size.

Table 1. Student Evaluation of the Western Civilization Course Compared with Other Traditional Courses (N)

	Worse	Same	Better
a) student interaction	3	5	8
b) student participation	2	11	3
c) your participation	2	8	6
d) access to teacher	3	7	6
e) lectures	3	9	4
f) assignments	3	9	4
g) group work	3	6	7
h) student presentations		6	10
i) your enjoyment of the course	2	1	13
j) course as a whole	2	10	4

4.2 Teacher Perspectives

Two teachers were interviewed: the Math 11 teacher and the Western Civilization course teacher. Their comments on impact on teaching time and the impact on student interaction and participation are shown below.

Impact on Preparation Time:

Both teachers noted that teaching by ISDN required significantly more preparation time, especially the first time that a course is offered online. Initially, the process of setting up and scanning in a slide took about 30 minutes per slide. Given that each class might require up to 20 or 30 slides, this was a time consuming process. By the end of the term, the scanning process required 15-20 minutes per slide.

The teachers noted, however, that subsequent offerings of the same course significantly reduced the preparation times, since the slides were already stored in the computers. Additionally, experience with the system increased the teacher's level of comfort and confidence in using the new technologies.

Teacher Views of Student Participation Online:

In rating the level of class interaction and participation online, teacher views differed according to the course. As can be seen in Table 2, the Western Civilization teacher consistently rated student interaction as good or excellent. In sharp contrast, the Math teacher consistently rated student interaction and participation as poor or terrible, especially at the remote sites. Moreover, their assessment of the MDLW and ISDN delivery differed.

Technological Fit with Course Content:

A major issue was that of the fit between the delivery media and the course content. This has less to do with ISDN than with the ability of the available computer tools to support the curriculum. Western Civilization is a course that is largely image-oriented, involving architectural diagrams, pictures, photos, etc. Mathematics requires tools that enable presenting mathematical symbols and easy drawing and modification of formulas, etc. The MDLW image conferencing system facilitated the former but tools such as the keyboard, mouse or graphics tablet were found to be very clumsy for the fine drawing and writing that Math requires. Subsequently, a light pen was introduced to facilitate these processes online.

Table 2. Teacher Evaluation of Learning Center Network (on a scale of 5, where 1 is terrible and 5 is great)

	Introduction to Math 11	Western Civilization
1. ISDN Network		
a) technical performance	3	4
b) audio quality	3	4
c) video quality	3	5
d) ease-of-use	2	5
e) set-up of workstation	2	4
f) computer software	4	5
g) workstation as a teaching tool	2	4
2. Interaction and Participation		
a) amount of student participation at center 1	1	5
b) amount of student participation at remote online	1	4
c) quality of student participation at center 1	2	5
d) quality of student participation at remote centers	2	4
e) amount of student interaction between centers	2	4
f) quality of student interaction between centers	2	4
g) amount of teacher-student interaction at center 1	3	5
h) amount of teacher-student interaction at remote centers	2	4
i) quality of teacher-student interaction at center 1	2	5
j) quality of teacher-student interaction at remote centers	2	4
k) effectiveness of ISDN in creating a classroom environment	2	4
l) configuration of the electronic classroom (i.e. number of sites, number of students at each site, total number of students)	3	4

Copyright

An critical issue with multimedia telecommunications, even in educational applications, is copyright. While the technologies enable scanning and transmission of high quality images, the teacher is limited by copyright legislation. Scanning and transmitting photos from journals, magazines, or even textbooks is not permitted without permission of the publisher. This requires significant preparation time and effort. Teachers in the project found it difficult to obtain the required permissions and thus sought public domain images and also created their own for use in the ISDN classroom.

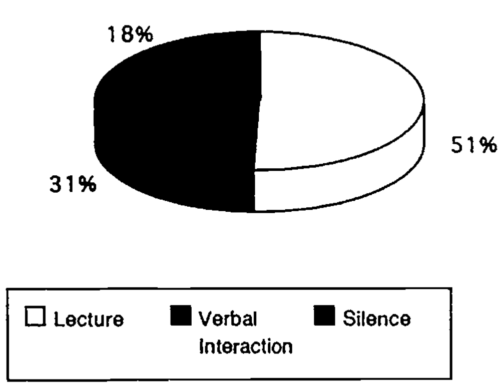
5. Usage Patterns: Impacts on Interaction

While reports from both the teacher and the students indicated that the ISDN electronic classroom facilitated higher levels of student participation and interaction, the use of video analysis allowed a finer examination of the nature of interaction online. Data on usage patterns and interaction in Phase 2 were examined from three perspectives: role of the teacher; role of the students; and user-technology interaction.

5.1 Nature of Teacher Interaction:

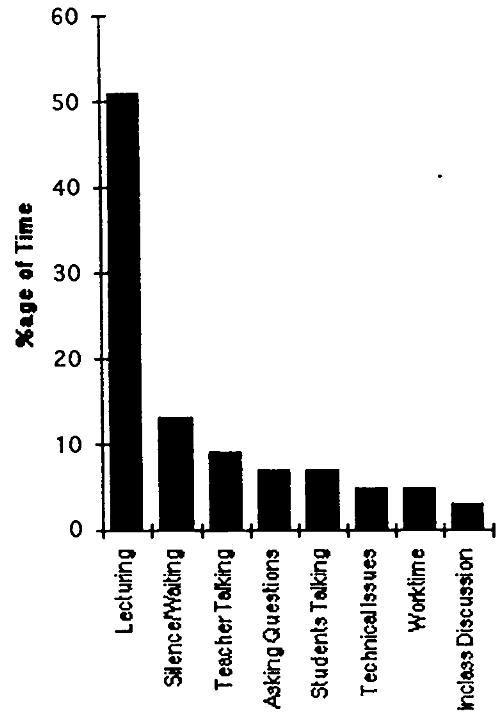
Video analysis indicates that the majority of class time was teacher-centered: of the segments analyzed over three days, the teacher devoted 51% of the total class time to lecture-type presentation of course material. Verbal interaction with students accounted for 31% and instructor silence, while waiting for an answer or waiting while students completed tasks, took up 18% of the total time (13% in waiting and silence and 5% in work time) (see Table 3).

Table 3 Breakdown of Class Time



The content of the verbal exchange between teacher and students is presented in Table 4:

Table 4: Nature of the Class Interaction

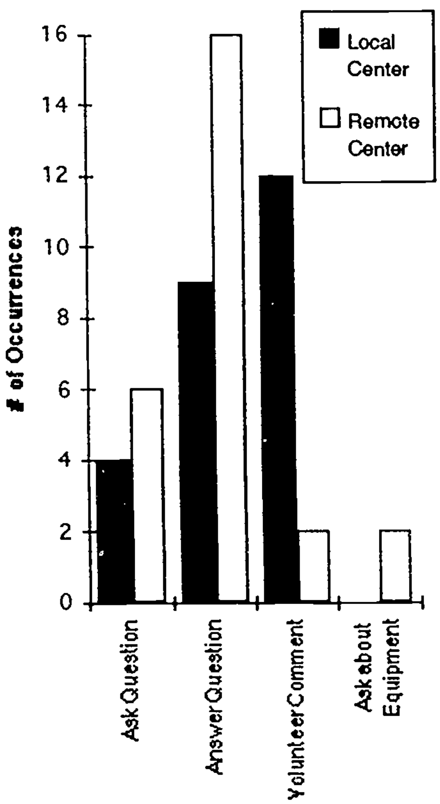


About 5% of the class interaction time was spent on issues related to using the technology, such as getting the system ready or dealing with problems with the audio links (i.e., "Can you maximize that picture?" or "Stand closer to the microphone, we can hardly hear you!"). The teacher also frequently repeated comments made by students either in the local or one of the remote sites, to ensure that everyone could hear the comment.).

5.2 Nature of Student Interaction:

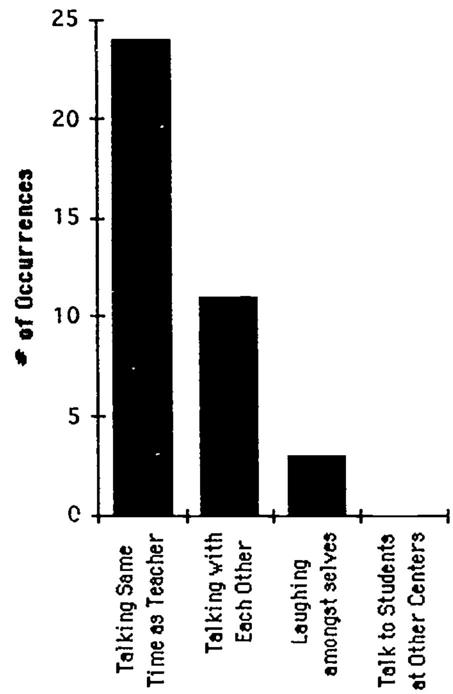
Student interactions with the teacher or with peers comprised 7% of the total class time, either in asking or answering questions, making comments [on or off topic] or interjecting in the discussion. The nature of interactions between students and the teacher are shown in Table 5.

Table 5: Student to Teacher Verbal Interactions (at 2 centers)



During the lectures, there was no incidence of student to student discussion at the local site. However, students at the remote sites did engage in discussion (approximately 3% of the total class time), some of which was off topic and related to joking, etc. (see Table 6).

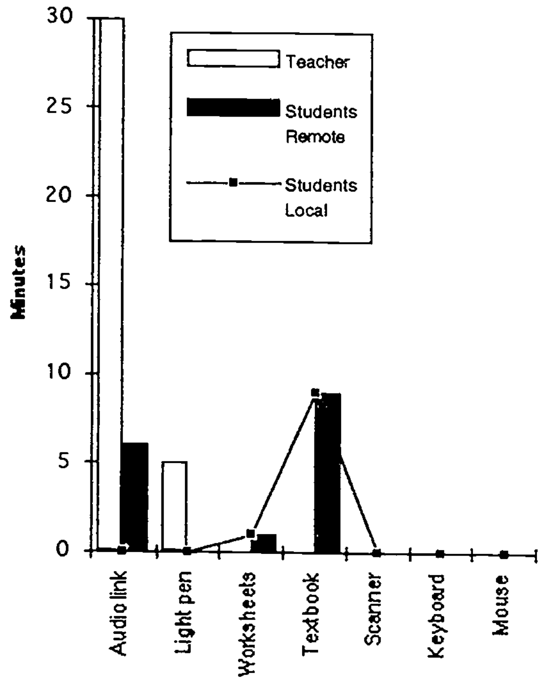
Table 6: Total Student to Student Verbal Interaction



5.3 Nature of User-Technology Interaction:

Prior to delivering the class, the teacher would scan up to 20 or more images (black and white, and in color) for each class. During the class, these images and the audio conferencing were the primary communicative tools used. The light pen was used only by the teacher, and was employed for drawing simple pictures, annotating an image, pointing, and highlighting to enhance the lecture presentation. The teacher essentially used the MDLW as a visual aid to display notes and illustrations that provided a common focus linking students at the four centers. Students at the remote sites did not use the audio nor any other tool to communicate with other centers, but only communicated verbally with the teacher. Table 7 shows tool usage by the teacher and students.

Table 7: User-Technology Interaction In Class



The audio link between students at remote sites and the teacher is the most frequently used technological tool, followed by the image conferencing which was used primarily as a visual aid rather than as a facilitator of interactive learning.

6. Conclusions and Lessons for the Future:

Despite numerous and sometimes debilitating technical problems that confronted students and teachers, both teachers and learners reported significant satisfaction with the technology and said that they would use it again if they had the opportunity. The quality of the ISDN-mediated class interactions and of the learning outcomes were rated as at least equal to that achieved in traditional face-to-face formats. Nonetheless, analysis of video outputs indicate that nature of the educational interaction was primarily lecture-based, with the ISDN and MDLW technologies used for audio presentation and visual aids. Student interaction was not enhanced by the technology, largely due to the nature of the curriculum design employed. Furthermore, the ISDN technology was not utilized to its capacity by this educational approach.

Critical success factors were: the leadership and organizational skills of the teacher; the design of the curriculum and the instructional methods developed and used for this project; student motivation; and adequate performance on the part of the technology.

The following lessons on the implementation of ISDN multimedia telecommunications for distance education applications can be drawn:

1. Ensure stable technology and ensure that the technology is appropriate to supporting the requisite tasks. Frequent technical problems can negatively impact upon the teacher's motivation to experiment with the course design, so that traditional teaching approaches may dominate, and on the quality of learning, the enthusiasm and concentration of the students. The media tools should fit with the course curriculum.

2. Provide adequate training to students and to teachers. User training should be provided to ensure comfort and confidence with all aspects of the equipment. Teachers also require a significant amount of training in curricular design for online, multimedia environments.

3. Curricular design should be more student-centered. Active and collaborative learning styles are proven to be educationally effective and are especially important in online environments to encourage student interest at remote sites, where there is no teacher present to encourage and monitor activity. Teachers should encourage student activities electronically through questions, student-centered assignments, and group projects, both within a site and between sites. Moreover, teachers should encourage or even require students to use the various media tools available.

4. New technologies provide new educational opportunities but also require new designs, approaches, and mindsets. This is not only true for teachers but also for students. The traditional student mindset to 'sit at the back of the classroom' and to avoid participation should be recognized and overcome by curricular designs that encourage student activity, rewards (grades for participation), and providing good access to the tools.

5. Provide a student-computer configuration conducive to encouraging active student involvement. Provide a computer configuration that enables individual or small group access to each tool.

6. Include asynchronous networking, such as email or computer conferencing, to increase the opportunities for student participation at times and locations other than a place and time-dependent class format. These could be used in adjunct mode, to increase discussion time, for electronic office hours, or even to deliver parts or all of an online course to homes, offices, and educational sites outside regular class hours.

7. Ensure an appropriate and comfortable setting for the electronic classroom, which provides a quiet and private space away from distractions and external noise and enables access after class time.

8. Recognize that an electronic classroom has new costs and requirements for implementation, support, and maintenance. Teachers need to spend considerably more time initially, in setting up an online class environment. Purchasing and maintaining computer equipment is costlier and more complex than traditional educational media like blackboards.

9. Other factors such as copyright laws need to also be recognized and planned for in setting up the electronic classroom.

Endnotes:

Tables 1-2 are adapted from D. Black and L. Harasim, (1992), *The ISDN Distance Learning Trial: Evaluation of Phase 1*. Open Learning Agency Report, Burnaby, B.C., Canada.

References:

Black, D. and Harasim, L. (1992), *The ISDN Distance Learning Trial: Evaluation of Phase 1*. Open Learning Agency Report, Burnaby, B.C., Canada.

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NTT's Four-Year ISDN Experience and the Future of Japan's Market

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1. ABSTRACT

NTT's version of ISDN service (called INS-Net) has been steadily growing since its inauguration in April 1988. As of January 1993, the service enters its fifth year. With the number of contracted lines now exceeding 150,000, INS-Net is expected to move from the introductory phase to the take-off phase.

This paper discusses NTT's four-year experience in developing ISDN service and the issues presently facing NTT, as well as efforts to expand the market through providing new service offerings.

2. NTT'S FOUR-YEAR EXPERIENCE

2.1 RAPIDLY GROWING SALES

The recent growth in the sales has been remarkable, with the number of subscriber lines as of the end of September 1992 for INS-Net 64 amounting to 116,208, and those for INS-Net 1500 amounting to 2,405. Accordingly, a total of 140,258 lines are being used for INS-Net service overall by more than 10,000 customers. (In calculating the total figure, a factor ten times the number of lines for INS-Net 64 was applied to INS-Net 1500.) (See Figure 1.)

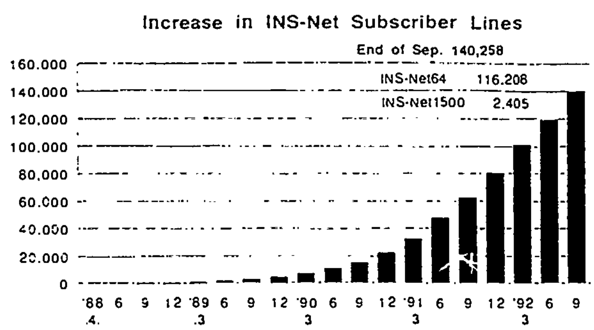

Figure 1

About 34 percent of INS-Net 64 subscribers are also using the packet mode (INS-P).

Forecasts indicate the continuation of steady growth in sales for the future, with the total number of lines for INS-Net service expected to reach 200,000 in the spring of 1993. Moreover, INS-Net service will be available in almost all urban areas of Japan, or about 2,400 municipalities.

(Note)
INS-Net 64 (basic-rate interface): Provides two 64-kbps information-bearing channels and one 16-kbps signaling channel.

INS-Net 1500 (primary-rate interface):
Provides twenty-three 64-kbps information-bearing channels and one 64-kbps signaling channel.

It is possible to use twenty-four 64-kbps information-bearing channels (in this case, the signaling channel for other INS-Net 64 or INS-Net 1500 lines can be shared).

In INS-Net 1500 service, other options include high-speed communications service at 384 kbps by combining six 64- kbps channels, or at 1.5 Mbps by combining 24 channels.

2.2 RECENT TRENDS IN APPLICATIONS

According to the breakdown of the recent ISDN applications in Figure 2, the data transmission accounts for about three-fourths of overall INS-Net 64 applications. In the data transmission category, moreover, POS applications have been increasing. In particular, the introduction of INS-Net 64 to all Seven-Eleven sales outlets in Japan has served not only as the leading case in the distribution industry, but also in all industries introducing POS systems. Specifically, the introduction of INS-Net 64 has been rapidly proceeding in supermarkets, the food service industry, gas stations, etc.

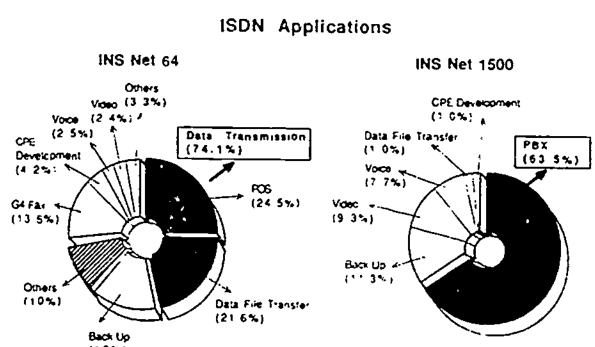

Figure 2

In the past, the emphasis in introducing INS-Net service focused mainly on reducing costs, such as monthly charges and call charges. Recent trends in applying INS-Net to POS systems, however, indicate that INS-Net is becoming an essential tool to formulate management and marketing strategies, as INS-Net makes fresh information available through an extensively spreading network. For industries struggling with each other to capture customer interest, it is essential to understand consumer trends on a timely basis. Because of this, the role

INS-Net is expected to play in these endeavors will become increasingly more important.

Another reason for the increased INS-Net applications in data transmission is that the combined usage of INS-P and circuit-switching mode has become readily available. One of the features of INS-P service is that charges are determined by the volume of packets transmitted, and there is no relationship between terminal-computer connection time and call charges. Because of this characteristic, INS-P is being extensively used in interactive computer processing work, such as inventory retrieval, ticket issuing work, order issuing and receiving work, etc. For transmission of a large volume of data from headquarters to each outlet, moreover, a digital communications mode is now available. Accordingly, the application of INS-Net service in multi-media formats is coming in for increased usage.

While the circuit concentration effect is considered the major advantage of INS-Net 1500 for users, digital PBX accounts for about two-thirds of all INS-Net 1500 applications. This increase in digital PBX applications has been realized through the full efforts recently started by manufacturers to make available a full line of digital PBX equipment. These latest PBXs make it possible to access both office lines and extensions through the I-interface, which means that G4 facsimile transmissions and FD transfers can be conveniently carried out through extensions.

Moreover, increased customer convenience stemming from CODEC standardization and reduced pricing is facilitating the introduction of video teleconferencing systems.

2.3 PROGRESS IN GLOBAL ISDN

Corresponding to the tri-polar trends in the world economy centered around the US, Europe, and Japan, three different approaches have been taken concerning ISDN as well -- mainly by AT&T and the seven regional holding companies (RHCs) in the US; British Telecom (BT), France Telecom (FT) and Deutsche Bundespost Telecom (DBPT) in Europe; and similar efforts in Japan.

In the US, a shift was made in November 1992 from area-designated (ISDN Island) service to standardized nationwide service under the name of "National ISDN-1."

In pace with EC unification, plans in Europe call for the integration of the telecommunications markets, and especially for positive approaches for the ISDN unification.

Among these world trends, Japanese companies are also positively dealing with the construction of global ISDN networks. NTT is also encouraging international connections together with overseas carriers. (See Figure 3.)

Global ISDN

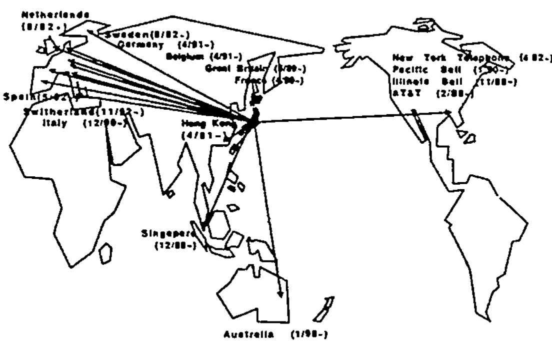

Figure 3

2.4 OVERVIEW OF ISDN DEVELOPMENT IN JAPAN

As stated previously, Japan's ISDN service is emerging from the introductory period and entering the take-off period. However, the road to this stage was not easy.

As shown in Figure 1, it took about a year before ISDN subscriber lines started to increase after service start-up.

While manufacturers singled out limited service areas as the reason for slow equipment sales, NTT (as a carrier) claimed that the unpopularity among 0users despite inexpensive ISDN charges was due to high equipment prices. Most importantly, potential users held the view that there were no advantages in introducing ISDN service at this stage because of high equipment prices and limited service areas -- both of which naturally limited ISDN usage.

All concerned, i.e., carriers, equipment manufacturers and users, were conscious of the need to break the vicious circle among the three parties indicated in Figure 4 for ISDN development to move forward. However, each party looked to the others to take the initial lead.

Vicious Circle

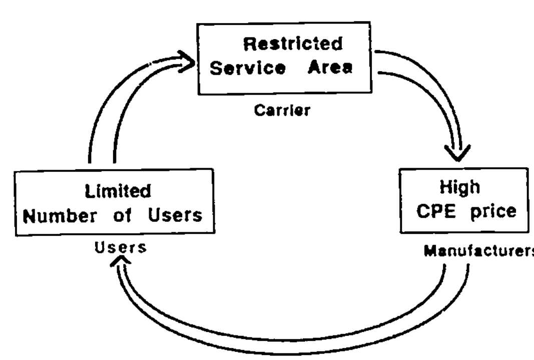

Figure 4

ISDN Application
POS Data Network

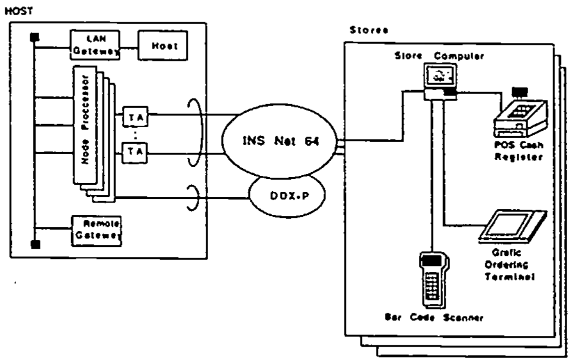

Figure 5

INS-Net Service Area

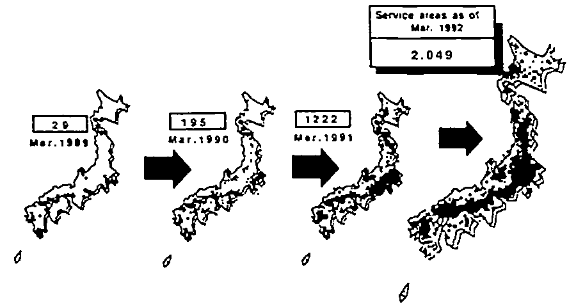

Figure 6

The resolution of this issue was triggered by NTT, which decided to alter its original service area extension plans after studying the provision of ISDN service to a specific user. This case involved providing ISDN service to about 4,500 outlets of a convenience store chain.

The original service area extension plan first called for service start-up in Tokyo, Nagoya, and Osaka. This coverage was to be expanded to include cities with over 500,000 population at the next stage, then prefectural seats and equivalent cities, followed by cities with over 30,000 population. However, this original plan could not meet the needs of this particular customer in terms of the pace of expansion. Because this approach could not keep up with the system construction planned by this user, it was consequently impossible to apply ISDN to the system construction -- effectively meaning that this user would not be able to construct a new system.

The area extension policy NTT first adopted required the start of ISDN service from areas that could produce greater profits at smaller risks. As NTT realized that user needs could not be met under this approach, the policy was completely changed in April 1990 to expand service areas in a single stroke by meeting every demand in as many cases as possible.

As a result, service areas were expanded to provide coverage to almost all cities with over 30,000 population. (See Figure 6.) This has accordingly led to success in breaking the vicious circle shown in Figure 4.

2.5 FUTURE CHALLENGES

Recently, the revised service area extension policy has brought about some problems of major concern. One is the need to meet demands such as only one line in a rural area even if a huge amount of investment is required. Due to the recent economic slowdown and a decline in the NTT's financial situation stemming from an intense competition with new common carriers (NCCs), the company is facing greater difficulties in following this revised extension plan on an "as is" basis.

As a result, a policy emphasizing marketing activities in existing service areas was adopted in 1992. This policy enabled the efficient sales and effective facility investment.

The other issue involves the fact that ISDN can no longer be considered an NTT monopoly. In the increasingly competitive environment involving NCCs, NTT has no choice but to take a more stringent approach in examining revenues and expenses, including every effort to maximize revenues in current negotiations with NCCs concerning interconnection conditions.

Handling these issues from the standpoint of short-term revenues and expenses, however, will distort the proper approach that NTT should take in the future. Accordingly, it is necessary to take into account the fact that ISDN will usher users into a new communications world, creating a new market for manufacturers of communications equipment and generating a new revenue source for telecommunications carriers.

3. FUTURE OF JAPAN'S MARKET

3.1 CUSTOMER EQUIPMENT FOR INS-NET SERVICE

NTT has promoted ISDN standardization activities by participating in relevant CCITT and *TTC committees, and has developed supplementary services conforming to CCITT and the Telecommunications Technology Committee (TTC) standards. Moreover, in order to facilitate the usage of supplementary services among customer equipment developed by different manufacturers, NTT has carried out interconnection experiments jointly with promotion conference of Harmonization of advanced Telecommunications Systems (**HATS Conference).

*The telecommunications Technology comittee was founded in October 1985 by various Japanese corporations active in telecommunications-related markets. Its main role is to coordinate activities aimed at establishing standards for domestic telecommunications netwarks.

**Interconnectivity of ISDN products is being promoted in Japan in cooperation with telecommunication operators and manufactures companies, under the HATS conference, which is held in the Ministry of Posts and Telecommunications.

In an effort to enable INS-Net applications for not only new services particular to ISDN, but also new analog services as well as existing supplementary services offered via the analog network, NTT took a positive approach in introducing various services. (See Figure 7.)

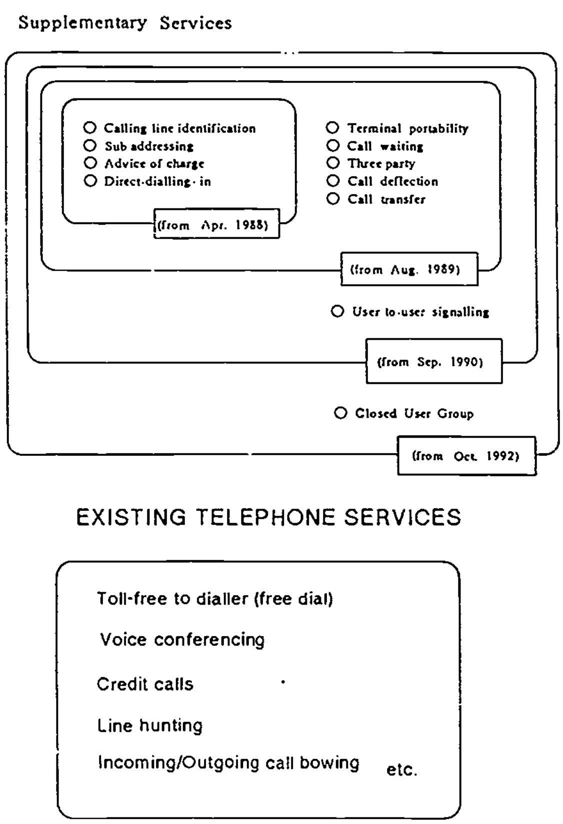

Figure 7

One index in measuring success in developing new applications relates to the extent of customer equipment available to realize such services. This index is highlighted in Figure 8, which shows differences between data for December 1988 (just after INS- Net service was inaugurated) and December 1991 for customer equipment in the facsimile, data transmission, video and voice categories.

ISDN Terminals in Japan

Terminals	As of the end of December 1989			As of the end May 1992		
	Vendors	Variety	Price Range (thousand yen)	Vendors	Variety	Price Range (thousand yen)
Terminal Adapter	8	29	80~ 400	26	122	80~ 3,000
G4 Facsimile	11	16	1,680~ 3,800	13	43	900~ 3,000
Videophone	6	6	2,500~ 6,000	5	7	950~ 7,500
Videoconferencing System	11	15	10,000~32,000	14	32	5,000~20,000
ISDN Interface Board	3	3	300~ 500	30	40	100~ 960
FD Transmission System	—	—	——	4	7	300~ 970
Digital PBX	9	16	Depending on system Configuration	15	37	Depending on system Configuration
Total	27	85	——	61	288	——

Figure 8 NTT ⓞ

Trends in the development of customer equipment indicate a growth of about 3.5 times in terms of the number of participating manufacturers, and 3.7 times in terms of the number of products - - indicating that small to large manufacturers are entering this market at a very rapid pace.

From a pricing standpoint as well, the range is moving lower, with substantial price reductions of about 40 percent for video phones and 60 percent for G4 facsimile machines.

Application formats can be broadly classified into data transmission, facsimile, video and voice.

Data transmission applications are increasing mainly in formats that take advantage of the high-speed capabilities of INS-Net. Major applications include POS data transmissions, PC communications, and inter-LAN connections.

Significant progress has been made in the spread of G4 facsimile machines that are capable of both higher resolution and higher speed transmission than available by G3 facsimile machines. Application examples include document transmission at administrative agencies and transmission of drawings in the printing and construction industries. Accordingly, G4 facsimile transmissions have gained an extensive public acceptance.

Video communications include still pictures applied to printing and medical fields, and moving pictures applied to remote monitoring and video teleconferencing. However, the usage frequency for video communications is still low, and price reductions in customer equipment is the key to the popularization of these applications.

For voice communications, customer equipment capable of transmissions up to 7-KHz or 15-KHz bands is starting to appear. With this new equipment, applications are being promoted in the fields of radio relay broadcasting and music broadcasting.

Starting in 1989, NTT has been successively carrying out end-to- end connection tests with various countries in the world to realize global ISDN service. So far, basic connections are possible with 15 nations, including the US, the UK, France, and Germany.

3.2 MEASURES FOR INS-NET DEVELOPMENT

3.2.1 NEW SUPPLEMENTARY SERVICES AND SERVICES COMPATIBLE WITH PSTN

As stated earlier, NTT is providing service in conformity with CCITT and TTC standards. In October 1992, NTT started CUG service via circuit-mode under the name of "Group Security Service." (Figure 9)

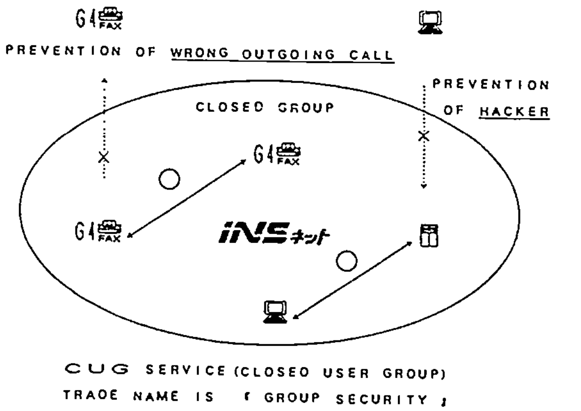

Figure 9

This service was developed with the aim of providing security for the public network, and prevents errors in call origination by users as well as intrusion by hackers. Sales targets include users who specifically request communications security similar to that available with leased circuits. This includes public agencies, such as city offices which issue copies of family registers, etc., via G4 facsimile, and other users wanting such security protections as preventing the tapping of data transmissions.

Plans call for the start of "free-phone" service by circuit-mode 64kbps unrestricted in the spring of 1993. Sales targets include translation companies which want to link individual translators working at home via G4 facsimile, and nonlife insurance companies using still pictures in transmitting damage and claim reports.

Taking various trends in CCITT and TTC standardization into consideration, the start of such supplementary services as reverse charging (REV), Support of Praivate Numbering Plan(SPNP) is planned in the future.

Supplementary Services

Future Implementation under development

- Support of Private Numbering Plan (SPNP)
- Reverse Charging (REV)
- Call Forwarding Busy (CFB)
- Call Forwarding No Reply (CFNR)
- Call Forwarding Unconditional (CFU)

Figure 10

3.2.2 NEW APPLICATIONS

An example of household applications in the data transmission category involves the usage of a "ISDN TELEASSIST" terminal. The Teleassist communicates with a data center via the D-channel packet mode by means of IC memory card for communications with a data center, and is expected to be used in such applications as home banking and home security transactions. Moreover, it is equipped with terminal adopter functions to permit the connection of two analog terminals.

ISDN multifunction terminal enables the customer to communicae with offices and to transfer data or graphics from outside locations. This terminal can be applied for the demand of data transmission, and is equipped with a "hand-drawn fax" function, a function to transfer images taken by memory-card camera to the called party's memory card, as well as outside ports for connections to other ISDN terminals (e.g. G4 facsimile machines). If this ISDN multifunction terminal is installed at high-traffic sites such as hotels, coffee shops and convenience stores, it can efficiently support various business and social activities by enabling people to transmit and receive information without returning to their offices or home.

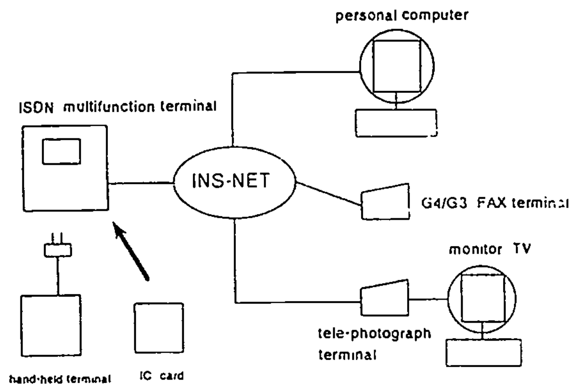

Figure 11

3.2.3 GLOBAL ISDN

In November 1992, NTT participated in the ISDN demonstration called "TRIP '92" organized jointly by major US telecommunications carriers in which connections were made through the "National ISDN-1" interface. This demonstration confirmed that end-to-end communications is possible through NTT, KDD (Japan's international carrier), AT&T and RBOCs. The applications that were successfully demonstrated at this time included video teleconferencing, G4 facsimile transmissions, and inter-LAN connections. The volume of international communications traffic between Japan and the US is high, and the US is Japan's biggest international communications partner. This occasion confirming end-to-end communications between the US and Japan is expected to lead to a rapid increase in ISDN communications as well.

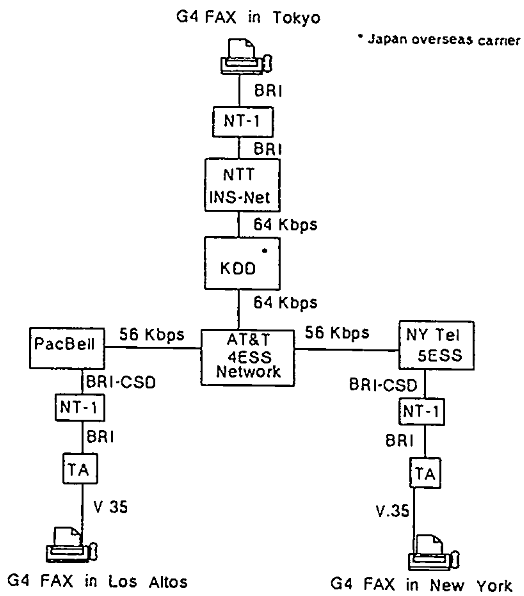
G4 FAX in Tokyo
* Japan overseas carrier
BRI
NT-1
BRI
NTT
INS-Net
64 Kbps
KDD *
64 Kbps
PacBell
56 Kbps
AT&T
4ESS
Network
56 Kbps
NY Tel
5ESS
BRI-CSD
NT-1
BRI
TA
V 35
BRI-CSD
NT-1
BRI
TA
V.35
G4 FAX in Los Altos
G4 FAX in New York

Figure 12

ISDN COMPRESS VIDEO
THE LOGICAL NEXT STEP

John F. Archdeacon
General Service Administration
San Francisco, Califl.

Integrated Services Digital Network (ISDN) proves to be ideal for video conferencing. With over hundreds of Federal offices scattered throughout the nation, GSA has established a video network to meet this challenge. Like most users, GSA primarily uses video conferences to link widely scattered locations for business meetings that otherwise might not be held at all because of the expense of air fare and accommodations.

No one argues that video will supplant in-the-flesh discussion. Instead, the technology is billed as a supplement to travel, a way to boost productivity and add a more personal dimension to ordinary conference calls. There are times when you need to meet face to face to discuss complicated issues but don't want to take all the time to get there. This was exemplified during one video conference between a product safety agency and their headquarters concerning a toy that could ignite paper. Trying to explain this by a telephone conference would not have the impact as actually seeing it demonstrated.

General Service Administration conducted extensive tests to evaluate dial-up and point-to-point video conferences that can utilize either a single 56 Kbps circuit , Basic Rate Interface (112 Kbps), or Primary Rate Interface (PRI) and T-1 facilities (112 Kbps up to 1.5 Mbps). The point-to-point connection is a reservation video service that is an expansive mean of conducting video conferences. It required video coordinators to schedule video conferences through the use of a video operator. Because all conference calls are connected through a conference bridge, the conferees must make an appointment weeks in advance to reserve the bridge for their meeting. Not only was the use expansive but inflexible. The availability of the room itself limited the scheduling and the lack of video bridges throughout the country also limited the points of connection.

Currently, we are testing the capabilities of two bridging systems that employ different technology. One of the systems permits us to bridge multiple parties in a video conference at a fix data rate and supported by only one codec manufacture. The other conference bridge permits us to bridge parties of different data rates, multiplex/modem equipment and manufactures' codec. We are focusing our attention to the facilities in Honolulu, HI; Agana, Guam; San Francisco, CA; and Washington D.C.. Our other goal is to evaluate the ability to interconnect both of our FTS2000 networks together.

The Federal government has one of the largest private networks in the world and as such needs to find ways of reducing costs. One of the means is through the use of integrated facilities by aggregating various forms of services, i.e., switch voice, switch data, switch video, and switch imaging. ISDN gave us that ability and we in turn tested it out to determine its effectiveness. With BRI, we transmit voice, data, and imaging down the same twisted pair to the central office switch that routes it over the private network facilities. In turn we enjoy the elimination of redundant facilities and receive large discounts for the traffic passed over the aggregated trunk facilities.

As a result GSA employs a cutting edge approach to video technology. It successfully operated a compressed video dial-up ISDN Basic Rate Interface (BRI) application at 112 Kbps and comparing its performance with 332 Kbps that uses a dedicated T-1 span. The video signal processor (CODEC) interfaces with a Gandalf Terminal Adapter (TA). The TA enables the video signal processor, a synchronous data terminal device to connect to the ISDN network via a network terminal adapter (NT1) device that provides the ISDN "U" interface or "local loop" for the video system's signal to the central office CENTREX switch (DMS100). Although at 336 Kbps there is a slight improvement in resolution, all conferees agree that there was little to no degradation in their video conference. Reliability, our experience with dial-up ISDN video has shown that it is more reliable in completing calls than the reservation method over T-1 facilities.

In assessing the merits of ISDN, GSA was successful in implementing ISDN over our local area network by connecting remote sites to its LAN and electronic mail servers. Looking at other applications we determine that ISDN can also handle video simultaneously over both bearer channels: B1 and B2. The video equipment that handles the ISDN transmission was much smaller and can be transported to room to room or building to building with minimum ease. Additionally, we can prewire all conference rooms and upper level executives' offices with ISDN extension numbers.

ISDN is a technology for solving today's complex problems while guiding users toward the future world of multi-media communications. One mean is the roll about video system that delivers efficient and cost-effective video conferencing where you need it. There are several different equipment configurations and an extensive offering of options available to expand the basic system. The portability of the roll-about video codec makes it possible to conduct impromptu conference at the desired locations. Even those individuals who are reluctant to participate in any form of conference have found the use and use of this setup to be convenient.

The ISDN roll about system is fully self contained within a sturdy cabinet or installed on a three-tier roll-around cart. The equipment operates without special lighting requirements or expensive acoustical wall treatments. The unit can operate with a number of different reverse multiplexors (BANDWIDTH ON DEMAND), which allow you to create an expensive network of video conferencing studios or to add a single new room to your existing video network through the use of a video server.

The video conference system itself has been used for many-on-many, many-on-one, or one-on-one meetings by either scheduling or having spontaneous discussions. To enhance these conferences, we have incorporated the use of two monitors with one monitor displaying all attendees and the other used for displaying still, graphic images. In conjunction, the ability to display slides, overheads, PC presentations, VCRs, annotation pads, and specialized peripherals have enhanced our conferences. These same peripherals with the conference equipment are used during classroom training sessions and at the same time, the sessions have been recorded on VCR. Transmission qualities of these training sessions by the use of a VCR over ISDN lines have exceeded expectations.

__Impact of P X 64__

We also evaluated the P.64 Video Coding Standard. The standard enables various CODEC manufacturers to adapt to a single compression algorithm that can operate with other manufacture's equipment. The standard includes uniform method of decoding, transmission of data 64 to 2048 KBPS, CIF (high resolution), QCIF (low resolution), twin channel operation (synchronization), and audio. Problems exist when a federal agency obtains equipment from various vendors; and are unable to communicate with other agencies whose equipment is not compatible. Recognizing the need to provide ubiquitous video services, GSA has established a policy of obtaining only that vendor equipment that meets CCITT recommendation H.261, video CODEC for audiovisual services at P x 64 Kbps. Therefore the recommended video coding algorithm has to be able to operate in real time with minimum delay.

What Does this Mean to the User?

The increasing acceptance of video conferencing within the Federal community represents a strong Government commitment to increase mission effectiveness, improve productivity, and maximize the efficiency of available manpower and financial resources. The FTS2000 network provides digital video, data, and voice services for the entire federal government. The network services architecture, which allows multiple location access to a broad range of integrated services, is available among hundreds of Government locations.

Cost Analysis: Over the past several years the cost of transmission has fallen. The cost of T-1 or Switch 56 services is longer the deterrent factor in establishing new services. With the cost of transmission decreasing, the only major cost is the investment in the video system itself. The cost or this capital investment recovers itself within six to twelve months. Standardization will allow users to interconnect with various video systems and inverse multiplexes without accruing additional equipment. What does this mean, users who purchased one vendor's CODEC can conference with another vendor's CODEC without having to purchase another CODEC or third party's gateway.

Not all federal agencies have the budget or staff that would satisfy the capital outlay for video equipment, but they can utilize other agency offices to conduct video conferences. The procedure is simple as dialing up a plain voice telephone number. The only problem would be billing for use of a long distance call that is relatively low. With a large number of offices scattered throughout the country and the proliferation of video systems at these locations, small users can make arrangements to use those facilities.

Applications: We have employed the video conference for training, job interviews, introduction of new members to the organizations, policy meetings, contract meetings, engineering development, financial reviews, legal depositions, product demonstrations, editing of documents and Automated Computer Assisted Drawings (ACAD) by connecting PC's at each end and channeling them through the same video port simultaneously to transfer files and documents.

Video conference has replaced the standard phone conferences while minimizing the need to travel to other cities to attend a one to three hour meeting. The establishment of ISDN to transport the video signals across the network can open up some opportunities. It can include a multi-media environment that integrates video, data and voice into a single session. Video and data images can be stored on disk along with voice messages. Non-participating members can retrieve those disk files and review what went on in the video conferences. Other information can be stored and stored with those presentations and later displayed. There are now codec manufacturers and software vendors working towards a multimedia platform to develop this technology.

An Evolution Strategy Toward Digitalized Inter-exchange Network Structure in Seoul Metropolitan Area

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1. Abstract

This paper analyzes the impact of digitalization on networks in Seoul Metropolitan Area by considering facility investment together with operating costs. A stepwise evolution method toward a digitalized double-homming architecture is proposed to accommodate most efficiently with existing analog-oriented networks.

2 Introduction

Telecommunication networks in Korea have been rapidly changing in the last decades. In the periods of 70's and 80's, the main goal of telecommunication policy was one line per one household and successful execution of the policy resulted in large volume of telephone lines available to general customers. With the change of monopolistic structure of telecommunication business to market economy structure in the beginning of 90's, the telecommunication business environment has to be more competitive than ever with the growth of economy. Enormous demand on various services has been a characteristic trend in early 90's Korean telecommunication market. For the period of 90's, number of subscribers per 100 people has been expressed 39 by the end of 1992, will reach at the level of 40 by 1994, and will eventually reach at the level of 50 by the end of this century.

From the view point of telecommunication technology, with the theme of network digitalization, various projects including common channel signaling, intelligent networking, and ISDN pilot services have been actively pursued.

The following summarizes the trends in current telecommunication market: (1) customers want to utilize the existing facility with high quality services at low cost. Customers also try to take advantages of various telecommunication services for their businesses. (2) Operating companies, on the other hand, aim at supplying their customers with valuable services at proper prices. The services include speedy network formation, stable network maintenance, and continuous expansion of facility to meet advanced technological features.

This paper presents an evolution strategy established to solve problems with the current metropolitan networks. The strategy will result in flexibility of future networks and robustness of the managemental capability of Korea Telecom. This paper does indirectly or directly reflect the overall aspects of telecommunication strategy for the modernization of networks.

3 Current Structure of Seoul Metropolitan Networks

3.1 The current network configuration

The Seoul Metropolitan networks have been installed and connected to the toll network, heterogeneous network, and new service network for a large scale local telephone facilities. The networks are evolving with close relationship with networks of neighbor cities.

1) Toll network
Until late 1990, all toll traffics had been transacted through the toll exchange. Since 1991, however, the local exchange has included the toll transaction function between local and the 16 neighbor city areas which have high volume traffic.

2) Inter-local transit network
The transit network areas are classified as 8 areas; from the Area #2 to the Area # 9. The inter-local transit networks are maintained with numbering architecture: direct route for the traffic of the same area and the traffic between different areas.

3) Special number circuitry network and heterogeneous network
Under the circumstance of rapid increase in various services, the special number circuitry network such as 114 or 115 has the low efficiency and high complexity. The measures have taken to resolve these problems with the pure tandem network as a basic structure. Networks for various services are to be integrated and eventually to form fully dual network system in order to improve the stability of the network. In addition, rearrangement of the special number networks are underway as an effort to improve efficiency of the network since it is rather difficult to improve the entire local network by the tandem network alone.

3.2 Trends in subscriber demand and current facilities

1) Trends in subscriber demand
As shown in Table 1, Seoul Metropolitan Area has 4.4 million lines and 16 areas of neighboring city areas have 1.5 million lines as of 1991.

[Table 1] Trends in subscriber demand

(Unit : millions lines)

Class	'92	'93	'94	'95	'96	'97
City	4,430	4,900	5,270	5,560	5,780	5,970
Neighboring Cities	1,480	1,830	2,120	2,340	2,480	2,600
Total	5,190	6,730	7,390	7,900	8,260	8,570

2) Existing exchange facilities
Table 2 shows the composition ratios of current exchange facilities as of 1992. The digitalization ratios of exchange facility for the Seoul area and the neighboring city areas are 40.8 % and 67.4 %, respectively. Overall 47 % of all exchange facilities are digitalized. Our goal toward 100 % digitalization for exchange facilities is the year 2005.

[Table 2] Existing Exchange Volumes

(Unit : 1 K lines, system)

Class	Mechanical		Analog		Digital	
	Lines	Sys.	Lines	Sys.	lines	Sys.
City	323 (5.9)	15	2,906 (53.3)	80	2,225 (40.8)	58
Neighboring Cities	23 (1.4)	3	519 (31.2)	9	1,120 (67.4)	80
Total	346 (4.9)	18	3,425 (48.1)	89	3,345 (47.0)	138

Reference : the bracket is expressed in component ratio

3) Tandem facilities
The tandem network consists of 54 tandem exchanges with 534,000 lines. 11,955 tandem routes are under operation for various functions including local and transit toll traffic handling. Existing facilities of different route types are shown in Table 3. Note that 56.6 % of all exchange lines are direct route.

[Table 3] Tandem Facilites

(Unit : lines·

Types		DR	HUR	TR	Total
Route	lines	4,301	5,388	2,306	11.99[illegible]
	%	35.8	45.0	19.2	100.0
Trunk	lines	302,377	93,098	138,744	534,219
	%	56.6	17.4	26.0	100.0
Average Trunk per route		70.3	17.3	60.2	44.5

Reference : DR = Direct Route, HUR = High Usage Route.
TR = Tandem Route

3.3 Status Analysis and Improvement

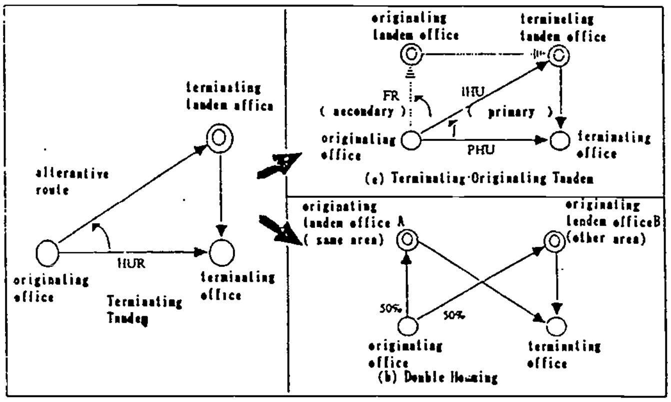
1) Complexity of tandem network
According to the design output of 11,191 tandem route, there are approximately 12,000 routes and 530,000 tandem trunks. This result is derived from the design criterion in which the current method is supplied the terminating tandem, HUR or DR between end offices if the traffic is more than 6 Erlangs or within the same area. This results in several problems including the followings:

- Any changes in design and installation can occur frequently because of the high error rates by complex network plan with the outgoing routes and the lines of tandem network.
- Rapid management is not available because of low network flexibility which is limited by emergency and new service provision.
- The efficiency of trunk lines for the case of small-grouped trunks is in low level. For example, in order to keep 1 % grade of services 30 trunks are required as the traffic is 20 Erlangs, 117 trunks are needed as the traffic is 100 Erlangs. It results in the improvement of 0.85 Erlangs per channel in the latter compared with 0.67 Erlangs per channel in the former.
- The direct routes composing 90 % of total routes cause a cost increase in operation and maintenance due to a growth route numbers, in comparison with a reduction of initial investments. The network handing cost will increase because of the personnel expenditure. On the other hand, network equipment cost will decrease by technology advance. This fact will make direct route uneconomical in the next 5-10 years.

2) Directions for the improvement of routing and network structure
Many problems in current network architecture can be solved by improving present routing methodology. The improvement in routing methodology can also help network digitalization. The following conditions should be considered when present routing methodology is modified:

- simplicity of network structure
- flexibility of network in future change
- supply of originating tandem function
- tightness of making direct route between end offices

Evolving from the current terminating tandem to future digital tandem network, the alternatives can be summarized as the two methods of terminating-originating tandem and dual homming tandem as shown in Fig.1.



[Figure 1] Two Evolution Strategies of Tandem Routing

In case of Fig. 1-a, the route can be offered to the central office of the region. Primary High-Usage (PHU) route and Intermediate High-Usage (IHU) route can be utilized for improving the network flexibility by admitting the alternate routes twice. It, however, may cost more than before since more routes between end offices and more complex network management are expected. In case of Fig. 1-b, the several routes can be grouped into one and the number of total routes is reduced. The star network which is a form of grouping method can be also found in many local networks in Japan or Sweden. This methodology will also increase the safety of the networks. The route from a digital end office to a tandem office can cover the 50 % of traffics transiting the route from a tandem office to a terminating office while covering the other 50 % of traffics transiting the route from a digital originating office to a terminating office. The dual homming tandem routing has several advantages including minimizing the number of routes and alleviating the burden in network management while showing disadvantages such as introducing the pure tandem exchange for solving overload problem in tandem exchange.

3) A plan for accommodating neighbor cities
The traffics between Seoul areas and neighboring 16 cities are handled by the gateway using 6 pure tandem exchanges (5 ESS, S1240). These exchanges have processed local and tandem functions. The system capacity will be fixed by the condition of customer traffic and tandem traffic. By the increases in the number of subscribers and the traffic per subscriber, the traffic is expected to have sharp increase and a large capacity of tandem exchange as a gateway will be required in the next 10 years. Therefore, the alternatives should be set up to cover the capacity of gateway accommodating huge traffic with the neighboring cities.

4 Comparison among the alternatives of evolution strategies

4.1 The proposed alternatives

1) Alternative 1 (Terminating Tandem: Current Routing Rule)
This rule has been used with forming pure terminating tandem routes since the exchange cannot cover the alternative routing functions due to the operation from most of electromagnetic exchanges in the period of 1960 - 1970. The traffic zones were split and operated individually by the numbers of the areas. The electronic exchange introduced later made it possible to cover the alternate routing within exchange module.
In order to improve the line efficiency in section handling, two routing rules are introduced and used optimally to minimize the cost of network equipment. The two routing rules are: (a) direct route for large volume traffic and (b) tandem route for small volume traffic. This rule is currently used in metropolitan network.

2) Alternative 2 (Terminating-Originating Tandem)
The terminating-originating tandem is a routing rule designed to improve the trunk line efficiency of the alternative route. This rule has been used commonly to minimize overall costs including physical network cost which is proportional to the distance between the two end offices.

3) Alternative 3 (Double Homming)
Double Homming is a routing rule for distributed processing individually to the two tandem exchanges dealing with all transit traffic between the end offices. While this rule suffers from the additional cost for the equipment, the simplicity of the network structure makes it more flexible in future expansion and its maintenance of facilities.

Other routing rules such as dynamic non-hierarchical routing and dynamic alternate routing are excluded from alternatives because of real time data and their complexity.

4.2 Qualitative analysis

Concept of telecommunication is continuously changing with the environment of globalization and advancing technologies in the field. The following summarizes the current trends:

- reduced equipment cost and shortened life cycle in technology
- increase of personnel expenditure
- rapid change of telecommunication market

In order to cope with the above challenges, telecommunication networks are required to satisfy several conditions. First of all, a flexible network structure is to be set up easily enough with minimum disturbance on the present networks as the facility expansion or change is required. The installation work can be restricted to the applicable end offices as the new facility is required. Secondly, the telecommunication structure should be able to be improved to the suitable network architecture according to the size of the network.

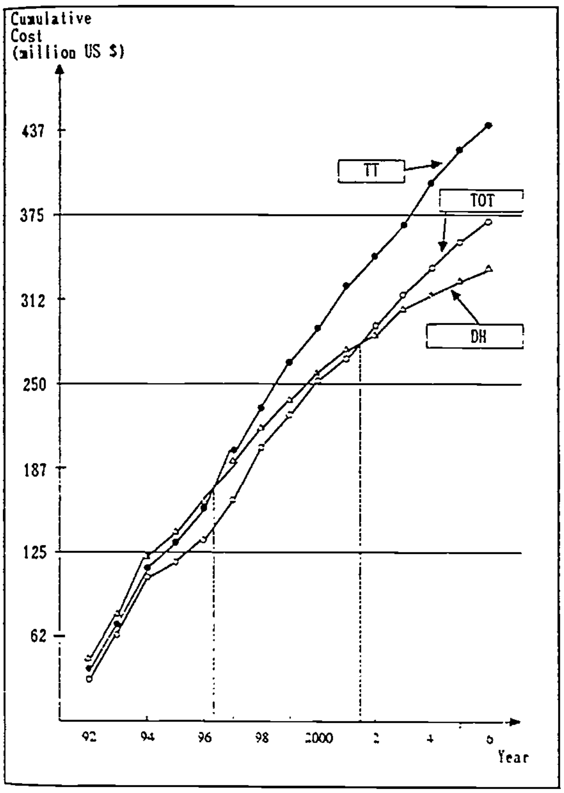
For the case of large scale networks, irregularity and complexity are another dimensions to be considered. A systematic analysis of operating condition and the position of office is a troublesome task especially in large scale networks. Since the level of operation should be quantified and well equipped with an automatic processing, it is not easy to adopt the centralized operation and maintenance system. The network architecture is an important factor to be considered in the case of large scale networks.

Another factor to be considered in deciding an optimal routing plan is the amount of installation labor work since the portion of personnel expenditure out of total cost is growing while the portion of equipment cost is comparatively shrinking as time goes by.

4.3 The results of alternative configurations

1) Comparison of network configuration with alternatives
Table 4 shows the expenditure analysis among the alternatives for next 15 years. During this period, the subscriber lines are expected to reach 7.6 million lines and the offered traffic is expected to 0.51 million Erlangs. However, the number of systems will decrease to 112 systems because new digital exchanges with large capacity will replace the electromagnetic and analog exchanges. In the aspects of route numbers, the double homming have the simplest structure due to the reduction in route numbers by removing the analog exchanges.
On the other hand, the double-homming requires the largest amount of trunks in order to offer the tandem routes except the same end office. The average numbers of trunks per route are 58 lines, 63 lines, and 171 lines for the terminating tandem, terminating- originating, and double homming, respectively. This results in 0.919 Erlang of the offered traffic in case of double homming depending on the large-grouped effect.

2) Engineering economy
The investment costs for the alternatives are estimated. As a result, Terminating-Originating Tandem (TOT) shows the most economical alternative with 117 million U.S. Dollors (USD) while the Terminating Tandem (TT) and the Double Homming (DH) with 139 million USD and 161 USD, accordingly. From the view point of maintenance cost, the DH is the most economical routing rule with 171 million USD. When we consider the total cost including the investment cost and maintenance cost to the net present value at 1991, the followings are the cost for three alternatives; 334 million USD for DH, 371 million USD for TOT, and 438 millions USD for TT.
The trend graph shown in Fig. 2 illustrates the cumulative cost with alternatives. The DH has the highest investment cost in the beginning of the period. However, the increasing trend will level off as time goes and the yearly cost will reach the point where the DH is the least expensive alternative in the year 1995. In the year 1997, the DH will surpass the TT even in cumulative cost. Finally, the DH will be the best alternative among the three alternatives in the year 2001 for the cumulative cost.



[Figure 2]The cumulative Cost Comparision with Alternatives

5 An Evolution Strategy Toward the Digital Networks

5.1 The conversion plan of the tandem network

In order to cope with rapidly varying telecommunication environment, the formation of tandem network should be initiated as soon as possible. During the conversion plan toward the digital networks, the two alternatives of routing methodologies will coexist and the conversion plan including network design and installation should be extremely complex. Therefore, the conversion should be completed within minimum period of time, say, in one year. However, there exist certain problems such as budget problem and traffic control if we try to finish the conversion in too short period of time.

After considering all the pros and cons of different time schedule in conversion plan, a two phase plan is proposed: Phase 1 (1992-1993) and Phase 2 (1993-1994). Four tandem offices will be installed and preparation of network conversion will be performed in the Phase 1 period. In the Phase 2, additional four tandem office will be installed during 1993 and switching of tandem networks will be conducted during 1994.

5.2 Network configuration during the conversion process

Since the network conversion should be conducted in parallel with yearly supply of facility and two different network architectures coexist, several complex conditions including proper switching of current tandem lines and tandem network configuration of new exchanges should be carefully considered.

The conversion plan of pure tandem have prepared with the two phases accommodating the existing and new systems during the installation of pure tandem exchanges. Otherwise, the existing tandem rule is applied as an alternate rule. Considering these conditions the tandem network is formed with the types of exchanges and the installation conditions of pure tandem exchanges.

5.3 Priority in the installation of tandem exchanges

Since the pure tandem exchanges will be installed on top of already existing networks and double homming architecture is conceptually over the numbering areas, no explicit installation priority exists. Only practical components such as growth of toll lines, the amount of required lines, and the provisions of installation space are considered in selecting tandem offices.

5.4 Accommodation of regional end offices

The double homming does not depend on the area and accommodates the regional end offices by existing facilities with areas as much as possible. Therefore, the pure tandem exchanges accommodates 50 % of outgoing trunk traffic and the exchanges of other areas takes over the other 50 % of traffic.

5.5 Supply scheduling of pure tandem exchanges

The tandem exchanges are basically facilities used for forming service networks of local end offices with transmission equipments. Currently, supply of local exchanges is performed as following: a plan, design of tandem networks, and design and construction of tandem exchanges are done usually two years, one and half year, and one year before the sale.

5.6 Generation of surplus facilities

Centralization of alternate trunks to the pure tandem exchanges produces surplus facilities. The inter-office trunk lines will increase the tandem lines even though lines in other offices are increased unlike subscriber lines. Therefore, new equipment can be still utilized even though the inter-office trunk lines are removed. Since the existing Time Division (TD) facilities require T1 trunk lines, the existing TD facilities can be accommodated by rearranging the surplus facilities out of TD systems. The toll lines will be handled by the TD exchanges for the time being.

5.7 Network switching and traffic control

In order to minimize the surplus facilities and to maximize the existing trunk lines, a certain amount of lines are reserved for switching among pure tandem offices and systems in end offices. The switching should be determined after considering whether the traffics can be handled by the already installed lines.

5.8 Conversion of CEPT transmission method

After considering the amount of the existing T1 facilities and the required amount of E1 facility in the future, we decide to install the tandem exchanges which have dual function of T1 and E1.

6 Concluding Remarks

The telecommunication networks have close relationship with various fields ranging from detailed execution of plan to management, equipment investment, and operations. The pure tandem networks have planned to gain such advantages in overall areas of telecommunication business over the existing network structure. The expected advantages include construction of regional network management, improvement of traffic control, efficiency increase in equipment investment, construction of intelligent networks, and flexible conversion toward ISDN.

Acknowledgement

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REALIZATION OF EDI MESSAGE TRANSFER ON AN MHS SYSTEM USING ISDN

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ABSTRACT

The Message Handling System (MHS) protocols of the X.400 series Recommendations are well known as an electronic envelope for conveying multi-media messages. Of a variety of applications over the MHS, Electrical Data Interchange (EDI) message transfer will be a major business application which can well utilize the store and forward capability of the MHS and high speed of the ISDN network. This paper describes requirements for realizing EDI over MHS using ISDN and the outline of an actual implementation which meets those requirements as well as functional standards. In addition, this paper outlines an efficient test procedure of interoperablity for EDI-MHS.

1. INTRODUCTION

Since NTT's ISDN services were started in Japan in 1988, various applications and devices for ISDN data communications have been developed. At the same time, an MHS functional profile for EDI transfer, based on the 1984 MHS Recommendations, was developed by the Telecommunication Technology Committee (TTC) in Japan. The authors developed an EDI transfer system by the MHS over ISDN, called EDI-MHS, based on the above functional standard and confirmed its good operablity. The EDI-MHS system consists of 1984 version's MHS system and EDI terminals which are DOS-based personal computers (PCs) with ISDN boards. This paper also describes the outline of the EDI-MHS configuration and specification and then test procedure taken in this prototype system.

2. ISDN SERVICE TRENDS IN JAPAN [1] [2]

NTT provides two types of ISDN services in full accordance with CCITT standards. Their profiles and features are shown in Table 1. These services are called INS-Net 64 and INS-Net 1500 respectively. INS-Net 64 is a circuit switched mode basic rate service, introduced in April 1988. INS-Net 1500 is a circuit switched mode primary rate service, introduced in June 1989. (The service names indicate service bandwidth.) Since June 1990, a packet switched mode service named INS-P has been provided to the subscribers of above two services on B channels and the D channel.

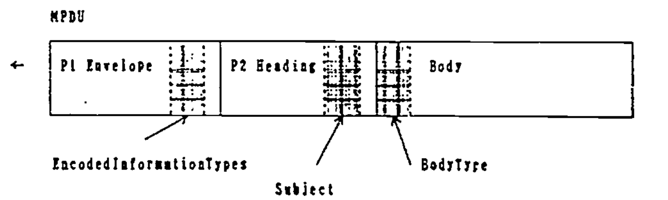
The number of service areas was reached to as much as about 2,000 local service areas by the end of March 1992. Along with the expansion of the service areas, the number of subscriber lines, counted in terms of INS-Net 64 lines, was almost 100,000 by that time. INS-P has gained a great popularity among ISDN users. INS-P service is being used by 33 percent of all INS-Net 64 lines.

3. STANDARDS FOR MHS AND EDI [3] [4] [5]

As the availability of MHS grows, EDI is expected to become one of the most important applications using MHS. TTC has already defined an MHS profile called JT-X411 as a TTC standard. This includes message transfer (MT) and interpersonal messaging (IPM) services and P1/P2 protocols based on the 1984 and 1988 X.400 Recommendations. There are two specific requirements to be considered for transferring EDI data over an MHS network in Japan. The first is to convey existing business formats based on major domestic industry standards such as the Japan Chain Stores Association (JCA) format. The second is to use a character code set for Japanese Kanji in EDI messages. To meet the requirements, several additional functions for EDI transfer were added to JT-X411 in April 1990 as shown in Figure 2. EDI data is transferred by being

Table 1 OUTLINE OF ISDN SERVICES PROVIDED BY NTT

Services	Profiles
INS-Net 64	Since April 1988 ·Basic rate interface (BRI:2B+D) ·Circuit switched mode (64kbit/s)
INS-Net 1500	Since June 1989 ·Primary rate interface (PRI:23B+D, 24B/D) ·Circuit switched mode (64kbit/s, 384kbit/s, 1.5Mbit/s)
INS-P (for INS-Net 64/1500)	Since June 1990 ·Packet switched mode (B/D)



Elements	Usage
EncodedInformationTypes	is used as 'undefined'
Subject	includes the character string which indicates the kind of EDI standard, character code, data type
BodyType	is used as 'unidentified'
Body	includes one EDI Interchange per Body

Figure 2 EDI RELATED FUNCTIONS DEFINED IN JT-X411

encapsulated within a body part. The type of business formats and the type of character code sets for Japanese Kanji are indicated within a P2 subject element. This approach was defined as a short term solution corresponds to the so called P2 method, in order to save immediate needs and use the widespread '84 MHS network. TTC also plans to standardize long term solution using X.435.

4. THE PROTOTYPE SYSTEM CONFIGURATION

4.1 USE OF ISDN NETWORK

Supposing the environment of the EDI transfer, a large number of business partners at various locations and a large volume of transaction are expected. Considering such characteristics of EDI traffic, ISDN is a reasonable choice as an access network to EDI-MHS systems because ISDN is a public network covering wide area, with a high speed transmission capability Therefore, ISDN was tried as an underlying transmission network in this system.

4.2 MHS SYSTEM CONFIGURATION

In this implementation, the MHS '84 system developed by NTT transfers EDI messages to and from other MHS systems according to the TTC standard profile described in Section 3. The EDI terminal submits and reads the EDI messages stored in the mailbox of this system. The mailbox access interface complies with the JUST-MHS profile [6], and the JUST-PC profile [7] which are domestic standards. This system has also a message relay capability among other MHS systems based on X.400 standards.

4.3 EDI TERMINAL CONFIGURATION

4.3.1 EDI TERMINAL HARDWARE [8]

Because the number of PC is increasing in business scenes, to realize an EDI terminal on a PC takes large benefit for end users. However, in order to realize the functions for transferring EDI data by means of the MHS protocols along with OSI protocol structure over ISDN, an appropriate configuration needs to be adopted for the program structure and usage of PC resources.

The EDI terminal hardware is an MS-DOS(TM) based PC equipped with an ISDN board. Under this configuration, PC can concentrate on Presentation layer and Application layer including EDI application. On the other hand, the ISDN board takes care of the function of layer 1 to 5. This configuration enables to save CPU power and memory usage of the PC.

4.3.2 EDI TERMINAL SOFTWARE

As an example of business format encapsulated in MHS message, this system is according with practical usage of JCA format. All items in JCA format are expressed by EBCDIC coding.

The EDI terminal software consists of two parts, one is an EDI management program and the other is a communication program. (see Figure 5) The management program is coded by a database language (DBXL, compatible with dBASE-Ⅲ) and C language. The main purpose of the program part written in C language is for code conversions. (from ASCII to EBCDIC, and vise versa) The EDI terminal system features are shown in Table 4.

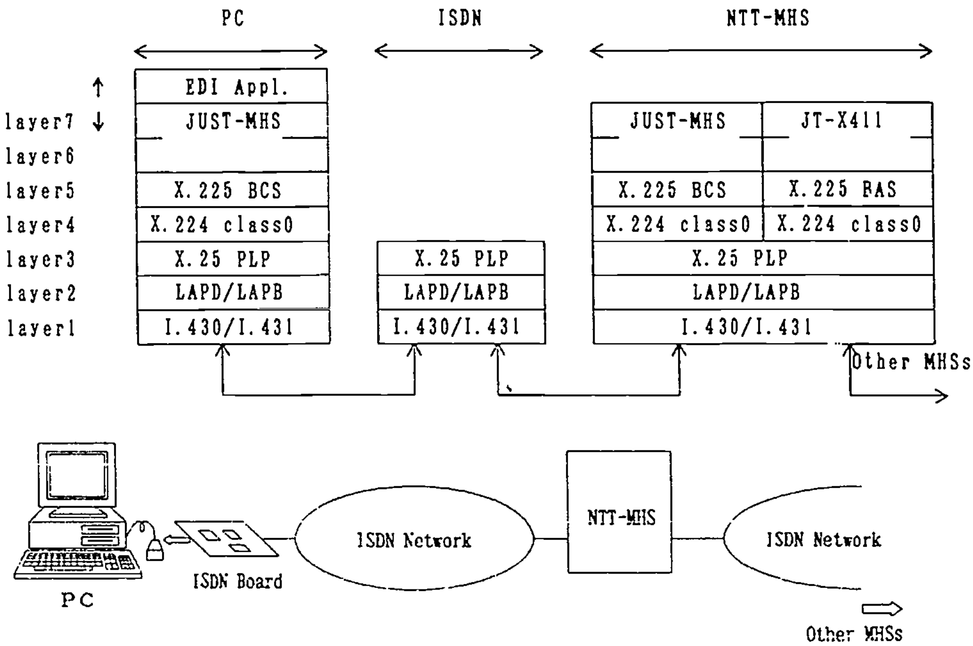


Figure 3 SYSTEM CONFIGURATION AND PROTOCOL STRUCTURE

Table 4 THE FEATURES OF EDI-MHS TERMINAL PROGRAM

	Feature	Benefit
Software structure	The DOS file interface is used between communication program and database program.	An existing communication program with a DOS file transfer capability can be selected as it is.
Communication program	A JUST-MHS control program is used.	This enables MHS mailbox access based on a standard profile.
	An ISDN control program is used.	The high speed capability and short connection time can be obtained.
EDI management Program	The data-base program has a function to swap out to Disk.	Execution of the EDI management program and communication program is realized on PC's restricted memory environment.
Other feature	RAM drive is mounted.	The response of executing the programs become reasonable for practical use.

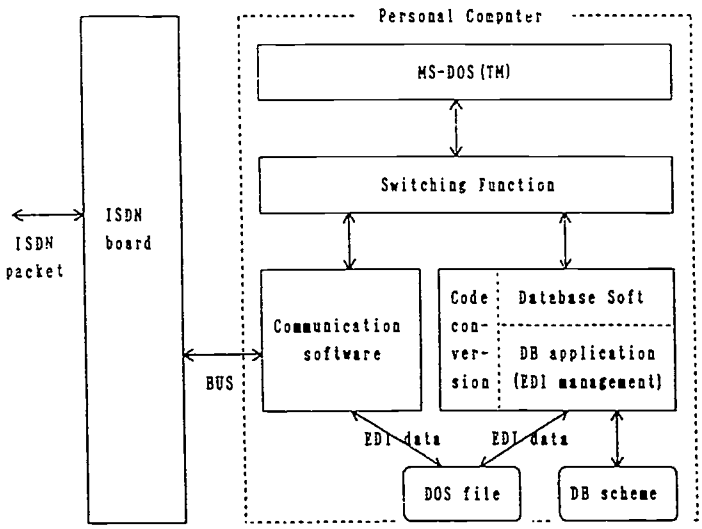


Figure 5 STRUCTURE OF EDI TERMINAL SOFTWARE AND HARDWARE

5. TEST PROCEDURE FOR INTEROPERABLITY

In order to confirm the functionality of the MHS, the system need to make interconnection with other MHSs developed by different vendors. An efficient method was necessary to make sure of the EDI-MHS system's interoperablity with other EDI systems via MHS including its message relaying function. The following testing method was introduced for connecting those systems.

STEP A: To establish a bilateral interconnection between a relay system and an end system.
STEP B: To establish end-to-end multilateral interconnections among end systems.

In each of step A and step B, there are sub-steps to confirm interconnection on a layer-by-layer basis. These sub-steps are as follows.

STEP A-0:To exchange connection data for MHS interoperation between MHS systems and check the connectivity. This step is described in [4].
STEP A-1:To test between one MHS and another MHS by using IA5 text message.
STEP B-0:To test between one MHS and another MHS through a relay MHS by using IA5 text message.
STEP B-1:To test between one MHS and another MHS through a relay MHS by using EDI interchange.

The purposes of each sub-steps are described below.

STEP A-0:To confirm basic connectivity for STEP A before actual testing steps.
STEP A-1:To confirm P1/P2, RTS and lower levels interoperablity bilaterally.
STEP B-0:To confirm end to end P1/P2 level interoperablity.
STEP B-1:To confirm end to end EDI format level interoperablity.

In order to efficiently execute STEP A of the procedure, an auto-answer in our UA in MHS is available. By utilizing this auto-answer UA, end systems can carry out bilateral tests at each systems' convenience. When all of end systems confirmed STEP A, then they can proceed to STEP B.

This procedure was adopted in the course of creating HATS (Promotion Conference of Harmonization of Advanced Telecommunication Systems) demo environment at Communication Tokyo '91 held in April 1991. It was exhibited to appeal the usefulness of EDI transfer over MHS to the public.

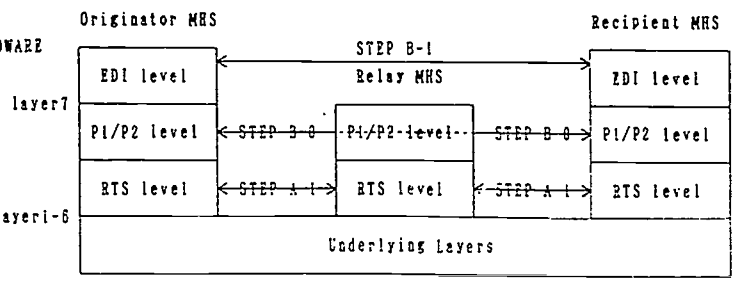


Figure 6 OSI LAYERS AND TESTING STEPS

6. CONCLUSION

This paper mainly described prototype implementations of our EDI-MHS and the testing method of interoperablity including EDI message transfer. The following points were presented.

(1) The 1984 MHS system and the PCs are workable to provide the function which meets the TTC standard profile for practical use of EDI transfer over ISDN.

(2) To divide the terminal program into the communication program and the EDI management program, and keep independence between those programs, enables users to select an existing communication program supporting an MHS access without change, in a PC's ordinal resource environment.

(3) For the demonstration in 1991 that NTT participated, the test procedure was introduced and the efficiency of it was confirmed. The interoperablity including relay functionality between our EDI-MHS system and other vendor's systems was also confirmed.

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BIOGRAGHY

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THE WRISTWATCH AS A PERSONAL COMMUNICATIONS DEVICE

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Honolulu, Hawaii, January 1993

ABSTRACT:

PCS is the "hot button" today in the telecommunications industry, but at present only the SEIKO RECEPTOR MessageWatch and cellular telephones can truly be called personal communication products. The RECEPTOR System and technology products such as the MessageWatch are uniquely mass-market oriented and intended for use by the general consumer. The RECEPTOR System is available today, offering not only personal messaging, but also a host of information services in a convenient, affordable, highly accurate wristwatch.

1. PERSONAL COMMUNICATIONS SERVICES: PROMISE VS. REALITY

Personal Communications Services (PCS) is without a doubt today's "hot button" in the telecommunications and information industries. Driven by the prospect of the typical consumers buying a wide variety of PCS devices that will materially increase the quality of their lives, sufficient to justify them paying hundreds or thousands of dollars for manufactured products and tens or hundreds of dollars a month for services, manufacturers and network organizations are touting the marvels of PCS in prose reminiscent of t . great expectations of the still-nascent home automation revolution.

SEIKO Corporation, and its sister company, SEIKO Epson Corporation, are also very bullish on PCS, but with one important exception from most of the rest of the pack: We have developed, manufactured, and are selling and servicing the only mass consumer PCS product available today, the RECEPTOR MessageWatch. Shortly we will provide a description of the RECEPTOR system and its first consumer product form factor, the MessageWatch. First, though, a little marketplace reality testing is in order.

Let's start with the almighty consumer. Why do they want ?ersonal Communications Services and Products?

For efficient time management.

For rapid communication with family and business in today's extended social environment.

For effective, convenient means to handle the information overload that has become the norm of our daily lives.

In other words, the Consumer Wants Mobile, Portable, and Convenient Communications Tools that help him or her manage and enhance his or her day-to-day life.

Sounds good, so far. In addition, we would contend that, for a product to be truly PCS, it has to meet rather rigorous Consumer Requirements:

Small and rugged

Easy to use

Relevant to daily lifestyle needs

Low product prices

Low service prices

We would suggest that, based on consumer wants and requirements, there is only one PCS product available in the market today, the RECEPTOR MessageWatch.

This is not meant to ignore or snub such fine products as the HP95LX with SkyTel's data module, Motorola's EMBARC and Info-TAC, Apple's Newton, AT&T's GO/Hobbit, and many others. At present, though, these products are geared for and targeted to the niche market so admirably represented here at PTC '93 -- the business professional. All of these products satisfy the Consumer Wants criteria, but miss badly on one or more of the Consumer Requirements criteria.

Even cellular telephone has been struggling to meet these consumer requirements, for example through marketing strategies such as "bundling": treating the cellphone product as a "razor blade" handle, it is almost literally given away to attract consumers into becoming service subscribers with contracts to pay for airtime (the "razor blades"). The first time the consumer gets a monthly bill of more than $100 for airtime (keep in mind that the average long distance bill in the U.S. is $35 per month), the cellphone gets put on the shelf, as evidenced by the very high churn rate for non-business cellular customers. The consumer just isn't going to pay many hundreds or thousands of dollars for products and services if these are, at bottom, extremely sophisticated, elegant, but expensive substitutes for paper and pen, or provide answers to problems people never knew they had in the first place.

As a result of spending billions of dollars on developing products spurned by the market, communications product manufacturers have gotten the message, and have come up with other ways to try to stake out a presently narrow but possibly large future market. One of these methods is particularly evident today in PCS: concentrate on building a platform to support end-user products. There is an abundance of activity in planning for the construction of satellite, narrowband, and broadband platforms, all requiring significant capital investments, all predicated on a very small base of business users who will provide both the market impetus and profit margins required to trigger the explosive growth of demand for PCS products and services. To top it off, many of these platforms require the issuance of basic rules and regulations by the FCC for both PCS platforms and devices.

It may yet happen. In the meantime, we have RECEPTOR MessageWatch.

2. THE RECEPTOR SYSTEM

RECEPTOR is the essence of simplicity, operating on a standard FM radio transmission platform. Personal messages and information intended for MessageWatch are created using anything from plain old telephones to more sophisticated input devices, and sent to our Message Center over the existing telephone network utilizing the standardized X.25 network protocol. Message Entry, Message Processing, and Message Transmission are all handled at the Message Centers.

The final element in the platform, Message Transmission, is accomplished by the insertion of subscriber messages and information services into the SCA portion of the FM transmission utilizing an SCA generator.

The RECEPTOR technology, currently offered in its first configuration as the SEIKO RECEPTOR MessageWatch, is an extraordinary PCS device worn by the consumer. When not operating in its receiver mode, the MessageWatch is a multi-function, digital quartz timepiece with SEIKO's legendary quality and accuracy -- accuracy enhanced by automatic radio transmission updating, 36 times per day. The MessageWatch is an engineering marvel, a fully addressable personal information terminal: a unique FM antenna built into the wrist band; a frequency-agile receiver capable of locating messages broadcast anywhere from 88MHz to 108MHz; on-board testing and diagnostic functions; a programmable memory; and liquid crystal display.

3. RECEPTOR CAPABILITIES & FEATURES

The capabilities and features of the RECEPTOR MessageWatch make it the general consumer PCS product for today:

Utilizing a patented time-slot protocol for packet transmission, data is distributed at a speed of 19.2 kpbs.

With a standard lithium watch battery, MessageWatch will provide personal information services and timekeeping functions for One Year.

Each MessageWatch is fully addressable, and, with the unprecedented data speed, enables subscribers to receive a vast array of personal information services, in addition to the typical paging services including: Weather Reports, Sports Scores, Coded Messages, Lottery Numbers, Stock-Market Quotes, and Voice-Mail Alerts, and Bank Balances.

System capacity is enormous, with the ability to service hundreds of thousands of subscribers in a single market using only one Message Distribution System, and all operating within an FM/SCA transmission environment that eliminates the need for any of the in-field, capital-intensive distribution plant required for paging, cellular, or PCN technologies.

The use of FM/SCA transmission has other advantages. No FCC license is required (the subcarriers are leased from radio stations), and there are essentially no foreign ownership or other FCC restrictions. In addition, the FM band is in use for the same broadcast purposes around the world, making RECEPTOR the only PCS device that could potentially be used, with no modification, anywhere on the globe.

4. CONCLUSION

RECEPTOR is operational and available today, with services and products being offered at present in Portland, Oregon and Seattle, Washington. We have thousands of happy subscribers who use MessageWatch to fill personal, business, or both personal and business needs.

The MessageWatch is being sold in the Home/Consumer Electronics section of retailers in these cities at price points around $150, and the response is nothing short of fantastic. They are charged $12.50 per month for as many information services and messages as they would like to use.

We have found that people who purchase the MessageWatch for personal use are not accustomed to making use of PCS services, so we have expanded the array of information services to provide connections between their day-to-day information needs and RECEPTOR's capabilities.

We have already completed work on the next generation MessageWatch, which is almost half the size of the present version, with even more capabilities and features. We are also working on development of other devices and modules utilizing the basic RECEPTOR technology package.

We view RECEPTOR MessageWatch as a basic, enduring Personal Communications Services product, completely compatible and synergistic with all of the Business Communications Services (BCS) products that are currently available and the new PCS products that everyone is still talking about. We look forward to that time, possibly in the not-too-distant future, when RECEPTOR works hand-in-hand with other PCS products that are not available today. Until then, there is RECEPTOR, which is already making a difference in the lives of general consumers.

The Expansion and Liberalization of Mobile Telecommunications in Korea

by

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1. Abstract

The paper focuses on the situation of mobile telecommunications services. This sector has been growing so fast in the last decade or so as the nation is getting informatized. To meet the increasing demand of this, the nation established Korea Mobile Telecommunications Corporation in 1984. The second and third mobile telecommunications corporations will be established in the 1990s not only to better serve the local market but to positively face up to the international competition.

2. Introduction

The basic structure of Korean telecommunications includes the broadcasting sphere like the network and cable broadcasting, and the electronic sphere that encompasses telephone, telegraph, value-added telecommunications and mobile network.

The structure of Korean telecommunications sector has normally been administered as well as practiced by a state or public corporation in an exclusive manner. The trend is, however, moving towards a civilian hands as the nation is undergoing the fast democratization process to fit the global liberalization process.

Especially, the mobile telecommunications is the core area in this sector that shows a tremendous growth. The mobile area will continue to expand at a faster pace than ever before as the nation is moving towards the informatization process. The future is bright because of an ability of mobile telecommunications to transcend time and space.

The mobile telecommunications has been growing fast in Korea during the last several years both in paging and cellular phone services. The selection of second mobile telecommunications company will be made in near future. This is surely not only to increase supply of mobile telecommunications facilities but to upgrade the technology of this sector.

Based on this backdrop, this paper intends to examine the current situation of Korean mobile telecommunications sector, and further to probe the ways to improve this sector.

3. The Situation and Policy of Korean Mobile Telecommunications.

1) Historical Sketch of Mobile Telecommunications.

The mobile telecommunications was first used in 1910 when the nation used this technology as a means for air-traffic signal. During the Japanese occupation of Korea (1910 - 1945), the primary function of mobile telecommunications was not only to effectively perform the colonial policy but to maximize the war effort.

The mobile telecommunications has, however, become operational in 1960 when Korea Telecom introduced the manual IMTS(Improved Mobile Telephone Service) system to provide movile telecommunications service primarily to governmental agencies in limited areas around Seoul. The kind of this service was very limited, and its quality of function was poor as well.

The improved mobile telecommunications service, however, became possible when the nation introduced the AMPS (Advanced Mobile Phone Service) system, called cellular phone system, invented in North America. The introduction of this system made the mobile telecommunications very popular. In the meantime, the wireless paging service first became operational in 1982, further improving this service by introducing the tone and display system in 1986.[1]

Based on this backdrop, this paper intends to examine the current situation of the Korean mobile telecommunications service, divided into the user, service area, market and the development of technology.

① The Situation of User

The user sector has showed a phenomenal growth when the nation announced a drastic measure to modernize the mobile telecommunications service in 1982. According to this plan, the Korea Mobile Telecommunications Corporation was established in 1984 to vastly improve the quantitative as well as qualitative services. The Korea Mobile Telecommunications Corporation was selected as the user of public telecommunication service in 1988. Accordingly, the facilities for mobile telecommunications service was completely transmistted from Korea Telecom into Korea Mobile Telecommunications Corporations. The company has developed so fast that it publicized its business content in 1989. The nation intends to selet user of the second mobile telecommunications company.

② Service Area and Scope of Market

The service area of mobile telecommunications includes car phone, hand phone, paging service, mobile wireless public phone and spectrum public telecommunications service.

Demand for mobile telecommunications service has greatly increased in the 1980s enough to move into a second stage of mass growth in the 1990s. The following table below shows a growth rate of Korean mobile telecommunications service subscribers from 1984 to 1992.[2]

Table 1) The Increase Rate of Subscribers in Korean Mobile Transmission.

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992
cellular	2,600	5,000	7,000	10,000	20,353	40,000	80,000	166,198	260,200
paging	15,000	19,000	37,000	60,000	100,000	198,000	410,000	850,516	1,403,000

③ Development of Technology Sector

Contrary to the fast development of mobile telecommunications sector, an ability to produce the various equipments and software is in a preliminary stage. Even the accumulation of technology in terminal, assumed to be relatively easy in technology, is still in a developing stage. However, it is very encouraging the nation is greatly increasing the research and development funds in this sector.

2) Policy Situation

The telecommunications business belongs to a highly technology-intensive as well as value-added sector especially in an information society. This kind of industry is fully supported in many countries as a core sector enough to improve advanced technology and economic development.

As shown in the breakup of ATT in 1984, the international trend of mobile telecommunications industry has been fastly moving towards decentralization in an attempt to maximize compitition. This process includes diversity and civilian control.

The mobile telecommunications sector is also in the process of structural change in Korea. Accordingly, the Governments is under investigation to promote the mobile telecommunications industry. The following is a

1) Sang-Soo Yoo, Market Situation of Mobile Telecommunications, Electronic Development, April 1992, pp.18-19.

2) Jung-Ang Ilbo, June 20, 1992.

brief review on the revision of laws related to the changing mobile telecommunications industry.

The structure of Korean telecommunications policy is aimed not only to ease the internal competition but to strengthen the international competition. The Ministry of Communictions, which is primarily responsible for the telecommunications policy, has recently shown a new telecommunications policy towards removing the current heavy restraints. According to this direction of policy, two basic laws-electronic telecommunications law and electronic telecommunications businesses law, were revised in 1991.

The basic telecommunications law primarily regulates the relationship between the Government and the electronic telecommunications business. This law was revised in a way to effectively meet the highly competitive international environment.

The telecommunications business law focuses on regulating the comprehensive business area of telecommunications. Under this revised law, general telecommunication business is supposed to be designated by the Minister of Communications, while specific telecommunications business is subject to license. The value-added business is possible upon registration only.

Ultimately, the revised telecommunications business law was to liberalize the traditionally restraint-oriented position to more effectively face up to the changing telecommunications environment. This liberalization policy made it possible to establish the second mobile telecommunications is to open a competition era.

4. The Plan for Establishment of Second Mobile Telecommunications and Its Issues of Conflict.

1) Background for Its Establishment and Selection for the User.

The mobile telecommunications environment has been fastly changing both internally and internationally in the 1990s. That is, the trend is moving towards liberalization and internationalization. The only solution for this is to improve the quality of technology. The rapid development of telecommunications technology brought the various new services, and the change in cost factor as well. That is, as this industry has greatly expanded both in size and scope, the traditional monopolization of this sector by a corporation is losing grouns for rationale. And, as income of people increase fast, so changes the life style. This is likely to increase the diversity of needs.[3]

Such change for environment caused a policy change to allow a competition by establishing the second mobile telecommunications corporation in the near future. The background for competition in the Korean mobile telecommunications sector can be divided into two aspects.

First, the mobile telecommunications service has greatly changed in the local market. This change was possible as the nation had continued to invest in this sector in the 1980s. As a result of such continued investment, the mobile telecommunications service was expanded to a nationwide scale in the 1990s. The expansion of this service area vastly increased a potential for market.

However, as the demand rose so fast, supply could not meet the demand. The qaulity of mobile telecommunications service was poor as well. This indicated a limit to growth under the traditional monopolization structure. The monopolization structure not only caused a poor customer service but an expensive rate of service.

Second, the mobile telecommunications industry has reached a mature stage in the developed countries enough to expand the foreign markets. Accordingly, the developed countries has been showing a keen interest in entering the foreign markets based on the advnaced technology.

The Korean Government has positively reviewed a competitive structure in this sector not only to accelerate the service area of mobile telecommunications but further to improve an international competitiveness. The preliminary stages for competition are as follows:

March-November, 1989 : Feasibility Study by Development Committee of Information Transmission: Proposal for Structural Change in Transmission Business and for Competitive Environment.

July 1990 : Decision for Structural Change in

3) KISDI, Telecommunications Policy Issue, vol.4, 1992, p.2.

Telecommunication Business for Competitive Environment; Transformation of Mobile telecommunications Business into an Approval System to Improve Competition.

August-December 1991 : Drastic Revision of Basic Law and Business Law in Electronic Transmission.

14 April 1992 : Announcement for Application of Approval in Mobile telecommunications Business.

23 June - 30 June 1992 : Acceptance of Application Form in Mobile Telecommunications and Paging.

August 1992 : Final Review and Decision on Application of Cellular Phone and Paging.

September 1992 : Return of License on Cellular Phone by TAEHAN Telecom.

2) Disputes in the Process of Licensing.

The Ministry of Communications announced the licensee of second mobile telecommunications service on 20 August 1992. However, the decision of licensee was under a great dispute as other bidders raised an unfair practice in the process of decision. This dispute further spread into a political and social issue.

First, viewed from a political perspective, the decision of licensee of the second mobile telecommunications business was regarded as the greatest priviliged rights of the Sixth Republic. As a result, a great dispute was focused on whether there was a political intervention in the process of decision in licensee. The reasons for such dispute are as follows;

First, there was a unfairness in the criteria of qualification for the licensee-applicant. The criteria for qualification was based on the telecommunication law. This law says that any corporation related to manufacturing telecommunications equipment can't participate in mobile telecommunications business exceeding 10%. This provision was made under a premise that a sound development of mobile telecommunications business is hardly possible in case one corporation is involved both in manufacturing and service areas. Under this provision, while such big corporations like Samsung Hyundai, Lucky-Gold Star and Daewoo were not qualified due to their involvement in this business, the other big corporations like Sunkyung and POSCO(Pohang Iron and Steel Company) were entitled to apply for the licensee because these companies were not involved in telecommunications service area.

Second, there was a unfair practice in the screening process of licensee. The Ministry of Communications established a licensee committee manned by specialists to decide the screening criteria. The Ministry screened the licensee-applicants two times based on this criteria. However, even this kind of process could not guarantee the fairness.

Especially, the decision of licensee couldn't dispel the political involvement in that this business will bring an enormous financial privilege. Therefore, the greatest task in the future decision process is how to guarantee a fairness that can be satisfied by all the parties concerned.

In another, the screening criteria should give more merits to technology point because this belongs to technology-intensive business. The technology point is far easier to guarantee fairness and objectivity.

The technology point, however, needs caution in that the applicant is supposed to collaborate with a foreign counterpart. This was proved as the six local appliants were shown an interest in joint venture with foreign companies.

As mentioned elsewhere, the decision for second mobile telecommunications business was postponed. The future decision should be made on a fairer basis with aforementioned disputes in consideration.

5. The Prospect for Korea Mobile Telecommunications.

There will be a fast as well as vast development in mobile telecommunications business as the nation undergoes the structural change in industry. Korea, as is known, is under the transition process from manufacturing to information and service industry. This is likely to raise diversity of customer needs in mobile telecommunications service.

The prospect for development in Korean mobile telecommunications service is predicted as below under this changing environment.

First, service will be diversified. The recent service competition in this area addes diversity of services to traditional paging and hand phone service. For instance, the paging service renders customer not only the traditional telephone number but the related message. The hand phone service is now possible even in underground parking lot and shopping center. The traditional hand phone service was not possible in this specific area.

The service area was also vastly expanded to an extent that international paging service is possible.

In the meantime, in addition to diversity of traditional service, new mobile telecommunications services show up. Several examples include CT-3 service, wireless data service, and mobile telecommunications service by satellite.

It is also expected that the combined service of wire and wireless telecommunications will be rendered to customers in the 21st century. In this process, the service will be more diversified from the traditional voice-centered service into the combined voice and non-voice services.

Second, there will be a great development in technology. The technology will be developed in a way to diversify as well as accelerate the diversity of service. This means development both of technology related to frequence resources and of technology related to service itself. The increase of mobile telecommunications business is likely to cause scarcity of frequency resources. This will increase an interest in technology development to effective use of the existing frequency resources. This requires a development of new frequency band. For instance, as the demand of cellular phone is fast increasing especially in the metropolitan area, supply couldn't meet the demand under an analog system. The Government, therefore, is developing a digitized cellular system, called CDMA (Code-Division Multiple Access), to make this system operational by 1994.[4]

Third, it is necessary to expand the scope of market, and strengthen the competitive structure. The Korean mobile telecommunications market is annually increasing by 76.4%. If this trend continues, there will be 4.5 million subscribers of cellular phone plus 3 million subscribers of paging service by 2.000. The market size will be about 2.7 trillion Won ($200 billion).[5]

Following the selection of the second mobile telecommunications licensee, the Ministry of Communications will announce the screeing pocedure for the third mobile telecommunications licensee in 1994.[6] The increase of mobile telecommunications licensees is likely to strengthen the competitive structure.

To revitalize the mobile telecommunications business, three areas—market (demand), technological and policy are to be examined as follows.

① Market Aspect

Viewed from a market perspective, mass use for mobile telecommunications will be necessary.[7] Any industry needs to motivate the energetic purchasing power for the continued growth. For this, the industry needs to closely examine what kind of services the customer needs.

A more concrete method for mass use is also to improve the system of mobile telecommunications business. This kind of method includes reducing installaton and rate fees. Ths ultimate method for this will drastically reduce the rate fee while the installation fee will be dropped. This ultimate method, however, will take time because the enormous investment should be compensated by both fees.

② Technological Aspect

The early development of domestic technology as well as a localization of service is vital to smooth growth in this sector. The mobile telecommunications sector still highly depends on the foreign technology. The urgent task is how to improve the technology of mobile telecommunications to an advanced level enough to compete with the developed countries when domestic market is open to international competition.

The localization of this technology is vital because the mobile telecommunications network will form the basic social structure as society is getting informatized. The development of local technology will also strengthen the bargaining power with international competitors.

③ Policy Aspect

A viable policy is vital to growth of any industry. A strong government policy is, therefore, needed for the mobile telecommunications business for this business to grow as a strategic industry. The mobile telecommunications network will form a vital ntwork in every sector of public and social life. This sector, as an highly advanced industry, is likely to greatly affect other industries related to this sector.

This effect will increase an opportunity for employment as market fast grows. At a national level, there will be an effect of accumulation in the basic technology.

4) Monthly New Media, August 1992.
5) The Domestic Mobile Telecommunications Business: Its Situation and Prospect, Ssangyong Economic Institute July 1991.
6) Monthly New Media, August 1992.

7) Phones per 1,000 persons in comparable countries (1991) are 26.1 phones in Hong Kong, 22.2 in Singapore, 7.7 in Taiwan, 6.8 in Malaysia and 3.8 in Korea

WIRELESS COMMUNICATIONS AND PERSONAL FREEDOM

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Honolulu, Hawaii, January 1993

ABSTRACT:

Through a wide variety of overlapping approaches -- e.g., PCS, CT-2, wireless LANs, mobile data, mobile satellites -- innovative companies are promising to integrate wireless data and voice communications over seamless networks. "Old" technologies, such as cellular and paging, are being used in new ways (for example, for information and data services), and the technologies today under development (particularly PCS and mobile satellites) suggest a future in which constraints of time and place will become essentially irrelevant to communications. Despite fears of invasion of privacy in this new wireless era, in fact these technologies should be liberating, freeing users to communicate with anyone, from anywhere, at any time.

I. INTRODUCTION

When the history of communications in the 20th century is written, the 1990s will be remembered as the decade of wireless communications. Although mobile services have been available for many years, it was only as the 1990s dawned that they started to become ubiquitous. As prices charged for mobile equipment and services dropped, a surge in demand followed.

Many have questioned whether the increasing ubiquity of mobile communications represents an unalloyed good for the community. In this view, having a portable phone always in your pocket, and perhaps a pager strapped to your wrist, represent unwanted intrusions; they mean that one is not safe anywhere -- not even on an airplane or in a boat -- from those demanding attention, be they office colleagues, disruptive salespersons, ex-wives, or even current ones. From a regulatory perspective, this view suggests that perhaps we should not be in a rush to implement new personal communications services ("PCS"), because we will only intrude further on individual privacy.

I take a different view. My thesis here is that mobile communications represent an essential element of personal liberty, freeing individuals from the constraint of having to be in a particular place in order to communicate with one another. This thesis is not a new one, but it is given heightened salience by the emergence of new mobile communications technologies. Through a wide variety of overlapping approaches -- e.g., PCS, CT-2, wireless LANs, mobile data, mobile satellites -- innovative companies are promising to integrate data and voice communications over seamless networks, allowing the user to communicate with anyone, from anywhere, at any time.

This paper explores these new technologies, not from a technologist's perspective, but rather from the perspective of the user and regulator. The paper will focus first on existing networks, such as cellular, SMR, and paging, and on how technological advancements have made these networks more accessible. The paper will then discuss proposed technologies, including particularly PCS and mobile satellites. Finally, the paper explores questions of convergence and standards-setting, and the relationship between wireless communications and personal freedom.

II THE "OLD" TECHNOLOGIES AND THE "NEW" APPLICATIONS

Cellular telephony, in approximately its current form, has been available commercially in the United States for some ten years. At the outset, cellular telephones meant car telephones; the large units were installed almost exclusively in automobiles. The cost of cellular equipment, cellular service, and cellular "airtime" were all relatively high, making cellular almost exclusively a service for the well-heeled and for those, such as salesmen, spending a substantial part of their business day traveling among various locations.

Today, this situation has changed dramatically. Thanks in large part to advances in miniaturization, spurred by advances in semiconductor technology, cellular phones have become both much smaller and much less expensive. The monthly price of access to the cellular network has dropped, with numerous discount pricing plans available, and per-minute airtime charges have fallen, making cellular service far more affordable. The combination of these developments has made cellular increasingly a consumer product, one used not just by the business person, but also by the father or mother worrying about the children, the woman concerned about a car breakdown on an isolated road, and the person who simply enjoys talking on the telephone.

The dramatic success of cellular over the past decade -- far beyond anyone's imaginings -- has led to attempts to use other spectrum for cellular-like services. The most publicized use of an "old" technology for this new purpose relates to the specialized mobile radio ("SMR") bands, where Fleet Call and others have proposed digital services with many similarities to cellular. These services, of course, have the healthy effect of creating competition for cellular, thereby driving down the prices of all mobile services. In addition, the apparent success of enhanced SMR services has led to demands for more spectrum, and thus to the PCS developments discussed below.

Finally, there is paging. This service has existed for many years, but it has always been a neglected stepchild of the mobile services industry. Now, however, with renewed interest in mobile communications, this situation is changing.. The consumer market has become a particular focus of paging companies, which now offer wristwatch products, credit card-sized pagers, and pagers in designer colors. Many believe that, with the consumer market still virtually untapped, the potential for growth in paging is phenomenal.

III. MOBILE SATELLITES, MOBILE DATA, PCS, AND MORE

The tremendous growth in cellular and paging services has led many to believe that the user's appetite for wireless communications is virtually unlimited. One response to this perceived appetite has been, as discussed above, the conversion of "old" services, such as SMR, to "new" uses for the general public. Another, more significant response has been the burgeoning proposals for the creation of new mobile communications services.

The most expensive of these proposals involve the construction, launch, and operation of satellites dedicated exclusively to mobile uses. The American Mobile Satellite Corporation ("AMSC") is planning to spend hundreds of millions of dollars to launch a single satellite, intended to fill in the rural and other "gaps" in U.S. cellular coverage; AMSC is backed by several large communications companies, including Hughes, McCaw, Singapore Telecom, and Mtel. Other large corporations -- most prominently, Motorola, TRW, and Loral -- have filed their own applications with the FCC, vying for the right to spend billions of dollars on mobile satellite systems.

Will all of these mobile satellite systems be launched? Almost certainly not. Great as the public's appetite may be for mobile services, the financial community's appetite for writing checks to finance these proposals is likely to be somewhat more limited. In addition, it is far from clear that all of these mobile satellite systems will receive licenses from the FCC, which is facing competing demands for quite limited spectrum. Finally, even the most optimistic of mobile service advocates may have difficulty justifying several competing mobile satellite systems, each using different handsets and different technical standards.

Mobile satellite systems face competition not only from conventional cellular services, but also from the increasingly ubiquitous mobile data systems. These terrestrial-based systems offer corporate users a host of new ways to communicate with their sales and delivery forces with regard to such matters as inventory control, order-taking, and the like. As the FCC learned when it opened up the 220-222 Mhz spectrum for digital communications and received some 60,000 applications, there is strong interest in providing mobile data services to businesses, and in obtaining any available spectrum for mobile services.

This strong interest has manifested itself in other ways. Many of those involved in hardware manufacture, such as AT&T, IBM, and Apple, have made recent announcements about small, handheld "personal communicators," which are essentially computers incorporating wireless messaging capability. The fact that these companies have devoted significant resources to the miniaturization and radio transmission aspects of computing devices is a strong indication that the era of wireless data communications has only just begun. Other developments, such as the increasing use of cellular frequencies for data transmission, underscore the importance of this sector.

All of these futuristic developments in wireless services are overshadowed by the promise of, and hype about, PCS. Unless one is referring to specific services in the 2 GHz band, it is difficult to define "PCS," which can mean any mobile service intended for personal use. Thus, for example, the cellular industry argues that, with the tiny portable phones available today, PCS is already available via cellular frequencies, and Seiko Corporation markets a wristwatch pager with other information service features as a "personal communications device." It is no accident, moreover, that the aforementioned small computers with communications capabilities are referred to by various names incorporating, typically, the word "personal."

The debate about who provides the "real" PCS is not a very productive one, and it obscures the fact that there are some significant technological developments, particularly with regard to spread spectrum propagation, underlying the many PCS proposals pending at the FCC. It is also the case that PCS developments in telephone handset miniaturization and radio transmission will benefit all mobile service users, including those now using cellular frequencies. And, of course, competition from PCS providers -- indeed, even the threat of such competition -- will inevitably lead to better quality service at lower prices from the existing mobile communications providers.

The future offers other possibilities for mobile communications. In Europe, numerous countries have committed to the so-called "global system for mobile communications," more typically known as "GSM." Several Asian nations -- including most notably Hong Kong, Australia, Singapore, New Zealand, and India -- have also committed to deliver GSM services. GSM's principal advantages are that it is a digital service, and that there will be a single standard (meaning, among other things, that one handset will work in several countries) throughout Europe and much of the rest of the world. The Europeans have also explored other mobile technologies, such as the use of FM radio subcarriers for radio data services ("RDS"), which allow the transmission of paging and other information, including particularly traffic bulletins and automatic tuning of radio stations by category of programming.

All of these technological options suggest the possibility of confusion, with competing systems and competing standards leaving the consumer with a bewildering array of choices. The Europeans and several Asian countries have chosen to solve this problem, in part, by adopting a single standard through GSM, and the United States did the same in cellular. As we move to the next phase of mobile communications, however, questions regarding the role of regulators in setting standards and dictating consumer choice become increasingly significant.

IV. MOBILE CONVERGENCE AND PERSONAL FREEDOM

In general, users of mobile services care little about the particular technology involved, and even less about the regulatory regime underlying a particular service offering. Rather, users are focused on a simple (if not always simple to answer) question: Does the service work for my intended purpose? The better that a particular service works in terms of a particular user's needs, the more pleased the user will be, and the more he or she will be willing to pay for the service.

For this reason, regulators should take a relatively hands-off approach in choosing winners and losers among those vying to provide mobile services. Plainly, the constraints of limited radio spectrum require regulators to make some choices, but those choices should not be based on a non-engineer's view of what technologies are best, or on whether the public is better served by voice or data services. Rather, regulators should try to get out of the way, encouraging competition as the best means of providing service to the public.

Some might argue that, if the regulators do not specify technical standards, there will be confusion on an epic scale, with service providers, equipment manufacturers, and ultimately the public paying the price. In fact, it is likely that the market will quickly sort out the competing proposals, and settle on a few common standards for mobile communications. As the experience with VCRs demonstrates (remember the Betamax?), users tend over time to gravitate toward a single technology, based on technological considerations, marketing, or some combination.

It is undoubtedly the case that, in this process of winnowing out technologies and services, there will be some losers, but there will also be winners. This is a necessary and accepted consequence of encouraging the entrepreneurial development of new technologies and services. And the big winners are going to be consumers, who will be free to select among numerous service providers and equipment manufacturers, with competition helping to drive down prices (as has been the case in cellular).

Is there any danger that these new wireless technologies will usher in a "brave new world" of privacy intrusions, in which "Big Brother" will be able to find any of us, any time? These kinds of fears, raised about mobile communications at least since cellular telephones became smaller and more portable, simply have no basis in reality. A mobile telephone may be turned off; a page may be ignored; a message on a computer screen may be reviewed at leisure.

Indeed, mobile communications have had just the opposite effect, acting as a strong force for personal freedom. In noting the recent fact that the ten million mark had been passed in terms of Americans enrolled as cellular subscribers, the commentator Ben Wattenberg wrote:

> Great inventions are liberating. New technology was supposed to be regimenting, but that's not what happened. Technology yields personal freedom . . . . Cellular lets people talk to people, even without a wall, or a wire. . . . Pushed by technology, liberation is sweeping the world.

Washington Times, Nov. 18, 1992.

Mobile communications stand at the forefront of this move toward "liberation," because they allow each of us to use our time most efficiently. If I can return business calls while driving home from work, I can spend more time at home with my children. If I can reach a colleague who is in an airplane, that colleague and I will not have to waste time trading calls while he is moving around the city after he lands. And -- although some will not like this -- if I can receive a fax while lying on a beach in Hawaii or sailing in the Caribbean, I may be able to take a few more vacations.

In these and countless other ways, the availability of mobile communications benefits all of us. Any intrusions on our private time are intrusions that we have chosen, often in order to have more, or better quality, private time later, or in some other way. It is this fact, the fact of choice, that is the essence of personal freedom, and it is in this sense that mobile communications are liberating.

PEACESAT: A Pacific Island Users Perspective on Searching for a Satellite

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1. ABSTRACT

This paper provides a user perspective on searching for satellite service in the Pacific region in the current environment of rapidly changing telecommunications technology and proposed service providers.

2. PEACESAT

PEACESAT, the Pan-Pacific Educational and Communications Experiments by Satellite project, is a non-profit, non-commercial, telecommunications network interconnecting users throughout the Pacific region. PEACESAT was founded by the University of Hawaii in 1971 and used a single voice channel on NASA's experimental satellite, the ATS-1, until that satellite ran out of station-keeping fuel in 1985.

During its fourteen years on the ATS-1 satellite, PEACESAT found that voice and data service using low-cost, low-technology VHF equipment met the needs of many Pacific island users. The ATS-1 provided full-disk coverage of the Pacific and PEACESAT developed into a interactive mesh network with over 100 terminals located throughout the Pacific.

In 1988, the National Telecommunications and Information Administration (NTIA), a division of the United States Department of Commerce, was directed by the U.S. Congress to reestablish the PEACESAT service. NTIA has been involved in the search for satellite service for PEACESAT for the past four years.

Because no satisfactory commercial satellite alternatives were available, NTIA secured the temporary use of a satellite supplied by another division of the Department of Commerce, the National Oceanic and Atmospheric Administration (NOAA). This satellite, the GOES-3, is available for PEACESAT use through 1994 while NTIA continues its search for a long-term satellite for PEACESAT use. The GOES-3 provides for the same full-disk coverage, mesh network configuration and voice and data services as the original ATS-1 but also permits twelve channels of service with higher data rates and better voice signal quality than the ATS-1.

Today, PEACESAT provides educational, medical and cultural information to approximately twenty Pacific island administrations. The Pacific island entities participating in the PEACESAT project are: American Samoa, Cook Islands, Federated States of Micronesia, Fiji, Guam, Hawaii, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Marianas, Palau, Papua New Guinea, New Zealand, Solomon Islands, Tonga, Tuvalu, Vanuatu and Western Samoa.

As part of our search for a satellite for PEACESAT, NTIA conducted two satellite surveys (1988 and 1991) and a feasibility study (1992). During these studies, we consulted with PEACESAT users about their requirements for satellite service after the GOES is no longer available. These requirements include the need for a full interactive mesh network to connect all the Pacific island nations, where each terminal can directly talk with any other user's terminal. The primary service requirement is for voice and data service. Voice service would be used in a teleconferencing setting with data to support facsimile and interactive computer services. Video capabilities were desired by several users.

NTIA and PEACESAT have concluded that these services can best be supplied by geostationary satellites which can provide full coverage of the Pacific region and which can support a wide variety of program services.

This paper relates NTIA/PEACESAT's experiences in searching for long-term satellite service to meet the requirements of the PEACESAT users. We hope this research will be beneficial to Pacific island users who are faced with the rapidly changing satellite environment which exists in the Pacific.

3. SATELLITE SURVEYS

After receiving responsibility for reestablishing PEACESAT in 1988, NTIA conducted a study with PEACESAT to begin the search for a suitable satellite. The 1988 study found only two commercial communications satellite systems serving the Pacific Basin.[1]

By the time of the 1991 study, the satellite environment changed significantly in the Pacific. The study identified over two dozen satellite systems that had been proposed which could serve the Pacific region[2]. The twenty-nine systems identified in the report did not include satellite systems directed at Asia that could not reach the Pacific island nations. Today, there are four commercial satellite systems operating over the Pacific.

A report summarizing each of the twenty-nine satellite systems was presented to the 1992 Pacific Telecommunications Conference. The forty-three page report was not published in the PTC'92 proceedings but is available from the authors.

Of the twenty-nine satellite systems identified in the 1991 study, seven were operating geostationary (GEO) systems and eleven were proposed GEO systems.

The NTIA study also identified eleven other systems that proposed using non-geostationary satellites, primarily using low-earth orbits (LEO). Two satellite systems proposed specialized orbits, one (ELLIPSO) using highly elliptical orbits (varying from 400 km at the low point to 3,000 km at the high point), the other (ODYSSEY) uses circular orbits at 10,000 km (5,600 miles) high. These two systems share many of the characteristics of the LEO systems and are, therefore, considered with LEO satellites in later discussions.

Information on the GEO satellite systems (including the PALAPA PACIFIC and RIMSAT systems announced in 1992 after the NTIA study) is included in Table 1. Information on the LEO satellite systems is included in Table 2.

4. SATELLITE COVERAGE

Since the coverage areas of different proposed satellite systems will vary greatly, each Pacific island user must determine its primary service objectives and what geographic areas must be served. Coverage requirements will be different for national service than if the requirement is interconnection with other Pacific island nations on a regional basis or for international interconnections with the United States, Japan, Australia, or southeast Asia.

For PEACESAT, the primary coverage requirement is a satellite system that serves all of the Pacific islands. The PEACESAT coverage criterion is perhaps unique, in that the system requires satellite coverage to permit a full-mesh network configuration among each of the Pacific island participants. We considered the full range of both GEO and LEO system options and concluded that GEO systems provide the best alternative for PEACESAT's needs. Other Pacific island users may find that several of the LEO options are attractive for their particular needs.

4.1 GEO SATELLITE COVERAGE

A GEO satellite located between 150° E longitude and 140° W longitude has the *potential* of providing service to the Pacific islands.[3] From these orbital positions GEO satellites are visible at acceptable elevation angles to the majority of current PEACESAT Pacific island users (situated at locations stretching from Palau at 134° E longitude to the Cook Islands at 160° W longitude and even to French Polynesia).

However, largely due to the sparse population density of the Pacific island region many of the proposed GEO satellites within the 150° E to 140° W orbital arc feature beams focused on service areas of higher anticipated traffic density than in the Pacific islands.[4]

The *actual* coverage areas of the proposed GEO satellite systems therefore vary widely. All the satellite systems can provide service from at least one location in the United States to Japan and Asia. Several of the systems have at least one transponder that can provide "full-disk" coverage where a satellite signal is available to any location on the surface of the earth facing the satellite. Full-disk coverage permits coverage not only of the Pacific islands but of areas along the Pacific Rim which have information resources that can be made available to the Pacific island user.

The ideal coverage for PEACESAT would be a satellite that provides full-disk coverage, although coverage of the Pacific Rim and Pacific islands can also be provided by using a combination of different transponders on a single satellite.

Many of the satellite systems have a transponder which provides coverage to the Pacific islands, though not all Pacific islands may be covered by a single satellite. The coverage patterns of many of the satellites are only preliminary and are based on the vendor's view of the potential market. In return for receiving a long-term contract, several potential vendors are willing to modify their coverage pattern to serve the needs of Pacific island customers.

The coverage patterns of the GEO satellites as they relate to the Pacific islands are summarized in Table 1.

4.2 LEO SATELLITE COVERAGE

It does not appear that LEO systems can provide the Pacific-wide coverage that PEACESAT requires. Since most LEO satellites will be located within 1,600 km (1,000 miles) of the earth, a constellation of many satellites will be required to provide worldwide coverage. Most LEO systems will only be able to cover regions hundreds of kilometers in diameter with each satellite. The two systems mentioned earlier which use highly elliptical or medium orbits, ELLIPSO and ODYSSEY, will have coverage areas the size of the continental United States.

The advantage of the LEO satellites' lower altitude is their ability to address the "last mile" connection to the end user. Small, battery-powered handheld units will be able to send and receive signals directly from the LEO satellites. However, because the handheld units have little power and the coverage area of a single satellite is limited, relatively large earth terminals ("gateways") will be required to interconnect the handheld units with other users. If the intended receiver cannot be served by a single satellite and gateway, the gateway must forward the message by other means such as a second satellite.

For example, under most LEO scenarios, a message from Palau to Hawaii would go from Palau to a regional gateway and then would use another satellite or cable to get to Hawaii.

The exception to this scenario is the Iridium system, which proposes to equip each satellite with the ability to directly switch a message to adjacent satellites. Therefore, a message could go directly from Palau to Hawaii through multiple inter-satellite links across the Pacific.

This does not mean, however, that the Iridium proposal is the only LEO satellite that warrants consideration by users in the Pacific islands. The other LEO satellites will be able to provide voice communications (the so-called "Big LEO" proposals) or data-only communications (so called "little LEO" systems) to areas from several hundred kilometers to several thousand kilometers in diameter. Therefore, the LEO systems will have the capability of providing access to people on many of the outer islands that are currently beyond the reach of existing communications.

Depending on the system constructed, a Big LEO system with a single strategically placed gateway terminal could provide domestic service to a Pacific island nation or could provide regional services to several island countries. Communications from outer islands or from several nations could be fed from a LEO gateway to another satellite system or undersea cable to reach the rest of the world.

The small coverage area of each LEO satellite, however, does not fulfill PEACESAT's goal of reaching all the Pacific islands.

5. ABILITY TO MEET PROGRAMMING OBJECTIVES

A satellite system must be able to meet the users current communications objectives and should have the flexibility to provide for future service growth.

The teleconferencing capability of the PEACESAT network constitutes the most important criterion of whether a particular satellite system will support PEACESAT's mission. An interactive mesh network allows a high degree of user initiative and system flexibility to successfully implement PEACESAT's distance learning programs and teleconferences.

5.1 GEO PROGRAMMING SERVICES

Most of the GEO systems operate on the Fixed Satellite Service (FSS) bands as designated by the ITU. FSS systems normally use frequencies in the C-band and Ku-bands and provide channels up to 36 MHz wide for voice, data, and even full-motion video service. FSS satellites usually support high traffic volumes and mesh networks where any user can directly access any other user. FSS systems can provide wide-band service for PEACESAT and other Pacific island users.

If VSAT terminals (very small aperture terminals, usually less than 3 meters in size) are used, the systems usually require the use of a large central hub. Through the use of very powerful satellite transponders and advanced VSAT earth terminals, some satellite systems can operate VSAT networks without the need for hub terminals. The power and bandwidth of the FSS GEO satellites provide the opportunity for users to expand service to high speed data rates and video if appropriate.

INMARSAT operates on the L-band frequencies assigned by the ITU to Mobile Satellite Service. The INMARSAT satellites can provide voice and data services but not full-motion video. The INMARSAT system supports low traffic rates and requires that all communications go through a "land earth station" hub, such as those located in the Pacific region at Santa Paula, California and Yamaguchi, Japan. The INMARSAT satellites are designed to provide a different service than the FSS GEO satellites and do not provide the opportunity for service expansion into new technologies that would be available from the FSS systems.

5.2 LEO PROGRAMMING SERVICES

The objective of most of the Big LEO proposals is to provide a voice and data service to almost any location on earth comparable to existing cellular telephone service. Such systems theoretically should be able to support the voice teleconference calling and two-way data now used by PEACESAT on the GOES-3. However, whether the Big LEO systems will actually be able to reliably provide Pacific-wide teleconferences is unknown at this time. The Big LEO systems are in the design stage and will be optimized for service in the United States and Europe. Pacific-wide service from the Big LEO's, other than Iridium, is not only dependent on the availability of gateway terminals, but also on an adequate second communications link that serves all potential user sites.

The little LEO systems will provide chiefly data communications service. This will usually be limited to short messages of several hundred characters in length. Messages of this size would be of limited value to PEACESAT users but could be used by Pacific island users to exchange environmental data, disaster warning information, position location or research data. Two of the little LEO systems, GONETS and VITASAT, propose to "store and forward" data with the ability to distribute many pages of text. These systems could provide for efficient transfer of written message and data from outer islands to distant locations in 2 to 12 hours.

The LEO satellites utilize a very small amount of bandwidth. The bandwidth used by a Big LEO system, for example, is less than a single 36 MHz transponder on the typical GEO FSS satellite. Expansion beyond the initial services presented by the LEO services appear limited by the capacity of the systems and none of the LEO satellite proposals appear to be able to provide enhanced services, such as 64 kbps channels.

6. DEGREE OF LONG-TERM VIABILITY

In planning to initiate a new satellite communications system, Pacific island users should look at the long-term viability of the system and technology under consideration. The major financial investment when establishing a satellite-based network is in the earth terminals. The compatibility of earth terminals with more than one satellite system gives the user the flexibility of migrating to another system as conditions warrant.

PEACESAT is now searching for another satellite to continue the recently reestablished GOES service. The ideal solution for a long-term satellite would not only solve the immediate problem for continuation of PEACESAT service but would also have a high degree of assurance that replacement satellites would continue to be available for the long term.

Ironically, the vast number of active proposals for satellite systems at the moment lessens the chances that any single system will ultimately succeed. The accompanying tables list over thirty proposed satellite systems that are in various stages of development. The announced timetable for most of these systems would place them in service in the 1995/96 time frame. While these timetables appear to meet the current PEACESAT requirement to obtain replacement satellite service by 1995, it is clear that all the proposed satellite systems will not, indeed, cannot, be placed into service by 1995. We believe that there are several reasons that all of the proposed systems will not be constructed as planned.

6.1 TECHNICAL REQUIREMENTS

Several of the proposed services appear technically incompatible with each other since one system would cause interference with another system. This is true both of LEO systems that have incompatible frequency plans (such as Iridium's frequencies conflicting with several other LEO systems) and of GEO systems where multiple satellites are proposed to be placed at the same orbital location (such as PALAPA PACIFIC and TONGASAT @ 134° E or PACSTAR and PANAMSAT @ 168° E).

6.2 REGULATORY REQUIREMENTS

There are many levels of potential regulatory requirements. The first is the authorization to construct and operate a satellite system. Many of the systems proposed are based in the United States and must be licensed by the Federal Communications Commission. All satellite systems must be coordinated in accordance with the procedures of the International Frequency Registration Board. Finally, permission to serve a country must be granted by the regulatory agency of that country.

6.3 FINANCIAL REQUIREMENTS

Perhaps the largest barrier for most proposals is the challenge of obtaining the capital funds necessary construction. These costs range from hundreds of millions of dollars to, in the case of the Iridium proposal, over $3.5 billion dollars. The large number of proposals intensifies the competition for capital funds. Several systems that were first announced in the mid-1980's are still searching for funds.

6.4 LAUNCH REQUIREMENTS

This final hurdle is one shared by all systems, no matter how well capitalized. Unfortunately, it is a fact of life for the satellite industry that some launch vehicles will fail on lift-off or will fail to place a satellite in the proper orbit. Even if a back-up satellite is available, a second launch often requires a year to accomplish due to the priority of other customers' launches.

6.5 THE PRESENT OUTLOOK

INTELSAT and INMARSAT, both large international consortia, are currently the world's largest satellite operators. They have already contracted for the next generation of satellites to continue service to the Pacific. The primary factor that could limit their continued services would be revenue decreases due to an increasing number of competing separate services for regional and international communications.[5]

The PACT service operates on an INTELSAT satellite and could continue on future INTELSAT satellites or on several of the proposed systems. Continuation of the PACT service is dependent on its ability to provide regional telephone interconnection service to its customers in the South Pacific.

PALAPA PACIFIC is majority owned by the Indonesian domestic satellite operator and has enough satellites already in orbit or on order to continue the service until 2010.

Two satellite systems that definitely will not continue in their present form are AUSSAT-3 and COLUMBIA-TDRSS. The AUSSAT-3 will be operational until 1997 and is the only satellite in the AUSSAT series that will serve Pacific islands. The follow-on Advanced TDRSS satellites will not have the C-band transponders contained on the current COLUMBIA-TDRSS satellite. However, Columbia has proposed its own satellite, COLUMBIASAT, and has also entered into a marketing agreement with the proposed PACIFICOM project.

Two other systems, PANAMSAT and EXPRESS, already have operating satellites and therefore have achieved a level of experience beyond those that are just beginning. PANAMSAT currently has a satellite in the Atlantic region, with its Pacific satellite scheduled for launch in 1994. The Russian EXPRESS satellites will replace the operating STATSIONAR system. Given the major economic upheavals in Russia and the other former Soviet states, it is unknown whether or when the EXPRESS system will be constructed.

The following GEO systems will be placing their first satellite in operation: ASIA-PACIFIC, FINANSAT, PACIFICOM, PACSTAR, TONGASAT, and UNICOM.

None of the ten LEO systems under review is currently operational, but VITASAT is using an experimental satellite. VITASAT has received a "pioneer preference" and approval from the FCC to construct a two satellite system. Several other systems have received FCC approval to construct a few experimental satellites.[6] The Big LEO systems face complex regulatory challenges regarding the use of frequencies. The expense and technical challenges to construct, launch and then operate satellite systems containing up to 66 satellites are immense. The satellites will be complex, they will require continual monitoring of orbits and the size of the systems will require continual replacement of satellites as satellite problems occur.

The proposed VITASAT system will use only two satellites, and they will be simple LEO satellites in orbits that do not require the precision of the other systems. Since VITASAT is a non-profit organization, the greatest hurdle to the long-term viability of the VITASAT system may be obtaining the funds to construct and launch the two satellite system.

7. COST

The cost of a satellite system has two major components, satellite costs and ground costs. Satellite costs usually are limited to rental of satellite transponders, either on a dedicated basis or for a per-usage charge. Ground costs include the cost of operating, maintaining, purchasing and installing earth terminals (or modifying existing earth terminals).

7.1 TRANSPONDER COSTS

Transponders on most GEO satellites can be leased on a yearly basis. The costs are known in advance and the service can be tailored to the available funds. Satellite costs can be reduced by entering in a long-term (3-5 year) contract with a vendor. NTIA has found that many of the services are currently unable to provide firm price estimates for a service projected in 1995.

Satellite time on most LEO systems will be charged by the minute, with a per minute cost estimated to be between $1/min and $3/min. The annual costs will be directly dependent on the amount of use. The exception to this is VITASAT, which is a non-profit organization serving developing nations and is currently not charging for satellite time.

7.2 EARTH TERMINAL COSTS

For users already operating a satellite-based network, such as PEACESAT, compatibility of satellite alternatives with the existing earth terminals and the cost of conversion to another system are a significant consideration. Since the PEACESAT terminals were specifically designed to use the GOES meteorological frequencies, their use with any other non-meteorological satellite system will require modification to the transceiver electronics, antenna, and tracking mechanisms.

Even though most commercial satellite communications are located in either the C-band or the Ku-band, conversion costs of existing C-band or Ku-band terminals can include changing from analog to digital equipment or changing modulation techniques.

The major advantage of the LEO systems is that they are designed to operate with very small, inexpensive ground units. The typical LEO ground terminal is a handheld unit costing between $250 to $3,000 depending on the system and its capability. The cost of most ground units is not a major expense. However, the user earth terminals for most systems can only operate with a regional gateway terminal. Gateways will be constructed by a regional operator in many areas of the world for a cost ranging between $100,000 and $2 million, depending on the system. However, given the expense of constructing and operating a gateway, their availability in some remote regions of the Pacific islands is not assured.

The VITASAT ground terminals are not designed to be mobile and cost about $5,000.

8. CONCLUSIONS

After reviewing satellite developments in the Pacific for the past two years, NTIA believes that it does not have sufficient definitive information upon which to base a decision regarding a specific satellite system for PEACESAT's long-term use.

We reached this conclusion primarily because the commercial satellite environment in the Pacific is currently very unsettled. It is impossible to determine at this time which of the two dozen proposed satellite systems will ultimately be successful in inaugurating a service. Estimates of construction costs, leasing costs, service levels and timetables are all primarily speculative. New entrants can appear overnight and affect the market.[7]

PEACESAT believes that GEO satellites provide the best option to meet the PEACESAT user needs. Systems such as INTELSAT, PANAMSAT, PACSTAR, UNICOM, PACIFICOM, ASIA-PACIFIC, and TONGASAT, have bandwidth with the potential of providing flexible services to Pacific island regions. Service areas of these systems will, however, vary depending on the final coverage patterns of each satellite.

The COLUMBIA-TDRSS and PALAPA PACIFIC satellites only serve the North Pacific and cannot provide coverage of all the Pacific islands from a single satellite. The INMARSAT system can cover the Pacific islands but is limited in the services that it can provide.

The six Big LEO systems, ODYSSEY, GLOBALSTAR, ARIES, ELLIPSO, IRIDIUM and the INMARSAT Project 21 have the potential of providing voice and data service to the Pacific islands. Most of these systems (with the exception of IRIDIUM and possibly Project 21) may be limited by technical design factors and the requirement to use regional gateways to make Pacific-wide international interconnections. IRIDIUM and the other Big LEO proposals also have to compete within the regulatory process for operating authorization.

NTIA will defer consideration of the low-earth orbiting satellites in favor of the geostationary systems which have the potential of covering the Pacific islands and providing current and future PEACESAT services.

The small LEO systems ORBCOMM, VITASAT and GONETS have the ability to provide a data service to the Pacific region. This type of service may be most appropriate to connect areas of very low population density, such as outer islands, with regional centers.

ENDNOTES

1. NTIA/PEACESAT, "Final Report: PEACESAT Satellite Selection Study," January 1989.

2. William Cooperman, Dennis Connors, Charles Franz, "Communications Satellites for the Pacific Islands." paper presented to the Pacific Telecommunications Conference, Honolulu, HI, January 1992.

3. NTIA/PEACESAT, p. 6.

4. Many of the world's leading and emerging industrial nations are located along the Pacific Rim, including the United States, Japan, Korea, Singapore, Hong Kong, Taiwan, etc.

5. Both the INTELSAT and INMARSAT agreements provide that competing telecommunications satellite systems be coordinated with their respective agency and that the competing system demonstrates that no economic harm will occur. To date, all separate systems have successfully completed coordination with INTELSAT or INMARSAT.

6. The FCC has approved the construction of the following experimental satellites: Iridium, five experimental satellites; Ellipso, four experimental satellites; etc.

7. Palapa's relocation of an old satellite in early 1992 to establish the Palapa Pacific is only one example. Asia Pacific Telecom purchased an in-orbit satellite from GTE for service to China and east Asia. (Satellite News, September 28, 1992. Vol. 15 No. 39. Satellite News also reported that GTE is trying to sell four other in-orbit satellites as well.)

TABLE 1 GEOSTATIONARY SATELLITE SYSTEMS

SATELLITE SYSTEM	TYPE OF SERVICE	COVERAGE AREAS	STATUS	COMM
Asia-Pacific @ not announced	Fixed	Full-disk	Seeking financing for late 1995 launch	Intends and not
Asiaspace @ not announced	Direct Audio Broadcast	Full-disk	Parent co. has experimental license for service in Africa (Afrispace)	36 DAE receiver
AUSSAT A-3 @ 164° E	Fixed	South Pacific	Satellite full, no further capacity on Pacific island beam	Replace have Pa
COLUMBIA-TDRSS @ 174° W	Fixed	North Pacific	Some capacity has been leased to TRW (Pacificom)	Compar over the
Columbiasat @ 165° W	Fixed	Unspecified	Conditional authorization seeking financing	Compar Columb
Express @ 140° E, 155° W, 145° E	Fixed	Full-disk	IFRB notice provided	Does nc as West satellite
Finansat @ 178° W	Fixed	Unspecified	Conditional authorization IFRB registered, seeking financing	Target p financia nations
INMARSAT @ 177.5° E (INMARSAT II) @ 180° E (on INTELSAT)	Mobile	Full-disk	Plans to expand capacity in POR	Require use sma more li
INTELSAT @ 174°E (main) 177°E and 180°E, 177° W	Fixed	Full-disk and regional	Intelsat VIIs to expand capacity in POR in 1994	Primary worldw satellite
Pacificom @ 172° E	Fixed	South Pacific	Application pending, 1994 proposed launch	Using c Columb initiate

Satellite Systems in CAPS are CURRENTLY OPERATIONAL

TABLE 1 GEOSTATIONARY SATELLITE SYSTEMS (Continued)

SATELLITE SYSTEM	TYPE OF SERVICE	COVERAGE AREAS	STATUS	COMM
Pacstar @ 167.45 °E, 175° W	Fixed	C-Band spot beams for South Pacific, ASEAN coverage	IFRB registered	Majority of Papu
PACT @ 174° E (on INTELSAT)	Fixed	Uses full-disk beam on INTELSAT satellite	Provides domestic, regional, & intl. service to six island nations	Project OTCI,
PALAPA PACIFIC @ 134° E	Fixed	North Pacific	Operational with inclined orbit satellites	Replace orbit or service
Panamsat @ 168° E, 166° E	Fixed	Pacific islands spot beam in C-Band	Satellite under construction, projected 1994 launch	Compan ation in
PEACESAT @ 175° W (on GOES-3)	Experimental	Full-disk	GOES-3 available through 1994, expanding with NTIA assistance	Non-co
Rimsat @ Uncertain	Fixed	System footprint from Australia to Hawaii	Announced agreement to use Tongasat slots, lease Russian satellites	First tw would b orbits
Sat/tracs @ not announced	Fixed	Full-disk	No FCC application, seeking financing	Ka-Banc mission persons
STATSIONAR @ 175°W, 155°W	Fixed	Full-disk and regional	Operational with inclined orbit satellites	Will be system station-k
Tongasat @ 83.3 E, 130° E 134° E, 1142.5° E	Fixed	Multiple spot beams, coverage unspecified	Uncertain, see Rimsat and Unicom entries	Has ma Rimsat orbital s
Unicom @ 170.75° E, 138° E	Fixed	Regional in Asia and Pacific, also international to/from U.S.	Agreement to use two Tongasat slots. Planned 1995 in service date	Also se McCaw

Satellite Systems in CAPS are CURRENTLY OPERATIONAL

TABLE 2 NON-GEOSTATIONARY SATELLITE SYSTEMS

SATELLITE SYSTEM	TYPE OF SERVICE	FREQUENCIES	STATUS	COMMI
VOICE CAPABLE SYSTEMS				
Aries (48 satellites)	Voice and data, RDSS	Uplink - 1624.5-1626.5 MHz Downlink - 2483.5-2500 Mhz	Pending FCC approval	Will requ with C b
Ellipso (24 satellites)	Voice and data, RDSS	Uplink - 1610-1626.5 MHz Downlink - 2483.5-2500 Mhz	FCC approved 4 experimental satellites	Direct ac
Globalstar (48 satellites)	Voice and data, RDSS	3 frequency plans proposed depending on other users	Pending FCC approval	Will requ with C b
Inmarsat Project 21	Voice and data	To be determined	Proposal is currently under study, no details announced	Decision made in
Iridium (66 satellites)	Voice and data, RDSS	Uplink & downlink 1610-1626.5 MHz	FCC approved 5 experimental satellites	No gatew will use intersatel
Odyssey (12 satellites)	Voice and data, RDSS	Uplink - 1610-1626.5 MHz Downlink - 2483.5-2500 MHz	Pending FCC approval	Will requ with Ku-
DATA ONLY SYSTEMS				
Gonets (36 satellites)	Store and forward data, electronic mail	321-390 Mhz -transponder 1 1541-1643 MHz -transponder 2	Two microsats launched July 1992, system operational in 1995	Second g (1997) to
Leosat (18 satellites)	Data from moving vehicles	uplink - 148-140 Mhz downlink - 137-138 Mhz	LEOSAT is appealing FCC decision to return application	Intends t from veh
Orbcomm (20 satellites)	Data, short messages, RDSS	uplink - 148-149.9 Mhz downlink - 137-138 Mhz	Pending FCC approval, has experimental license	Plans to first, exp
Starsys (24 satellites)	Data, short messages, RDSS	uplink - 148-149 Mhz downlink - 137-138 Mhz	Pending FCC approval, has experimental license	Plans to first, exp
Vitasat (2 satellites)	Store and forward data, electronic mail; community development non-profit telecom	uplink - 400 Mhz downlink - 137-138 Mhz	Received pioneer preference from FCC; one experimental satellite operating-UoSAT 3	Has alter 400 Mhz if necess

Low earth orbits (LEO) are within 1,600 km of the earth

UNICOM: MOVING INTO ASIA

Steve Collin
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Aspen, CO 81611
USA

UNICOM SATELLITE CORP. will launch and operate private satellites that will link Asia to North America and Europe and also provide domestic and regional services throughout Asia. The UNICOM principles bring their experience of the deregulated US marketplace to the venture and are creating teaming arrangements that will enable turn key satellite services.

Ladies and gentlemen before I introduce to you the Unicom Satellite venture, I'd like to share with you my perspective on the telecommunications business as I have personally experienced it; where we have been and where we are going. In 1981, three of us founded SAT TIME Inc., the company that preceded Unicom. Working from a one room office and sharing a single phone line. At that time, there were approximately 10 commercial satellites in service over the US and we bought and sold available time on transponders earning a fee from numerous owners that we represented. In this manner, the company closed over 600 contracts for satellite services and we learned to meet customer requirements, especially helping those that had never used satellites to create successful services. SAT TIME also designed and raised the capital to construct Teleport Denver in 1986. Today the facility which provides satellite, microwave and fibe. optic services employs 300 people and is valued at over $50 million. Denver, Colorado is equidistant between Asia and Europe and thus we have been keenly aware of the opportunities for international satellite services.

1981 was also the year in which the personal computer was first introduced. The Information Age was in full swing and in the ensuing decade the US experienced a revolu.ion brought about by the microprocessor. Today in the US, 33% of homes have a computer, 67% have cable TV, 77% have a VCR, 31% have Nintendo or Sega videogames, and 17% of homes have camcorders, a relatively expensive consumer product. In my home, just for my family's personal use, we have three telephone lines, 2 cellular phones, a fax machine, 2 VCR's a and satellite dish which can receive over 200 hundred independently produced news broadcasts each day. Additionally, there are more than several hundred transponders of 24 hour programming from 37 satellites serving the North American markets. Satellite communications services now influence every day of our lives and are the most successful business sector of the space industry generating several billion per year in sales revenues.

Some key points that we have learned in our US experience:

1) Telecom deregulation has brought more products and services to customers more efficiently and at reduced prices,
2) A competitive entrepreneurial environment has fostered new technologies such as VSAT, cellular, and mobile, for communications purposes, while satellite news gathering,

pay per view, compression and soon, video on demand, and interactive TV technologies will revolutionize our use of the television media. 3) Customers will pay for entertainment and education, especially education for their children. 4) Information Agencies, a new business service, are being developed to guide consumers through the information marketplace. On a daily basis 7,000 technical articles are published worldwide and it is now possible to connect via a modem into 60,000 on-line computer bulletin boards. In the Information Age, the consumer wants to PULL the information, or programming he wants, no longer will broadcasters PUSH their programming upon us. We will decide what to watch on television, not what's on. In our children's schools teachers will utilize information agencies to guide them to video programming on demand, specific to the lesson of the day.

All of these developments are occurring because communications is going digital and therefore compression is possible. Today a gigabit of information can be sent over a satellite channel in one second. In that second 60,000 typewritten pages can be transmitted, without error; in a new breakthrough a 2 hour movie can be delivered in approximately seven minutes over a telephone line and therefore enormous central libraries can be created storing video programming in a compressed digital format. An upcoming venture in the US plans to utilize a compression ratio of 10:1. Should Unicom operate each of its satellites in digitally compressed mode, it would have the capacity of 240 transponders.

What's next? The mobile revolution. In the US, during 1991, 200,000 cellular customers signed on each month; for the first time new mobile customers exceeded the number of new wireline customers per month. By the year 2000 the mobile industry predicts 100 million wireless customers worldwide, a growth factor of 1000 times since 1980. They will communicate on digital portable phones that select the least cost routing offered choosing between terrestrial, wireless and satellite carriers, with batteries that will last one week on a single charge and with voice quality equivalent to that of the public switched networks. Eventually these mobile communicators will be fashion accessories that we will wear containing personal computers with text and image displays and in case we get lost, the GPS function will show us the way. These devices have been imagined and shortly they will be made.

Economic growth in virtually every country in Asia is growing at the highest rates in the world - typically between 5% and 10% annually. As these economies boom, enormous amounts of money will be spent on telecom and broadcast services effecting telephone carriers, electronic retailers, and information service providers. Relative to any other part of the developed world, the Asian marketplace is severely underdeveloped. Telephone penetration averages below 5 phones per 100 persons; high speed transmission of data is restricted to major trunk lines, and even fax services are constrained by the public telephone network. Except for Japan, where one can find the most advanced technologies in the world at work, such as DBS, HDTV, and business television, the Asian television and cable industry is in its infancy. Most countries still offer only a limited amount of television programming, provided by state-owned broadcasters. Cable is underdeveloped and DBS is non-existent. Asia has the best opportunity to leap frog wire technology and install wireless systems which are less expensive and faster to install. The phenomenal growth of the paging and cellular industries across Asia confirm the strength of the demand.

This is the communications environment that UNICOM will find in the next decade. We have chosen to locate our venture in Singapore which, in the most recent World Competitive report of the United Nations, was noted to have the best telecom structure in the world each year since 1989, and is number two in the world in computer literacy. Singapore's strategic location between the Pacific and Indian Oceans and its development as an Asian financial and communications hub under it's IT 2000 plan, the "Intelligent Island," fully support the goals of our venture. Unicom satellites will support Singapore's quest to become a world class telecommunications hub in the midst of the world's largest market which is growing at the rate of $12 billion dollars per month.

We at Unicom stand before you as a satellite capacity provider. Our transponders will be easy to acquire via local marketing offices throughout Asia, easy to use, with no restrictions on the direction of traffic or footprint options. Our customers will use Unicom transponders for domestic, regional and international services all under longterm fixed price contracts, and those prices will be set to attract customers. Unicom will manage its transponder bandwidth and power to provide the most efficient utilization of capacity, but this will be transparent to the user.

Unicom has selected Fairchild Space and Defense Corporation to supply two "Ultrasat 24" satellites and McDonnell Douglas for launch services. Each satellite will carry twelve 36 MHz C band transponders and six 72 MHz Ku band transponders. All transponders are configured to provide "cross-strapped" and "broadcast" transmission capabilities providing network flexibility. In this mode, a single uplink will activate both C and Ku downlink channels resulting in broadcast service throughout the entire coverage areas. The satellites deliver a broad first contour minimum EIRP of 36 dBW at C-Band and 50 dBW at Ku-Band. This provides the necessary signal strength to make efficient use of smaller, less costly earth stations that can be located at end user premises. Every Unicom transponder is capable of two-way, point to multipoint transmission. In Figure 1, the geographical area of coverage of the Unicom satellites is presented.

The Unicom satellite system is ideally suited for broadcasters, cable programmers and telecommunications carriers and value added service providers seeking to establish state of the art analog or digital regional and international networks. Wireless technologies offer the fastest and most economical implementation of new networks. In the Asian marketplace, Unicom will market satellite-based wireless networks; supporting digital multimedia, videoconferencing, cable-TV, VSAT data networks, and private business networks. To encourage the growth of thin route services, Unicom will support digital compression applications by providing just the right amount of power and bandwidth for a particular application to reduce the cost per channel to the end user. Unicom will headquarter in Asia and seeks to establish strategic joint ventures with local partners throughout Asia. These teaming arrangements will be capable of creating complete network solutions combining transponder space and ground facilities into seamless networks.

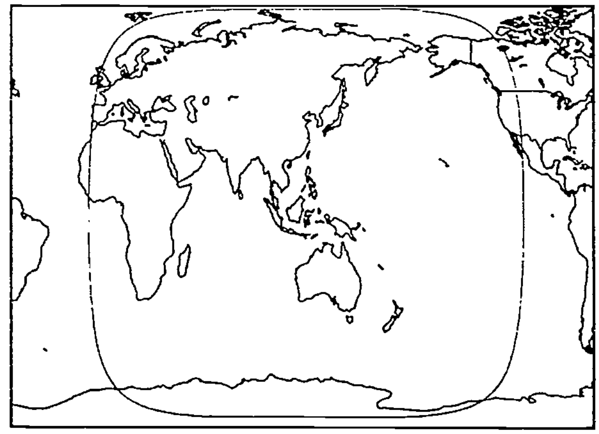

Figure 1 — Geographical Coverage of Unicom Satellites

The Unicom organization brings together a highly qualified group of engineering and business professionals and stands ready to assist in the development of turnkey satellite based-networks, from initial concept through implementation. Management's experience includes a decade of satellite leasing activity, spacecraft program management, the development and operation of transmission and relay facilities, and the successful formation and operation of other space companies.

As I close, let me leave you with several thoughts that have become apparent to us which are driving the demand for satellite services:

1) Networks will always grow larger.

2) Networks will operate at ever increasing speeds.

3) Technology and its applications will always develop at a faster pace than governments can regulate. Government imposed regulations must accommodate customer requirements or business will relocate.

4) Telecommunications services are the most essential services required by market based economies which are dependent on trade.

Unicom is moving into Asia with experience and a clear understanding of the telecommunications environment. We look forward to the challenges of serving the most dynamic market in the world.

Thank you for your attention...

Unicom Satellite Corp. can be reached in the USA at 303.920.2400 or in Singapore at 65.321.8939.

The Rise of Competing Satellite Systems
and the Fall of the Intelsat Monopoly

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1. ABSTRACT

In 1992, Intelsat took steps towards opening the international satellite services market to competition. The authors argue that, based on these steps, as well as permanent technological and economic changes, the transition to open competition will be rapid.

2. WHITHER GOES THE MONOPOLY?

Although it was done without much fanfare, 1992 proved to be a watershed year for Intelsat and for the future of separate satellite systems. Intelsat has taken further "baby steps" towards divesting itself of its sanctioned, monopolistic position in the international satellite services market, but in the process, we believe, has irreversibly committed itself towards opening the market to full competition. Moreover, we believe that circumstances will bring Intelsat to open its markets to competition by 1996, if not earlier.

At its November 1992 Assembly of Parties, the organization agreed to "consider" eliminating all Article XIV(d) "economic harm" restrictions on the use of separate systems by 1996 or 1998. Article XIV(d) currently prohibits Intelsat-member nations from deploying or using any separate satellite system unless Intelsat has been "consulted" about the system and has found that use of the system will not cause "significant economic harm to the global system of Intelsat." In the eyes of many, Article XIV(d) has stymied the efforts of entrepreneurs to bring competitive systems to the international satellite services marketplace and, as a consequence, has deprived the world of the benefits of increased competition.

While the Assembly of Parties' November 1992 decision may appear to be only an incremental step, we believe that, now that it has been taken, there is no going back and that the international satellite services market will, indeed, be opened to fully competitive systems by no later than the end of 1996.

2.1 THE CUSTOMER'S PERSPECTIVE

Keller and Heckman is a regulatory law firm founded in 1963 and based in Washington, D.C., U.S.A. The firm was borne out of, and continues to thrive on, the incessant change in the telecommunications marketplace. While the firm's telecommunications practice group is dominated by some 17 attorneys, the firm recognizes that telecommunications problems necessarily blend legal, technical, and economic issues. Consequently, the firm also employs a full-time telecommunications engineer, a regulatory analyst, and a handful of paralegal specialists.

Unlike many U.S. telecommunications law firms, we have provided counsel to a wide array of telecommunications <u>users</u> since our inception. It is fair to say that, while many other firms have built their practices by representing telecommunications providers first and users second, we have built our practice in the opposite direction.

We, of course, represent both numerous users and providers. However, our unique development gives us a unique perspective. Over the course of our 30 years, we have come to understand users' desires and expectations, because we assist them with their telecommunications concerns on a day-to-day basis. As a consequence, we believe we more fully appreciate where market demands are attempting to push (or pull) the services suppliers.

2.2 THE CUSTOMER'S INTEREST IN COMPETITION

Our interest in international satellite issues stems from the fact that many of our clients are large multinational corporations. As the world's economies are becoming more tightly intertwined, these companies' demands for international telecommunications services are growing exponentially. Indeed, often the companies' production and marketing decisions themselves are responsible for the further "unification" of the world's economies.

Our clients, for example, are among the first companies to enter the newly liberated

Russian Far East with significant investment capital. They have similar operations in other lesser developed areas, as well as in the most developed areas of the world. In order to coordinate their far-flung activities and remain competitive, they need the fastest, most advanced, and most reliable international communications services available. In brief, they are anticipating 21st century telecommunications capacity today; they are driving the next gyration in the telecommunications revolution.

Perhaps more importantly, to get there from here, the users with which we are acquainted believe strongly that competition in the telecommunications industry must be fostered wherever possible; that competition is essential not only to keeping prices down, but to ensuring that there are sufficient incentives for telecommunications providers to meet customers' ever increasing and ever-more complex demands. Consequently, large users look for opportunities to promote competition where they can. And it is these efforts, in conjunction with Intelsat's acceptance of them, that we believe will push the international satellite services market to relatively open competition by 1996.

3. 1992 IN REVIEW

Intelsat's initial steps towards accepting the inevitability of open competition were actually coaxed along in late 1991. In November of that year, the United States' Commerce and State Departments released an analysis, finding that the Intelsat system would not be harmed economically if all separate systems were allowed to sell private line services interconnected with public-switched networks. More significantly, the U.S. Commerce and State Departments also announced that they believed <u>all</u> restrictions on separate systems' provision of switched services should be eliminated by January 1997.

The Federal Communications Commission promptly accepted the Departments' recommendations, and in March 1992, it adopted an order allowing separate systems to interconnect their private lines. Subject to further review, the Commission then set January 1, 1997 as the sunset date for all restrictions on separate systems' provision of switched services.

With the United States squarely behind open competition, Intelsat's on-going Article XIV(d) working group faced accepting or rebuffing the U.S. position. A so-called "Inter-sessional Working Party" had been commissioned by the 1990 Intelsat Assembly of Parties to develop recommendations on the further liberalization of the international satellite services market. In June 1992, the working group presented its recommendations to Intelsat's Board of Governors, largely paralleling the U.S. position.

The recommendations were significant, for they not only paralleled the U.S. position, but exceeded it with regard to separate systems' ability to provide switched services in the near term. Specifically, the working group recommended:

- to phase out Article XIV(d) "economic harm" review over the course of four to six years;

- to assume that all non-switched services, <u>including</u> private lines interconnected with the public switched networks, would not cause significant economic harm to Intelsat

- to allow each <u>satellite</u> in a separate system to supply 1,250 equivalent 64 kbs circuits for international message telephone service (IMTS) (the existing standard had been 100 equivalent 64 kbs circuits per separate <u>system</u>); and

- to raise the 1,250 circuit ceiling for switched services over the last years of the phase-out period.

Essentially, the working group recommended that full competition be eased in and that significant steps in that direction be taken now.

The Board of Governors approved the recommendations and sent them on to the Assembly of Parties which, in turn, approved the bulk of them. The near term objectives were adopted in full. Also, Intelsat will look at raising the ceiling on the number of circuits for switched services at its 1994 and 1996 assemblies. And most significantly, the Assembly agreed to "consider" completely eliminating all economic harm considerations in either 1996 or 1998.

4. COMPETITION SOONER RATHER THAN LATER

Again, despite the Assembly of Parties's commitment only to "consider" further liberalization down the road, we believe open competition will come sooner rather than later. Obviously, no measure of economic analysis nor prognostication can say with certainty where the international satellite services market will be by 1996. The variables are too many, and the flow of events too irregular. However, we do believe that there is an outstanding predictor in reviewing closely the dismantling of AT&T's monopoly.

The parallels between AT&T's position in the 1970s and Intelsat's position today are replete. And comparing the two is only natural. But we have found that the parallels and comparisons are more than skin deep. Despite the greater complexity of dealing with international markets, we believe this analogy serves as perhaps the most compelling indicator that Intelsat and separate satellite systems will be moving towards open competition rapidly over the next few years.

Of course, the more superficial comparisons between AT&T's past circumstances and Intelsat's current situation are easily stated. In the 1960s, MCI Corp. began its long assault on AT&T's seemingly invincible monopoly in the U.S. long-distance market. While AT&T and the U.S. Federal Communications Commission initially opposed opening the long-distance market, by the early 1980s all interested parties were embracing competition. Now, three decades later, while AT&T maintains a formidable market position, the monopoly clearly is broken and the substantial benefits of increased competition have brought to the U.S. public.

Currently, in the international satellite realm, PanAmSat and others aspire to do the same to Intelsat's virtual monopoly in international satellite services. Indeed, U.S. regulators' and PanAmSat's deregulatory bent, coupled with Intelsat's apparent desire to compete, suggest that Intelsat is in the same position AT&T was just prior to the dismantling of AT&T's monopoly -- perhaps anxious, but moving towards full acceptance of open competition. Moreover, like the U.S. Federal Communications Commission in the early 1980s, many of the world's regulatory bodies and PTTs (and likely officials within Intelsat) are overcoming their almost instinctive reservations about fostering competition with Intelsat. Those reservations have gradually been moving away from concerns about whether competition should be fostered and towards concerns about when and how it should be fostered.

4.1 ECONOMIC INCENTIVES FOR GREATER COMPETITION

A closer look at the situation reveals why we believe any lingering concerns regarding open competition will evaporate rapidly.

First, from an economic perspective, Intelsat undoubtedly has felt for some time that its economic viability, even in a competitive market, can easily be preserved. Intelsat now operates a fleet of 15 satellites from its orbital slots over the Atlantic, Pacific, and Indian oceans. Over the course of the next seven years, Intelsat intends to add even more satellites, so that its total will exceed 18 modern, high-capacity satellites. The system currently is heavily utilized, and all expectations are that the system will be used heavily for years to come. Intelsat director general Goldstein was quoted in the October issue of Satellite Communications as noting as much. Citing the fact that approximately 80 percent of Intelsat's switched traffic is committed under long term agreements, he is confident that Intelsat's expansion will continue, despite the potential for increased competition.

The director general's sentiments reflect a refreshing faith in Intelsat's continued viability. However, the roots of Intelsat's long-term economic security run much deeper than anticipated traffic reports. Like AT&T's position in the early 1980s, Intelsat's established infrastructure gives it such formidable advantages over its potential competition so as to ensure the consortium's survivability even in a more fully competitive market.

Intelsat has in place network facilities, international affiliations, and human resources that no separate system could hope to duplicate within the next 10 to 15 years. In addition to its fleet of satellites, the consortium has offices worldwide and intimate relationships with government officials in each nation. In contrast, potential satellite competitors have no such advantages.

The title of a recently released Intelsat paper, "Can Satellites Compete with International Fiber Optic Cables in the 21st Century?", suggests Intelsat might be apprehensive about competition because of internal concern that the organization might not survive in a market where it is competing with both separate systems and fiber optic cables. Intelsat undoubtedly feels competitive pressure from fiber optic cables. However, from a strategic perspective, the growth in fiber optic cables is more a blessing than a bane.

Fiber optic cables certainly are direct competitors with satellite services in many sub-markets. Nonetheless, such competition is a far greater threat to new separate systems than to Intelsat. In order for separate systems to attract the large amounts of risk-capital necessary to construct and launch additional satellites, they will have to convince investors that the new satellites can produce significant returns quickly.

Consequently, the greater amount of fiber capacity available, with the attendant perception that fiber provides better service, the more difficult it will be for separate systems to grow into any meaningful size. Certainly, there may be enough "cream" in the international satellite market to support a handful of separate systems, but investors will be wary of sinking moneys into systems intended to compete head-to-head with Intelsat's and fiber optic cables' core businesses.

In some regards, Intelsat's prospects for long-term prosperity in a competitive market may be even better than AT&T's were when it faced the dismantling of its monopoly. In both cases, the costs of entering competition with the e tablished carrier are significant. However, in the satellite realm, the risks of failure are extraordinary. As Intelsat well knows, launch problems continue to plague the industry. And while Intelsat may be able to survive launch failures, start-up competitors may find it very difficult to secure additional financing if they suffer a single failure. In addition, since its fleet of satellites is already deployed, Intelsat has greater flexibility to address in-flight failures and shifts in demand than any separate system could hope to attain.

With its formidable assets in place, Intelsat has little economic reason to fear competition from separate systems. Indeed, competition from other systems may provide just the impetus the organization needs to compete more effectively with fiber optic cables. Additional competition in the satellite realm undoubtedly would produce greater advances in satellite technology than possible under a monopolistic regime, and Intelsat could use these advances to sure up its own position.

4.2 THE ORGANIZATIONAL ABOUT-FACE

Obviously, for Intelsat to assume a competitive posture, it will need more than mere faith in the consortium's survivability. What the organization needs is for it, as a whole, to welcome and embrace competition. The AT&T paradigm, here, perhaps provides the most pointed insight into where we believe Intelsat will be going in the next few years.

By the time the dismantling of AT&T's monopoly was complete, the company's perspective on competition had turned 180 degrees. The company accepted the new competitive order, and it set its sights on prospering within the new order. As a result, while it has lost market share over the last several years, the company has established itself firmly as the major service provider, offering high quality and innovative services at competitive prices. Moreover, AT&T's revenues and profits continue to grow.

The question Intelsat now faces, then, is whether, from its own perspective, there remain fundamental social reasons for retaining a monopolistic position, or whether retention of any monopolistic power is more by force of habit? Our comparison of Intelsat's position to AT&T's former position strongly suggests that, once an organization's "corporate culture" recognizes that the theory underlying its monopolistic position has evaporated, the organization seeks to redefine itself as an entity which would best serve its social goals as a competitor. We believe Intelsat is on the verge of making this cultural change.

4.3 THE GOALS OF THE Intelsat TREATY HAVE BEEN ACCOMPLISHED

We base this assessment on our belief that Intelsat must be coming to realize (if it has not already) that the organization has fulfilled the tasks for which it was created. The Preamble of the <u>Intelsat Treaty</u> sets forth three fundamental reasons for establishing Intelsat's monopolistic position in the international satellite services market. In brief, they were:

- to bring satellite communications capacity to all the nations of the world, on a non-discriminatory basis, as quickly as possible;

- to develop a single commercial satellite system to provide such services; and

- to continue to provide such services as efficiently, economically, and equitably as possible.

The first and second purposes underlying the <u>Intelsat Treaty</u> obviously were met some time ago, and they continue to be met. Simply put, the world now enjoys the benefits of the satellite system the <u>Treaty</u> created.

If there is any philosophical hesitancy within Intelsat about moving towards competition, it would be based on whether the third purpose, <u>i.e.</u>, continuing to provide service economically, could be pursued within a competitive market. Obviously, the goal of "providing service economically" is not easily defined. However, we believe that now that Intelsat has attained long-term viability, its leadership is coming to realize that the goal can be more suitably reached through open competition.

Under Article XIV(d), as mentioned above, separate satellite systems have been permitted to operate, provided they do not inflict any significant economic harm on the Intelsat system. For many years, the consortium struggled with how to define "significant economic harm." Indeed, for most of Intelsat's history, the focus had been on loss of customers and the customers' potential revenues. This microscopic approach, however, is increasingly at odds with the initial purpose of Intelsat. Nothing in the Treaty's text suggests that the organization is obligated to preserve its customer base. Certainly, maintenance of a healthy customer base is essential to the consortium's well-being. However, as the AT&T example indicates, losing customer share does not necessarily result in significant economic harm, so long as the enterprise is growing as it becomes more competitive.

In this light, Intelsat's proposed abandonment of the "economic harm" test demonstrates to us that the organization itself is coming to these same conclusions.

4.4 THERE IS NO GOING BACK

Independent of the treaty's text, we believe that Intelsat's pledge to consider abandoning the economic harm test also reflects that the organization is coming to grips with the economic inevitability of competition. In a word, Intelsat is recognizing that its monopolistic position has served its greater social role and that it is time to move on.

Outside the text of the treaty, the Intelsat organization, as it was originally conceived, stands as the signatories' statement that international satellite communications capacity is a "public good." Public goods are generally recognized as those items which society deems essential to its welfare, and which, for the very same reason, society deems they should not be provided at prices which would prohibitively expensive for even the smallest segment of society. The most obvious public goods are electricity and water. But basic telecommunications service also is a public good in most countries. And certainly, the Intelsat Treaty deemed international communications a public good.

Because public goods are deemed essential to public welfare, governments routinely require that the goods be priced low enough to ensure wide spread availability. Such price controls, in turn, serve as a disincentive to capital investment, especially where the goods require substantial investment. Since the costs of entering a public good market often are extremely high, capital will not flow without a guarantee of profitability. Consequently, if there are to be price controls and guaranteed profits, then at least initially there must be a limit on market entry -- i.e., there must be a monopolistic market structure in order to insure that investors in such large projects have an incentive to provide the good.

The lesson of the latter half of the 20th century is that a service, once deemed a public good, need not remain subject to monopolistic policies indefinitely. In other words, not every public good necessarily requires the maintenance of a "natural monopoly" in order to ensure that the service is available to all at a reasonable price. As technology advances, the public good can be produced at a lower and lower cost, making it easier and easier for the provider to distribute its service widely at a low cost. Monopoly "rents" are no longer necessary to subsidize the wide provision of reasonably priced service.

When potential competitors see the opportunity to produce a public good cheaply, and at the same time reap profits while undercutting the monopolistic prices of a sole-provider, they naturally clamor for the opportunity to do so. In the end, technological advances ultimately can reduce the costs of entry into the market for the public good, making it easier and easier for competitive firms to thrive despite a social mandate to provide their services at a reasonable cost.

In the U.S., the long distance telecommunications market had developed to this point by the late 1970s. MCI argued that it could substantially undercut AT&T's prices, thereby providing its customers more efficient service, without impairing the public's access to reasonably priced service. MCI's initial prices were a full 30 to 40 percent below AT&T's existing rates. Further technological advances made it clear that long distance service could be provided at a reasonable price to all by fully competitive, overlapping networks.

There is little doubt that the international communications market has reached this same plateau. Separate satellite systems are cropping up throughout the world, demanding access to Intelsat's markets. PanAmSat's AOR satellite, PAS-1, is full and construction of satellites for the POR and IOR is underway. The company's ultimate plan is to have two satellites serving each of the three regions. Columbia Communications currently has 24 transponders on board AOR and POR satellites owned by NASA. Also in the works are separate satellites to serve the African, European, Indian, South Asian, and South American land masses. In sum, the satellites are planned to overlay the Intelsat system, just as MCI's network grew to overlay AT&T's.

Such wide-spread efforts to compete on a global scale confirm that technology has advanced to the point where entrepreneurs feel they can fill the shoes of the monopolist, without any significant degradation in service or increase in cost. Faced with such an inevitable presence of voices advocating for competition (and putting up quasi-competitive systems), we believe Intelsat has recognized that it has little choice but to open the door to competition, and in doing so, that it must make itself competitive as quickly as possibl

5. POLITICAL CONSIDERATIONS

Obviously, economics alone cannot move Intelsat to rapidly abandon its internationally sanctioned protections. The Intelsat Treaty ultimately is a political document, and changes to it are subject to the vagaries of political whim. In the next several years, however, we do not foresee any diminution in the political forces moving Intelsat towards a competitive role either.

In particular, the United States' view towards fostering competition likely will remain the same. Historically, the United States, as the organization's largest shareholder, has wielded significant influence in directing Intelsat. In the past, the world also could expect from the United States fluctuations in economi policy with presidential changeovers. Bill Clinton's recent election, however, was seen as a mandate to "revitalize" the United States' competitiveness. Certainly, policies will change as a result. Nonetheless, the United States' policies towards Intelsat, since they now are premised on fostering competition, likely will remain the same.

6. RAMIFICATIONS FOR THE PACIFIC RIM

The relatively rapid transition to open competition in the international satellite services market will have obvious and tremendous benefits for users and service providers in the Pacific Rim countries. In addition to Intelsat's existing POR facilities, users and providers can anticipate greater and greater access to Columbia's facilities on the TDRS satellites, to former Soviet satellites, and to PanAmSat's POR satellite. The increased access will bring with it the lower costs, greater flexibility in networking, and more efficient service expected from competitive service providers. And if our projections are correct, that day should be around the corner.

WARC-92 and Low Earth Orbiting Satellites: A Case Study of the Process for Accommodating Spectrum Requirements of New Technologies

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ABSTRACT

The recently concluded World Administrative Radio Conference ("WARC-92") provides a view of the "New Telecommunications World Order" as old alliances and paradigms dissolve. The means by which nations agree on spectrum allocations and service definitions increasingly will depend on whether and how advocates evidence benefits to developing and non-aligned nations.

This paper will assess how the United States in large part succeeded in securing global frequency allocations usable by low earth orbiting ("LEO") satellites for mobile voice, data and position reporting services. An allocation for "Big LEOs" in the L-band at 1610-1626.5 MHz represents a surprising victory in view of opposition by a major regional bloc and existing users of the band. The paper also will evaluate the domestic regulatory process with an eye toward determining when and how the FCC will act on LEO license applications.

International telecommunication requires coordination and resource sharing among nations.[1] Geostationary orbiting ("GSO")[2] communications satellites occupy a narrow orbital arc approximately 22,235 miles above the equator that enables such facilities to appear stationary relative to the earth. Low earth orbiting ("LEO") satellites[3] provide an alternative for voice and data service users requiring mobility and lightweight terminals. For either type of satellite, frequency spectrum remains a scarce resource vulnerable to harmful interference.

Nations recognize that universal agreement on frequency and orbital slot usage fosters efficiency and reduces the potential for harmful interference. Still, incentives exist to use international policy making and standard setting forums to pursue self-serving policies designed to promote national enterprises at the expense of consensus decision making geared to optimize technology and consumer welfare.

The manner in which nations agree on frequencies, technical parameters and operational rules for LEO systems furnishes a timely case study of the difficult task in balancing self-interest with international comity. The International Telecommunication Union ("ITU") provides the forum, and nations of the world supply the players for six week conferences tasked with establishing global or regional rules of the road for spectrum usage, satellite parking places and assorted procedures for avoiding or resolving harmful interference.

Increasing, consumer demand for "tetherless" and ubiquitous, communications has prompted the United States and other nations to propose significant spectrum allocations for terrestrial and satellite delivered mobile radio services. The FCC recognized the need in its preparations for the 1992 World Administrative Radio Conference, ("WARC-92")[4] and proceeded to revise its domestic spectrum allocations after WARC-92, substantially expanding the spectrum available for mobile services.

This paper will examine how the United States achieved much of its spectrum objectives for LEO satellites, despite the efforts of numerous opponents with differing strategic visions, industrial policies, or uses for the targeted frequencies.

The International Telecommunication Union

Founded in 1865, the International Telecommunications Union ("ITU") serves as the international forum for conflict management and resolution in telecommunications.[5] It establishes treaty level policies and rules, promulgates technical standards and operational recommendations, and registers frequency/orbital arc uses.[6] The ITU is a specialized agency of the United Nations, and with rare exception, avoids distracting political issues.

The ITU's major function can be described as telecommunications conflict prevention and resolution. Its success depends in large part on the willingness of nations to serve as fair-minded global citizens willing to relinquish a degree of sovereignty. The ITU succeeds by forging consensus at various world or regional administrative conferences,[7] leading to ratification of conference Final Acts by nations, followed by domestic codification of spectrum allocations, rules and regulations.[8]

The future viability of new services and spectrum allocations depends in large part on the willingness of the ITU's community of nations to reach closure. The FCC may await a global consensus, or take unilateral actions on domestic allocations to expedite the availability of new services and technologies, and perhaps also to affect future global allocations.[9]

ITU Structure and Function

The ITU structure can be divided into permanent, plenary and ad hoc elements. Supreme authority lies with the 170 member nations who waive individual sovereignty, primarily through formal treaty, and agree to comply with promulgated rules and regulations. The infrequently convened Plenipotentiary Conference ("Plenipot") revises the ITU's basic documents, the International Telecommunications Convention and Constitution.[10] At the Plenipot, nations holding one vote each, establish budgets for future Conferences and for the ITU's permanent staff called the General Secretariat. The Plenipot also elects the ITU's Secretary-General and other officials. It selects 36 nations to participate in the Administrative Council that performs executive board functions.

The Plenipot also schedules the various Administrative Conferences that, _inter alia_, create or modify rules, regulations or recommendations including frequency and orbital arc allocations. Administrative Conferences can involve one of three geographical regions of the world, or have global application.[11] These meetings have addressed such diverse issues as mobile radio, the orbital arc, high and middle frequency radio, satellite frequencies, and the terms and conditions for provision of information services.

The Administrative Council implements ITU policies and regulation, oversees the General Secretariat, and establishes the questions and issues that will be studied by two permanent "Consultative Committees"--one for telephone issues, the Consultative Committee for International Telegraph and Telephone ("CCITT"); and one for radio and spectrum matters, the Consultative Committee for International Radio ("CCIR").

IFRB Roles: Conflict Prevention

Once the CCITT, CCIR and individual nations have proposed rules, regulations and recommendations on frequency and orbital arc usage, which have been accepted by the ITU member nations, the International Frequency Registration Board ("IFRB") performs registration, coordination and conflict prevention functions.

The IFRB maintains a master list theoretically containing all nations' actual and proposed frequency and orbital arc uses for non-military/national security applications.

Before recording a new use, the IFRB reviews it for compliance with the ITU Constitution, Convention, and applicable rules, regulations and frequency allocations on a regional, or worldwide basis. It also assesses the potential for interference with other registered uses (in operation or planned), and issues an "Advance Publication" of the proposed new use. The issuance of this document triggers a time period within which nations may report potential interference, and express their desire to participate in future meetings convened to resolve such problems. Upon successful conclusion of this "coordination" process, the IFRB officially registers the use and "notifies" all Member nations.

ITU Conflict Resolution in Satellite Orbital Slots

Notwithstanding shared interests in consensus and conflict prevention, the ITU regularly bears the duty to broker compromise and lend its "good offices" to resolve conflicts. Particularly for shared resources like satellite orbital slots, nations vie for a finite number of available positions. Absent wide geographical separation of users, or costly earth-based improvements in the selectivity of earth stations to permit closer spacing of satellites without interference, nations face a zero sum game: one nation's orbital slot use often can occur only at the expense of another nation's future use.

The geosynchronous orbital arc represents a relatively narrow sliver of space where satellites can operate as stationary relays for signals transmitted from earth. The optimal location for geosynchronous satellites to cover the broadest geographical area with a usable signal, i.e., the satellite's footprint, lies above the equator. With only recent limited alteration, the ITU rules favor incumbents and prior registered uses. Typically, developed nations like the United States and global cooperatives like INTELSAT[12] and INMARSAT[13] have completed the IFRB registration process for a large number of satellites.

Nations "notified" of a future satellite deployment have an affirmative duty to avoid causing harmful interference should they seek to use the same orbital location. Developing nations often are left with less than optimal orbital slots, because their later launched systems must not interfere with already operating networks. The congested orbital arc and limited finances prompt such nations to lease capacity from cooperatives' satellites, even for domestic applications.

The FCC's "open skies" policy,[14] which encourages satellite carrier market entry, exacerbates the scarcity of satellite parking above North, Central and South America. In practice, this policy has resulted in capacity gluts, unused transponders and accusations that the United States has occupied more than its fair share of orbital slots.

Inequity in Access to Satellites and Information Resources

The matter of orbital parking place negotiations takes on even greater significance when one considers its impact on national access to information resources. Inequitable and inadequate access to orbital slots can exacerbate the gap between information rich and information poor nations. If one subscribes to the view that the wealth of information resources has a direct and substantial effect on national financial wealth, then access to the orbital arc has a profound impact on nations' overall social and economic welfare. Accordingly, the stakes in the orbital slot access sweepstakes involve more than how many television channels a nation can access.

It impacts the broader issue of whether and how a new World Information Order can be achieved, and what burdens developed nations should assume to promote parity of access to public (orbital slots) and private resources (programming and data bases sent via satellite).[15]

In the face of growing demands for orbital slots, compounded by an inability or unwillingness by many nations to commit to reduced spacing between satellites,[16] the ITU regularly becomes the forum for fact finding, arbitration and conflict resolution. It fashions remedies at the macro-level by convening World Administrative Conferences to revise spectrum allocations, and to consider changes to the method for reserving orbital arc slots. At the micro-level, the IFRB publishes prospective uses, coordinates the necessary technical and operational assessment of a nation's interference claims, resolves real interference problems and formally notifies the ITU membership of newly registered orbital arc uses.

Satellite orbital arc policy raises political questions, and juxtaposes equity and efficiency concerns. For its part, the ITU must fashion a compromise that balances financial concerns regarding satellite spacing and efficient frequency use, with equity concerns that developing nations deserve access to the GSO, despite their later filed applications that under the "first come, first registered" process could result in subordinate status.

Many developing nations have advocated an a priori, "allotment" plan for satellite orbital arc deployment.[17] These nations advocate a scheme that guarantees slots, even at the risk of leaving fallow a resource that other nations, singularly or collectively, could put to use in the near term.

Space WARCs

The ITU has found itself in the middle of a geopolitical battle of philosophies, particularly at Space World Administrative Radio Conferences ("Space WARCs"). Space WARCs establish rules, regulations and policies for various types of satellite services, e.g., fixed (for telecommunications from and to many fixed locations on earth), broadcast (for satellite broadcasting of vidéo and audio programming directly to dispersed receiver locations), and mobile (for telecommunications between fixed locations and mobile stations or between mobile stations). They also determine at what frequencies such services should operate, ensuring that these operations do not interfere with other existing satellite networks, or other operators whose uses are authorized for the same frequencies.

Most importantly, Space WARCs must anticipate and resolve future bilateral conflicts possibly involving nations whose representatives might lack the expertise or inclination to help shape a speedy and fair compromise. Accordingly, most member nations of the ITU invest significant resources for extensive pre-Conference preparations, and send representatives to marathon international meetings that can run for six weeks or more.

Recent Space WARCs have confronted the issue of equitable GSO access, and while grandfathering existing registrations, they established a framework for reserving at least one orbital slot for each nation, and for resolving conflicts on a bilateral, multilateral and regional basis. Software can compute optimal orbital slot reservation plans based on such variables as frequencies, service parameters, coverage plans, transmission power and interference levels. But there will always be a human component that requires an honest and impartial broker.

The Space WARCs also have considered the role of global cooperatives like INTELSAT and their status within the ITU. While cooperatives' satellites serve the telecommunications needs of many nations, the ITU must acknowledge the interest of individual nations in retaining options for national systems. A proliferation of satellite systems can result in excess capacity and inefficiency, much like what arguably has occurred in international commercial aviation given the number of national flag carriers.

Cooperatives like INTELSAT have official observer capacity at the ITU, and use the services of the nation where the cooperative's headquarters is located for satellite registration and official advocacy. Conferring international cooperatives greater opportunities to participate might improve satellite coordination, but some nations argue that such status would create a "super-sovereign" organization. In any event, the ITU will have to impose increased spectrum and orbital arc sharing to avoid the tougher task of deciding who must share spectrum and satellite parking places, and what services have priority access.

Orbital Slot Reservation Alternatives

Given the prospect for more satellite systems separate from international cooperatives, one should assess whether the GSO registration system can remain intact, and whether nations like the United States can continue to enjoy the luxury of supporting an open skies policy that currently fills in excess of 25 orbital slots. Noting that an allotment plan to reserve orbital slots for developing nations might result in an unused resource, some policy makers have proposed the use of auctions and other types of market valuation mechanisms that would enable a developing nation to transfer a slot for financial compensation.[18]

While the Communications Act precludes United States licensees of spectrum from viewing their authorization as property, the FCC has encouraged property-like conveyances of transmission capacity between facilities-based carriers and users, or capacity resellers. In the satellite arena, the FCC does not quarrel with pre-launch sale of transponder capacity for the lifetime of the satellite.[19] By extension, should a developing nation decide against operating its own satellite system, separate from a regional or international cooperative, then its reserved slot might have significant resale value if nearby developed nations need additional slots.[20] While the GSO has the characteristic of a <u>res communes</u>, a shared global resource, consensus-reached decisions to reserve slots for a specific nation, or group of nations, could result in a market for converting an orbital slot into a more desirable resource: hard currency.

The 1992 World Administrative Radio Conference

The thirteenth ITU Plenipot[21] held in Nice, France (May 23-June 29, 1989) determined that a WARC should convene in 1992 to address frequency allocations in various parts of the spectrum.[22] The Plenipot passed a Resolution proposing that the 1992 WARC address the Resolutions and Recommendations generated by three previous WARCs convened in 1987 and 1988:

1) one addressing High Frequency, i.e., short wave, broadcasting;

2) one on terrestrial and satellite-delivered mobile services; and

3) one on planning and using the orbital arc for geostationary satellites.

Accordingly, WARC-92 had a quite diverse agenda spanning the frequency spectrum from 3 MegaHertz ("MHz") to above 20 GigaHertz ("GHz").

The substantive issues ran the gamut from addressing the additional spectrum requirements of existing services like shortwave and terrestrial mobile radio, to the spectrum requirements of new services like high definition television, digital audio broadcasting. As if the agenda did not already promise controversy and challenge, on June 21, 1990, the ITU Administrative Council agreed to expand the WARC-92 agenda to include Low Earth Orbiting ("LEO") satellite issues.[23]

The Battle of the Haves and Have Nots

The domestic administrative process to prepare United States positions for WARC-92 and actions at the Conference exemplify substantial differences in terms of spectrum and satellite orbital arc priorities. A number of dichotomies and schisms developed between:

* incumbent users and proponents of new services;

* LEO satellite proponents and advocates for protecting GSO satellites from potential interference and competition;

* developed nations, having the option to establish spectrum priorities between competing technologies, and developing nations perceiving the need to avoid foreclosing any single option that might serve as their best, and possibly only, near term technological solution to basic telecommunications requirements;

* blocs of nations and cooperatives whose industrial policies and strategic visions could be furthered or frustrated by WARC-92 decisions; and

* advocates for looser, generic service definitions and proponents for retaining service-specific, block allocations of spectrum.

United States Preparations

The United States approached WARC-92 with the following guiding principles:

a. To promote the implementation of a variety of new operational programs as rapidly as practicable so that all countries may realize the benefits and spectrum savings promised by modern telecommunication technologies;

b. To provide flexibility in the international regulations to ensure that the needs of all countries can be met;

c. To reduce regulatory, technical and operational barriers so that technologies can rapidly be introduced and used to the benefit of all mankind; and

d. To provide up-to-date regulations that assure greater safety-of-life on land, on the sea, in the air and in space.[24]

Taken as a whole, the United States principles emphasize change and flexibility over the status quo. The fact that the United States position reflects a forward thinking approach belies the confrontation and compromise occurring during the multi-year preparations for the Conference. The Federal Communications Commission ("FCC") sought public participation in two ways: 1) through public notices seeking comment in a formal Inquiry;[25] and 2) through the formation of an Industry Advisory Committee comprised of representatives from trade associations, user groups, manufacturers, carriers and other interested enterprises with a mission of either advocating spectrum reallocation to accommodate new services, or protecting previously allocated spectrum from reallocation. The Interdepartment Radio Advisory Committee ("IRAC"), under the auspices of the Commerce Department's National Telecommunications and Information Administration,[26] conducts a parallel, and often separate process for coordinating the preparation activities for government users.[27]

In the area of mobile telecommunications provided over "L-band" frequencies (around 1.5-2.0 GigaHertz), the United States has aggressively advocated a "generic" mobile satellite service allocation that would accommodate the previously separate ITU allocations for maritime, land mobile, aeronautical and safety/distress satellite services.[28] In addition to affording greater flexibility among services whose spectrum demands might grow at varying rates, a generic allocation would provide an adequate breadth of service opportunities to domestic MSS operators.

The FCC is not beyond gerrymandering market definitions and limiting the scope of competition to ensure private sector viability. In the domestic mobile satellite arena, the FCC forced all applicants to form a consortium, and then conferred it a domestic monopoly.[29] The Commission refused to allow domestic users the permanent alternative of accessing Inmarsat capacity, but did allow such use on an interim basis until the U.S. licensee launches a satellite.[30]

The United States Position on LEO Satellites

The United States suggested that the best way to accommodate growing demand for MSS would be "to permit flexible usage to adapt to dynamic changes in communication needs," with due consideration for priority safety services.[31] In application, the United States generated several concrete proposals:

* Reallocate a large portion of the 1.5-1.6 MHz[32] "L-band" from geographically specific services, e.g., land, maritime or aeronautical mobile services to a generic mobile-satellite service;

* Earmark a portion of this band--1610-1626.5 MHz (for satellite-to-Earth, i.e., "uplink"[33] transmissions) and paired frequencies at[34] 2483.5-2500 MHz (for Earth-to-satellite, i.e., "downlink" transmissions) for mobile-satellite services, particularly those offered by LEO satellites, who might not have the ability to operate in other portions of the L-band due to the potential for causing or receiving harmful interference from existing or prospective GSO satellites operated by incumbents like the International Maritime Satellite Organization ("Inmarsat");

* Create a new worldwide 40 MHz allocation--2110-2130 MHz and 2160-2180 MHz (for uplink transmissions) and 2390-2430 MHz (for downlink transmissions) to accommodate likely future requirements;

* Add a footnote permitting the use of frequencies in the 1850-1990 MHz band for mobile-satellite service as an adjunct to the terrestrial, personal communication services projected to flourish in the future;[35] and

* Provide for a more formal basis for interference

avoidance between LEO and GSO satellites providing mobile-satellite services.

WARC-92 Deliberations and Decisions

Dr. Pekka Tarjanne, Secretary General of the ITU, deemed WARC-92 "the biggest, most important and difficult conference of its kind."[36] Significant controversy arose on the issues of spectrum allocations for LEO satellites, and the method for coordination to avoid interference to both LEO, GSO and land-based systems. Many of the nations, which coordinate telecommunications policies in the European Conference of Postal and Telecommunications Administration ("CEPT"), favored terrestrial solutions to future mobile telecommunication requirements.[37] United States advocacy for LEO satellite mobile services may have appeared as a threat to industrial and strategic policies:

The United States and Europe went head-to-head over this issue because neither country was certain that the market could sustain both FPLMTS [future terrestrial land mobile services in the 1700-2300 MHz band] and LEOs above 1 GHz. As a result, both wanted to make sure they received an allocation to get their systems off the ground. Europe, however, has had a head start, because FPLMTS could begin with . . . [digital] cellular service, which is finishing its test phase . . ..[38]

Incumbent radio astronomy and navigation users of the band targeted for LEO mobile satellite services also expressed concerns about the potential for harmful interference. While Russia might possibly provide launch services for United States LEOs, a more immediate concern predominated: the need for technical standards and procedures to safeguard the GLONASS global navigation system that transmits in a portion of the 1610-1626.5 MHz band, with the prospect of expanded use if a future generation of satellites is launched. The United States and Russia negotiated a footnote to the spectrum allocation stating that the "use of the 1610-1626.5 MHz band by the mobile-satellite service . . . is subject to the application of the coordination and notification procedures set forth in Resolution COM5/8."[39] These procedures require operators of LEO systems to coordinate with other LEO, GSO and terrestrial systems, and has the practical effect of requiring very low power mobile radio transmissions in the part of the band where GLONASS operates.[40]

Many observers attribute the successful outcome for LEO satellites to the eleventh hour reconsideration by a number of developing countries that initially considered LEO systems potential bypassers able to syphon traffic and revenues from the government owned and operated telephone company:

European opposition to the allocations was ultimately overcome by the merits of the U.S. proposals and their attractiveness to many developing countries, which see LEOs as a lower cost way to provide communications in rural or other areas with an insufficient telecommunications infrastructure. Politically, the Europeans were reticent to be seen as blocking the development of new technologies, particularly with regard to developing countries with low telephone densities.[41]

Small LEOs

Prior to WARC-92, the FCC proposed new frequency allocations for "small LEO" satellites in a narrow portion of the VHF and UHF bands.[42] These satellites will provide low cost, non-voice services only, such as data messaging and position determination that can improve the efficiency of oil exploration and transportation industries, enhance remote monitoring of the environment and provide an emergency signaling system.

LEO satellites orbit more closely to the earth than conventional GSO satellites. This close proximity enables both terminal and satellite to operate at low power. LEO satellite services can cost significantly less than equivalent services provided via GSO satellites, because LEO launch costs are one twentieth as expensive.[43]

The United States WARC-92 proposal for Low Earth Orbiting Satellites Below 1 GHz was straightforward: 137-138 MHz and 400.15-401 MHz (downlink) and 148-149.9 MHz (uplink).[44] WARC-92 considered this proposal as non-controversial, because of the small amount of spectrum requested for a new allocation, evidence submitted to show that small LEOs would not harm incumbent operations,[45] including weather satellites, and the shared view that the two-way data services available via low-cost pocket-sized terminals could "support economic development worldwide."[46]

WARC-92 provided "everything the U.S. wanted, plus more"[47] for small LEOs:

Developing countries were particularly vocal that . . .[such] service will be a low-cost tool to relay messages, especially in emergency situations when ground-based telephone service is not available. . . . African nations also supported the allocation because receivers for this service will be available at one-tenth the cost of hand-held telephones for [GSO] satellite-based voice communications.[48]

After WARC-92, the FCC made a preliminary determination whether any small LEO applicant deserved a Pioneer's Preference[49] designation that would guarantee a future license. A Pioneer's Preference provides "a party first proposing a service through a spectrum allocation rule change the right to obtain a license in that service . . . [provided the Commission decides] to reallocate spectrum and authorize the new service."[50] The Commission in effect reduces administrative and regulatory uncertainty by permitting the pioneer to file its license application without being subject to competing applications.[51] If the FCC proceeds with a service authorization and spectrum allocation, consideration of the innovating party's license application will precede the filing opportunity for other applicants. Hence, the extent of the marketplace headstart afforded the pioneer depends on the time it takes the Commission to establish for non-pioneers an application filing window, processing, deliberation and license grant.

The Commission tentatively granted a Preference to Volunteers in Technical Assistance ("VITA") that had proposed to provide data communications via a small low-Earth orbiting satellite operating on a few Very High Frequency channels.[52] The Commission denied the applications of other applicants that arguably had greater financial and technical resources. The Commission held that VITA had demonstrated that:

1) its proposal is technologically innovative;

2) the innovation reasonably will lead to establishment of a service not currently provided, or will substantially enhance an existing service; and

3) it had conducted an experiment, or demonstrated the viability of its proposal with detailed technical submissions.[53]

The FCC noted that VITA "clearly was the first to develop LEO data communications technology and to experiment with the operation of an actual LEO system to support data communications in the VHF spectrum."[54]

The Commission also decided that it could expedite the small LEO licensing process by encouraging applicants to negotiate technical and regulatory terms under which all could operate.[55] The Commission has legal authority to create advisory committees[56] and to encourage them to negotiate regulatory solutions.[57] "If consensus is reached, it is used as the basis for the Commission's proposal" to regulate the service.[58] The Commission believed it could use a negotiated rulemaking arrangement to develop technical and licensing rules[59] for small LEOs, because of the limited number of identifiable interests, and a reasonable likelihood that an advisory committee could reach consensus having considered in good faith the various viewpoints.

Big LEOs

Soon after WARC-92, the FCC issued a Notice of Proposed Rulemaking to modify the domestic Table of Frequency Allocations to incorporate spectrum allocations for MSS in the 1610-1626.5 MHz and 2483.5-2500 MHz bands.[60] While the FCC tentatively concluded that "the services to be provided by the proposed non-geostationary systems offer the promise of significant new benefits to both domestic and international communications users,"[61] the Commission refrained from awarding any Pioneer's Preference. The Commission stated that "none of the five [LEO] proponents has demonstrated sufficiently that it merits award of a pioneer's preference,"[62] primarily on grounds that no applicant had proposed a "significant improvement or innovation over the state of the art"[63] particularly in light of the failure of all applicants to provide analyses demonstrating technical feasibility.[64]

The Commission also declared its interest in having a Negotiated Rulemaking to assist it "in developing regulations that will facilitate the maximum number of MSS providers."[65]

Notwithstanding the Commission's interest in having the affected parties manage the rulemaking process, the prospect for a consensus decision appears much less likely than in the case of small LEOs. The six applicants for a Big LEO license[66] have proposed incompatible transmission systems, and may have business plans that assume a certain amount of channel capacity, and hence, a certain amount of interference-free frequency bandwidth. Some of the applicants may not want an expedited licensing process that would impose a deadline for launch and operation.

Conclusion

WARC-92, along with the domestic regulatory activities that precede and follow the Conference, involves high stakes decisions. The vision of ubiquitous communications via small handsets cannot become a reality without a global consensus on mobile satellite service frequency allocations. Likewise, the vision requires timely action by the FCC to incorporate the spectrum allocations, issue rules and license applicants.

The outcome at WARC-92 demonstrates that the international process can accommodate new spectrum requirements, despite the lack of a consensus going into the Conference. On the other hand, the domestic regulatory process, which emphasizes procedural fairness at the expense of timeliness, may take years to run its course. The success at WARC-92 means very little indeed if the FCC cannot follow up and find a way to evaluate each Big LEO applicant, resolve technical incompatibilities, equitably assign the available spectrum and award licenses.

1. For extensive coverage of international satellite communications law, see White and White, Jr., The Law and Regulation of International Space Communication, (Dedham, MA.: Artech House, 1988).

2. "A geostationary satellite's circular and direct orbit lies in the plane of the Earth's equator and remains fixed relative to the Earth. The distance to the Earth is approximately 35,785 km (22,235 miles). Amendment of Sec. 2.106 of the Commission's Rules to Allocate Spectrum to the Fixed-Satellite Service and the Mobile-Satellite Service for Low-Earth Orbit Satellites, Notice of Proposed Rulemaking, ET Docket No. 91-280, 6 FCC Rcd. 5932, n. 2 (1991).

3. "LEO satellites are satellites that are not in geostationary orbit about the earth. LEO satellites orbit the earth at altitudes generally in the order of 1000 to 2000 km (650-1300 miles). LEO satellites have been utilized primarily for military, scientific, and amateur radio communications purposes." Id., 6 FCC Rcd. at 5932.

4. "We believe that the demand for mobile-satellite service is beginning to grow. Until recently, most MSS has been limited to maritime systems, but recent years have seen a significant increase in interest in providing land and aeronautical MSS." An Inquiry Relating to Preparation for the International Telecommunication Union World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum, GEN Docket No. 89-554, Second Notice of Inquiry, 5 FCC Rcd. 6046 at para. 65 (1990).

5. For an overview of the ITU, see The International Telecommunication Union: Its Aims, Structure and Functioning, ITU Press and Information Section (Oct. 1991).

6. For a general description of the ITU, see Rothblatt, "ITU Regulation of Satellite Communications," 19 Stanford J. Int'l L., 1-25 (1982), Codding and Rutkowski, The International Telecommunications Union in a Changing World, (Dedham, MA:Artech House, 1982); Jaku, "The Evolution of the ITU's Regulatory Regime Governing Space Radio Communication Services and the Geostationary Satellite Orbit," 8 Annals of Air and Space L. 380 (1983); Gregg, "Capitalizing on National Self-Interest: The Management of International Telecommunication Conflict By the International Telecommunications Union," 45 L. and Contem. Prob. 37-52 (1982).

7. To see how the United States prepared for the 1992 World Administrative Radio Conference, see An Inquiry Relating to Preparation for the International Telecommunications Union World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum, GEN Docket No. 89-554, First Notice of Inquiry; 4 FCC Rcd. 8546 (1989), Second Notice of Inquiry, 5 FCC Rcd. 6046 (1989); Supplemental Notice of Inquiry, 6 FCC Rcd. 1914 (1991); Report and Order, 6 FCC Rcd. 3900 (1991); United States Dept. of State, United States Proposals for the World Administrative Radio Conference Malaga-Torremolinas, Spain 1992 (Washington, D.C. 1991).

8. For an example of how the United States implements international spectrum allocation decisions, see Amendment of Parts 2, 25, 80, and 87 of the Commission's Rules regarding Implementation of the Final Acts of the World Administrative Radio Conference for the Mobile Services, Geneva, 1987, 4 FCC Rcd. 4173 (1989); 4 FCC Rcd. 7603 (1989); See also Amendment of Sec. 2.106 of the Commission's Rules to Allocate the 1610-1626.5 MHz and the 2483.5-2500 MHz Bands for Use by the Mobile-Satellite Service, Including Non-geostationary Satellites, ET Docket No. 92-28, Notice of Proposed Rule Making and Tentative Decision, FCC 92-358 (rel. Sep. 4, 1992) (proposing to implement spectrum allocations for "Big LEO" mobile satellite services decided at the 1992 World Administrative Radio Conference).

9. See, e.g, Amendment of the Commission's Rules with regard to the Establishment and Regulation of New Digital Audio Radio Services, GEN Docket No. 90-357, Notice of Inquiry, 5 FCC Rcd. 5237 (1990), Notice of Proposed Rulemaking and Further Notice of Inquiry, FCC 92-466 (adopted Oct. 8, 1992); outlined in press release, 1992 FCC Lexis 5756 (Oct. 8, 1992); creating a license application filing window, DA 92-1408, Applications Report No. DS-1244, 1992 FCC Lexis 5804 (rel. Oct. 13, 1992).

10. See Final Acts of the Plenipotentiary Conference, Constitution and Convention of the International Telecommunications Union, Optional Protocol, Decisions, Resolutions, Recommendations and Opinions, Nice, 1989 (Geneva, Switzerland: International Telecommunication Union, 1990). The Constitution contains the basic provisions and purposes of the ITU. The Convention complements the Constitution and addresses more functional provisions relating to the operation of the ITU and its Conferences).

11. For an analysis and criticism of United States participation for ITU Conferences, see United States Congress, Office of Technology Assessment, The 1992 World Administrative Radio Conference Issues for U.S. International Spectrum Policy--Background Paper,OTA-BP-TCT-76 (Washington, D.C. 1991).

12. The International Telecommunications Satellite Organization ("INTELSAT") is a global cooperative, formed by an inter-governmental agreement, with a mission of providing ubiquitous satellite communications service via GSO satellites. See Multinational Communication Satellite System, opened for signature Aug. 20, 1994, 15 U.S.T. 1705, 514 U.N.T.S. 26 (19 nation agreement establishing interim arrangements for a global satellite cooperative); Agreement Relating to the International Telecommunications Satellite Organization ("INTELSAT"), opened for signature Aug. 20, 1971, 23 U.S.T. 3813, 1220 U.N.T.S. 21 (INTELSAT Agreement), Operating Agreement Relating to the International Telecommunications Satellite Organization ("INTELSAT"), opened for signature Aug. 20, 1971, 23 U.S.T. 4091, 1220 U.N.T.S. 149.

13. The International Maritime Satellite Organization ("INMARSAT") is a global cooperative, formed by inter-governmental agreement, to provide ubiquitous maritime telecommunications to ships in the high seas, with aeronautical and land mobile services available on an anciliary basis. See Convention of the International Maritime Satellite Organization, opened for signature, July 16, 1979, 31 U.S.T. 1, T.I.A.S. No. 9605.

14. Domestic Communications Satellite Facilities, 35 FCC 2d 844 (1970).

15. See, e.g., B. Harris, "The New Telecommunications Development: Bureau of the International Telecommunication Union, 7 Am. U. J. Int'y L. & Pol'y 83 (Fall, 1991); Saunders, Warford and Wellenius, Telecommunications and Economic Development (Washington, D.C.: The World Bank, 1983); Crandall and Flamm, Changing the Rules: Technological Change, International Competition and Regulation in Communications, (Washington, D.C.: The Brookings Inst., 1989).

16. In Licensing of Space Stations in the Domestic Fixed-Satellite Service, 54 Rad. Reg. 2d (P&F) 577 (1983), the FCC ordered domestic satellite operators to position satellites within two degrees of each other. This reduced orbital spacing accommodates more satellites over the United States and enables the neighboring nations of Canada and Mexico to operate their domestic satellites with wider separation. However, it required higher investment in more sensitive earth stations.

17. "An a priori system of frequency and orbital position regulation uses administrative conferences to subdivide and allot radio frequencies and orbital positions to countries in advance of need or use. On the other hand, an a posteriori ["first-come, first served"] system requires subsequent satellite operators to coordinate with pre-existing satellites to avoid harmful interference." Straubel, "Telecommunication Satellites and Market Forces: How Should the Geostationary Orbit Be Regulated by the F.C.C.?" 17 N.C. J. Int'l L. & Com. Reg. 205, 211, n. 30 (1992).

18. "A market for spectrum licenses or rights, if properly structured, can maximize both `allocative efficiency' (i.e. prices bid for spectrum reflect the costs to society of spectrum use) and 'distributive efficiency' (i.e., those who value the spectrum most will use it." United States Dept. of Commerce, National Telecommunications and Information Administration, U.S. Spectrum Management Policy: Agenda for the Future, NTIA Special Pub. 91-23, 98 (1991).

19. Domestic Fixed-Satellite Transponder Sales, 90 FCC 2d 1238 (1982), aff'd sub nom., Wold Comms., Inc. v. FCC, 735 F.2d 1465 (D.C. Cir. 1984).

20. The Kingdom of Tonga Advanced Published with the IFRB a total of 31 "Tongasat" satellites to be located in 26 separate orbital locations. In December, 1991 Unicom Satellite, Inc. of Aspen, Colorado announced a business arrangement whereby it would acquire the rights to two Tongasat orbital registrations. "Tongasat Authorizes Unicom to Use Orbital Slots Over Asia," 11 Communications Daily, No. 231, 2 (Dec. 2, 1991).

21. The Plenipotentiary Conference ("Plenipot") is the supreme organ of the ITU having both regulatory authority and the power to modify the ITU's Constitution and Convention. It has been scheduled in 6-10 year increments, but a 1989 amendment establishes a 5 year interval not to exceed 6 years. International Telecommunications Constitution, Nice, 1989, Art. 8. In addition to scheduling WARCs, the Plenipot determines general policies, establishes budgets, elects the major office holders of the ITU management and selects which nations will have a representative at the ITU's executive board known as the Administrative Council.

22. Final Acts of the Plenipotentiary Conference Nice, 1989, Resolution No. 1, Future Conferences of the Union, Sec. 1.4.

23. See U.S. WARC-92 Preparations-Second Notice of Inquiry, 5 FCC Rcd. at 6046, App. B.

24. United States Dept. of State, United States Proposals for the World Administrative Radio Conference, Malaga-Torremolinos, Spain, 1992 (Washington, D.C. July, 1991). [hereinafter cite as U.S. Proposals].

25. See supra, n. 7.

26. "In 1978, the President delegated authority to manage the spectrum used by the federal government to the Secretary of Commerce through Executive Order 12046. The Secretary of Commerce further delegated this authority, under Department of Commerce (DOC) Organizational Order 10-10, to the Assistant Secretary for Communications and Information, who is also the head of the National Telecommunications and Information Administration (NTIA)." U.S. Dept. of Commerce, National Telecommunications and Information Administration, Long Range Plan For Management And Use Of The Radio Spectrum By Agencies And Establishments Of The Federal Government, 1-1, NTIA Spec. Pub. 89-22 (June, 1989). NTIA "seeks the advice of Federal Government agencies through the Interdepartment Radio Advisory Committee (IRAC). The IRAC, its related subcommittees, and ad hoc groups provide information and coordinate activities that help NTIA plan for future RF requirements, assign frequencies, and resolve conflicts." Id. at 1-2.

27. See Fisher, "Preparing For WARC-92 Major Decisions For Telecommunications In The 21st Century," 5 Via Sat, No. 9, 49 (Sep. 1990).

28. See Amendment of Parts 2, 22 and 25 of the Commission's Rules to Allocate Spectrum for, and to Establish Other Rules and Policies Pertaining to the Use of Radio Frequencies in a Mobile Satellite Service, GEN Docket No. 84-1234, Report and Order, 2 FCC Rcd. 1825 (1986); Second Report and Order, 2 FCC Rcd. 485 (1987), on recon., 2 FCC Rcd, 6830 (1987), further recon. den., 4 FCC Rcd. 6016 (1989) (allocating 27 MHz of L-band spectrum for generic mobile satellite service); Amendment of Parts 2, 22 and 25 of the Commission's Rules to Allocate Spectrum for, and to Establish Other Rules and Policies Pertaining to the Use of Radio Frequencies in a Land Mobile Satellite Service for the Provision of Various Common Carrier Services, Mem. Op. & Order, 4 FCC Rcd. 6041 (1989) (licensing a mandatory consortium of applicants), partially vacated and remanded sub nom. Aeronautical Radio, Inc. v. FCC, 928 F.2d 428 (D.C. Cir. 1991) on remand, Tentative Dec., 6 FCC Rcd. 4900 (1991); Final Dec., 7 FCC Rcd. 266 (1992); Amendment of Part 2 of the Commission's Rules for Mobile Satellite Service in the 1530-1544 Mhz and 1626.5-1645.5 MHz Bands, Notice of Proposed Rulemaking, 5 FCC Rcd. 1255 (1990) (proposal to add 33 MHz to the domestically allocated generic MSS band).

29. See, e.g., American Mobile Satellite Corp., 4 FCC Rcd. 6041 (1989) (approving formation of a single consortium of previously separate MSS applicants), partially vacated and remanded sub nom. Aeronautical Radio, Inc. v. FCC, 928 F.2d 428 (D.C. Cir. 1991) on remand, Tentative Dec., 6 FCC Rcd. 4900 (1991); Final Dec., 7 FCC Rcd. 266 (1992).

30. See Communications Satellite Corp. and American Mobile Satellite Corp. Requests for Interim Waiver of Sec. 2.106 of the Commission's Rules, 5 FCC Rcd. 4117 (1990).

31. U.S. Proposals at 4.

32. The specific frequencies targeted were the raidodetermination satellite service frequencies at 1610-1626.5 MHz/2483.5-2500 MHz, the land mobile and maritime mobile frequencies at 1530-1544 MHz and 1626.5-1645.5 MHz, and the aeronautical mobile-satellite and land mobile satellite services in the 1545-1559 and 1646.5-1660.5 MHz bands.

33. The United States also proposed a secondary allocation for space-to-Earth transmissions in the 1613.8-1626.5 MHz band to permit spectrum efficient bi-directional operation, as had been proposed by Motorola, Inc. for its IRIDIUM system.

34. At the 1987 Mobile WARC, the ITU proposed that the 1610-1626.5 and 2483.5-2500 MHz band be reallocated for a new radiodetermination-satellite service, that would provide for such functions as real time truck position reporting to a central facility. See, e.g, Application of Geostar Corp. for Authority to Construct and Operate Terminal Units in the Radiodetermination Satellite Service, 2 FCC Rcd. 1184 (1987). The United States proposed to make MSS co-primary with RDSS in these frequencies.

35. See Monheim, "Personal Communications Services: The Wireless Future of Communications," 44 Fed. Com. L. J. No. 2, 335 (March, 1992).

36. "WARC Comes to an End: Final Acts Approved," 3 PCN News No. 5 1 (March 5, 1992).

37. The extensive efforts by CEPT to block mobile satellite spectrum allocations prompted Ambassador Jan Baran, the United States Delegation Head to WARC-92 to allege that "an organized bloc of 32 European countries . . .often appeared to oppose new technologies." "U.S. 'Big LEOs Get Allocations At WARC Largely As Proposed, But Limits Aimed At Protecting Russian Glonass System Could Restrict IRIDIUM; CEPT Nations Get 230 MHz For Future Public

Land Mobile Service; BSS-Sound Gains Worldwide Allocation At L-Band," Telecommunications Reports 12 (March 9, 1992) [hereinafter cited at WARC-92 Summary].

The State Department's unclassified wrap-up cable declared success, in "buck[ing] the inertia and caution of the radio community, suspicion and stonewalling by a well-organized European block of thirty-two countries, and Russian singlemindedness in protecting its GLONASS radionavigation satellite system." Ambassador Jan Barran, "U.S. Success at World Administrative Radio Conference (WARC'92): Wrap-up Cable (March 3, 1992) [hereinafter cited as WARC-92 Wrap-up Cable].

38. WARC-92 Summary at 4. An unnamed source alleged that the "Europeans wanted to make sure that a terrestrial system was implemented before MSS and LEOs could serve hand-held terminals--basically, they were protecting their manufacturers, such as Ericsson and Nokia." Id.

Even the State Department wrap-up cable reported: "The well-organized and cohesive European ITU members (32 CEPT countries in all) cane to the WARC generally opposed to the specific LEO proposals of the U.S. This was because of a general European lack of interest in mobile satellite services (their priorities for WARC'92 were terrestrial mobile issues), a European desire for more time for their own industrial development of these technologies, and/or difficulties with the specific bands proposed." WARC-92 Wrap-up Cable at para 10.

39. International Telecommunication Union, Addendum and Corrigendum to the Final Acts of the World Administrative Radio Conference (WARC-92), Malaga-Torremolinos, 1992 Footnote 731X, A+C p.11. Resolution Com5/8 is entitled: Interim Procedures for the Coordination and Notification of Frequency Assignments of Non-Geostationary-Satellite Networks in Certain Space Services and the Other Services to Which the Bands are Allocated. It is included in Final Acts of the World Administrative Conference (WARC-92), Malaga-Torremolinos, 1992 at 101-113. During WARC-92, the United States tabled an Information Paper identifying ways multiple LEO systems could operate within a limited spectrum allocation. See United States of America, Information Paper, "Techniques For Establishing Multiple LEO Systems In The 1610-1626.5 MHz Bands, Addendum 13 to Document 12, dated 11 February 1992, filed at the WARC For Dealing With Frequency Allocations In Certain Parts of the Spectrum, Malaga-Torremolinos Feb./March 1992.

40. The United States Delegation Head, Ambassador Jan Baran characterized the compromise as "provid[ing] protection of Glonass and the opportunity for Russia to negotiate with one or more of the LEO [satellite operators] to determine how and when a LEO system will operate in Russia." Marcus, "Delegates Bestow Mobile Mandate," 3 Space News No. 9, 1,20 (March 9-15, 1992). Notwithstanding initial post-WARC euphoria, this coordination requirement may prove so difficult that the "defeated" European bloc may have the last laugh: "'If you look at the shopping list of what the Americans wanted, then they were successful,' said Mike Goddard, chairman of the European Radio Committee and chief of the British delegation to WARC. 'But they will find, on taking a second look, that there are restrictions that will make things much more difficult than they might imagine.'" Riccitiello and de Selding, "Consortium Chaos Muddle Results of WARC Talks," 3 Space News No. 10, 1, 20 (March 16-22, 1992).

41. U.S. Wrap-up Cable at para. 13.

42. See, e.g., Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum to the Fixed-Satellite Service and the Mobile-Satellite Service for Low-Earth Orbit Satellites, ET Docket No. 91-280, Notice of Proposed Rulemaking, 6 FCC Rcd. 5932 (1991).

43. Id. at para 9.

44. U.S. WARC-92 Proposals at 2-3.

45. Even before nations arrived at the Conference, there was a predisposition to favor this proposal of the United States: "Australia could accept an allocation for LEO MSS systems below 1 GHz provided that it can be accommodated with our current and planned use of the relevant band, and that adequate protection and coordinated procedures are agreed so that harmful interference would not be caused to existing and planned national systems." Department of Transport and Communications, Radiocommunications Division, Canberra, Australian Proposals For The World Administrative Radio Conference For Dealing With Frequency Allocations In Certain Parts Of The Spectrum, Malaga-Torremolinos, February 1992 9 (20 November 1991).

46. Id. at 3.

47. "U.S. 'Big LEOs Get Allocations At WARC Largely As Proposed, But Limits Aimed At Protecting Russian Glonass System Could Restrict IRIDIUM; CEPT Nations Get 230 MHz For Future Public Land Mobile Service; BSS-Sound Gains Worldwide Allocation At L-Band," Telecommunications Reports 12, 14 (March 9, 1992) [hereinafter cited at WARC-92 Summary]. In addition to allocating almost exactly what the United States sought the Conference also allocated, on a secondary basis, 6 MHz at 312-315 (uplink) and 387-390 Mhz downlink as requested by the Commonwealth of Independent States. See Id. at 14.

48. Marcus, "Delegates Bestow Mobile Mandate," 3 Space News No. 9 at 20.

49. See Establishment of Procedures to Provide a Preference to Applicants Proposing an Allocation for New Services, GEN Docket No. 90-217, Notice of Proposed Rule Making, 5 FCC Rcd. 2766 (1990), Report and Order, FCC 91-112, 6 FCC Rcd. 3488 (1991) [hereafter cited as Pioneer's Preference Report and Order], on recon., 7 FCC Rcd. 1808 (1992).

50. Pioneer's Preference Report and Order at para 23.

51. Id. at para 32.

52. Request for Pioneer's Preference in Proceeding to Allocate Spectrum for Fixed and Mobile Satellite Services for Low-Earth Orbit Satellites, ET Docket No. 91-280, Tentative Decision, 7 FCC Rcd. 1625 (1992).

53. Id. at para 14.

54. Id. at para 15.

55. FCC Asks For Comments Regarding the Establishment of an Advisory Committee to Negotiate Proposed Regulations, CC Docket No. 92-76, Public Notice, Release No. DA 92-443, 7 FCC Rcd. 2370, 1992 FCC Lexis 1968 (rel. April 16, 1992); see also Alternate Dispute Resolution, Initial Policy Statement and Order, 6 FCC Rcd. 5669 (1991).

56. See Federal Advisory Committee Act, 5 U.S.C. App. 2 (1990).

57. See Negotiated Rulemaking Act of 1990, Pub. L. 101-648 (1990).

58. Little LEO Negotiated Rulemaking Notice, 7 FCC Rcd. at 2370.

59. Some of the questions for resolution include whether to require Little LEOs to offer service on a common carrier basis, what transmission modulation to require, whether different rules should apply to non-commercial systems and how to resolve frequency coordination disputes between Little LEOs and terrestrial operations.

60. Amendment of Sec. 2.106 of the Commission's Rules to Allocate the 1610-1626.5 MHz and 2483.5-2500 MHz Band for Use by the Mobile-Satellite Service, Including Non-geostationary Satellites, Notice of Proposed Rule Making and Tentative Decision, ET Docket No. 92-28, FCC 92-358, 1992 FCC Lexis 5094 (rel. Sept. 4, 1992) [hereinafter cited as Big LEO NPRM].

61. Id. at para 13. The Commission elsewhere stated its intention to allocate spectrum and to promote development of new MSS systems, [b]ecause of the important economic and service innovations that could be provided." Id. at para 15.

62. Id. at para 33.

63. Id. at para 49 (rejecting Motorola's petition).

64. "Thus, we are unable to discern any innovative aspect of the LEO proposals that would warrant award of a pioneer's preference to any of the proponents. Based on the record, we are unable to conclude that any of the applicants has 'pioneered' the proposed service or has sufficiently demonstrated that it has developed the technology used in its system." Id. at para 51. The Commission did grant experimental authority to Motorola, Elipsat and TRW to test, and verify engineering evaluations and system functionality.

The Commission took extra time to consider the scope and cost of the experiments out of concern that it not get cornered into granting permanent authority to experimental licensees, simply because one or more had invested many millions of dollars into operational satellites, capable of providing commercial services. See Amendment of the Commission's Rules Relative to Allocation of the 849-851/894-896 MHz Bands, GEN Docket No. 88-96, Notice of Proposed Rulemaking, 3 FCC Rcd. 2436 (1988); Report and Order, 5 FCC Rcd. 3861 (1990), on partial recon. 6 FCC Rcd. 4582 (1991) (creating rules for multiple airplane telephone service providers notwithstanding the previous grant of a multiple year experimental license to one enterprise).

65. FCC Asks For Comments Regarding The Establishment of an Advisory Committee to Negotiate Proposed Regulations, CC Docket No. 92-166, Public Notice, Release No. DA 92-1085, 7 FCC Rcd. 5241, 1992 FCC Lexis 4451 (rel. Aug. 7, 1992).

66. The FCC placed the applications of Motorola Satellite Communications, Inc. ("IRIDIUM") and Elipsat Corp. ("ELIPSO-I") on Public Notice on April 1, 1991, Public Notice No. DA-91-407.
On October 24, 1991, the Commission issued a Public Notice, No. DS-1134, accepting for filing applications of AMSC Subsidiary Corp., (to modify it existing MSS authorization to operate with additional bandwidth), Constellation Communications, Inc., ("ARIES"), Ellipsat Corp. (for a second generation system), Loral Cellular Systems, Corp. ("GLOBALSTAR") and TRW, Inc ("ODDYSEY").

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WARC'92 and Future Considerations

ABSTRACT

WARC'92 has set the framework for many innovative and new technology applications and expanded services and radio communication uses between now and the end of the Century. These include an array of mobile services, including application of low earth orbit (LEO) satellites with hand-held units, telephones and pocket-size devices, as well as satellite sound (digital audio CD quality) broadcasting and opportunities in progress to film quality television.

Use of radio waves underpins fast growing industries as well as national competitiveness and economic performance.

The paper foresees review of the "L" and "S" bands and rationalisation of the WARC'92 allocations later in this decade.

Introduction

World Administrative Radio Conferences (WARCs) have to take the long term perspective; in particular, they must establish the provisions to enable industry, system designers, planners, manufacturers and service innovations to proceed with confidence towards cost effective production, service adaptation, innovation, investment and operation. They assume particular importance with the current emphasis on freer markets and the resulting search for world-wide compatibility, effective investment and more efficient use of the radio spectrum.

Uses of radio waves underpin fast growing industries, national competitiveness and economic performance. Wireless technology is a key element in bringing competition to the telecommunication sector.

Digitalisation is bringing significant quality improvements, greater band widths, enhanced reliability and stability for low powered and low cost service applications. There is also growing service connectivity, choice and flexibility between wireless (radio) and wired systems. These advances can bring unprecedented portability, mobility and personal user convenience. They bring opportunities for multi-purpose use of spectrum and facilities. They include satellite and terrestrial operations with superior digital applications. They extend to digital audio sound (up to CD quality) broadcasting and for a huge variety of quality mobile services. No longer is there the traditional dependence upon wired connectivity.

Countries demonstrated their degree of interest in new technologies against the background of:

. existing international allocations of radio frequency bands; and

. the difficulties found in changing current use of individual frequency bands for particular service objectives and the need for adequate lead times for change; and

. desire for introduction of specific services in the short, medium or long term.

Salient Points in Decisions

HF Spectrum. Modest changes were made in the regulatory allocation table for exclusive shortwave broadcasting (200 KHz below 10 MHz and 590 KHz between 11 and 19 MHz). The changes will become available for exclusive use for broadcasting on 1st April 2007 and used in single side band (SSB) transmission mode. It has been recommended that the date of 31st December 2015 for the general introduction of SSB and the cessation of double side bands in all bands (decided by WARC 87) should be advanced and the revised date so decided by the next competent Conference. A resolution was adopted on the convening of a future Conference for the improved planning of HF bands allocated to the Broadcasting Service. In some cases the extensions have rationalised existing "out of band" broadcasting use.

Mobile and Mobile Satellite Services. There was much focus on huge growth requirements for mobile services and accommodating diverse aspirations of particular countries and regions:

. terrestrial cellular mobile services;

. aeronautical public correspondence 5 MHz (1670-1675 and 1800-1805 MHz) world wide;

. Future Public Land Mobile Telecommunication System (FPLMTS) beginning from the year 2000 some 60 MHz for terminal units with provision for roaming and portability of hand-held units world wide and 270 MHz for the mobile units with the CCIR to

- prepare specifications for common application world wide. Terrestrial and space technology use has been recognised, and each country will be free to use for other purposes those portions of the bands concerned not required for FPLMTS within its borders (recognising differing channel needs between dense and light traffic needs); and
- mobile satellite services using the geostationary orbit (GSO) satellites, and low earth orbit (LEO) satellites, the latter only coming to the forefront recently for general service application. Some of the latter extend to medium earth orbit (MEO) applications.

Some LEO systems, notably "little" (i.e. non voice service) LEOs, would provide, for example, emergency, alert, alarm signals, position location for fleet movement, remote sensing, telemetry, data collection and environment monitoring, paging, short recorded message formats, e.g. 15 characters, radiodetermination (location) and slow speed data services for general or for specialised systems of daily messaging for health, environment education, energy or related social and welfare purposes. Allocations have been made in the VHF bands where technology components are well developed with primary and secondary sharing with other services, such as Space Research and Meteorological Satellite Service. The way is open for low cost terminals and minimal operational costs of a few cents per message operating 24 or more small satellites will provide global coverage through national gateways. These satellites are known as little LEOs. System applications are imminent, the technology having been proven for certain applications for a few decades and now set for commercialisation.

Frequency allocations were made for "big" LEOs and would provide for voice and high speed data cellular systems in space with 52-66 satellites for voice and higher speed data, relay, radio determination and a wide range of services. These systems are known as big LEOs. Decisions should enable at least two or more world-wide little LEO systems to start up in the foreseeable future, subject to international co-ordination and avoidance of interference with other services. Some proposed satellite systems extend to medium or elleptical orbit applications beyond 5,000 miles of a 12 or more in satellite constellations.

The Conference realised that there were now good reasons to have more extensive co-ordination processes for the establishment of non-geostationary satellite systems. Until now regulatory procedures have focussed largely on geostationary satellites.

<u>Broadcasting Satellite Service (BSS)</u>. After much divergence the Conference allocated on a primary world-wide basis 50 MHz (1452-1492 MHz) spectrum for the digital (up to CD quality) broadcasting through BSS and complementary terrestrial extensions.

The CCIR had identified the best cost effective/quality solution for BSS (sound) in the vicinity of 1.5 GHz; moving upwards would have meant additional cost/power considerations of the order 1 to 4 to 1 to 6 at 2.5 GHz for satellite and terrestrial operations, as well as delay in the development of BSS sound systems.

Provision has been made for early system development for national or regional BSS satellite up to 25 MHz and terrestrial use before a planning conference around 1998, and in advance of the allocated spectrum being available for primary use by all countries in the year 2007. Some countries, e.g. United States of America, Japan, Western European and Russian Federations, have kept open their interests in the other bands.

<u>High Definition Television (HDTV)</u>. Because of existing use a common world-wide allocation for wide-band HDTV was not achievable, but Europe, Africa, Asia and Oceania (Regions 1 and 3) joined to the CCIR recommendation at 21.4-22 GHz. The spectrum becomes available from 1st April 2007. In the case of the Americas, provision has been made in the 17 GHz band. Technology continues to develop and HDTV may well be introduced in other bands reserved and unused in bands reserved for the Broadcasting (TV) Satellite Service. For example, Regions 1 and 3 foresee a Conference to review the Broadcasting Satellite Service Plans emanating from WARC'77 and presumably greater flexibility will result to enable multi-purpose use of the satellite orbits.

<u>Other Decisions</u>. Other issues include:

- improved sharing and choices in use of bands - fixed and mobile, including in some cases satellite and broadcasting;
- more generic and consolidation within mobile satellite services - land, maritime and some aeronautical service allocations, with continued priority for safety and distress purposes;
- significant increase and sharing for earth-exploration satellite services (important for management of the environment) space research, inter-satellite and manned spacecraft operations;
- alignment of the equipment maintenance requirements on-board ships with the Convention on the Safety of Life at Sea (SOLAS) relating to the Global Maritime Distress and Safety System;

- increased uplink pairing (13.75-14 GHz) for the Fixed Satellite Service of special interest to INTELSAT;
- more specific protection and status for Radio Astronomy;
- adaptation of regulatory provisions for co-ordination of non-geostationary satellite systems, e.g. low earth orbit (LEO) systems, with geostationary satellite systems (GSO); the international Telecommunication Convention having concentrated so far on the latter.

Preparation and Conduct of Conference

The Conference was conducted under the legal framework of the Nairobi Convention (1982) as insufficient Members of the union have ratified the Nice Constitution (1989).

The Nice Plenipotentiary provided for a WARC of four weeks and two days in Spain to deal with "Frequency Allocations in Certain Parts of the Spectrum", taking into account Resolutions and Recommendations of preceding specified Conferences (Resolution No.1, Plenipotentiary Conference Nice 1989).

Like all WARCs since the Plenipotentiary Conference, Montreux, 1965, WARC'92 had a limited Agenda.

However, the Agenda established by the Administrative Council in consultation with Members of the Union took on a more extensive scope than originally foreseen in 1989.

In contrast to largely unresolved considerations, provisions were included in the Agenda for new opportunities such as low earth orbit and digital satellite and complementary terrestrial quality sound broadcasting, space research services.

No provision was made to extend the duration of the Conference nor to accelerate wide understanding of the significance of additional agenda items posed for WARC'92.

The particular seminars and pre-Conference information exchanges were narrowly focussed. Even the timing and conclusions of the CCIR report did not achieve the expected focus for such a Conference.

There was the late presentation of new issues and new technical information on sharing between services. Consequently it was necessary for the Conference to reach in principle type allocations, with the CCIR to carry out urgently detailed studies on sharing criteria. This applies particularly for LEO-type applications, sharing frequency bands with other services using the geostationary orbit.

It is important that ways be found to improve the individual and collective preparations for Conferences if adequate confidence is to be maintained for the smooth functioning for each WARC.

As regards mobile applications for geostationary and non-geostationary applications (LEOs, MEOs), further consideration of the extent of the frequency allocations in the "L" and "S" bands will undoubtedly be required. The interaction with other services will remain under study. It is likely that some rationalisation of the allocations in the amended Table of Frequencies covered by WARC'92 will be required sooner than later; hence the importance of timely studies, including in the Radiocommunication Sector.

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Multimedia Presentation System using ISDN

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1. Abstract

This paper describes an experimental on-line multimedia presentation system that provides multimedia information consisting of sound, full-color still pictures, subtitles, and pointing information via N-ISDN. We are applying this system to an on-line karaoke system for field trials now.

2. Introduction

NTT has been expanding its ISDN service area across Japan, and has increased the service menu since it first began offering commercial ISDN services in April 1988[1]. ISDN is expected to have a great impact on the development of multimedia information systems[2]. It enables the implementation of economically versatile multimedia information services. The high transmission capacity of ISDN (high speed and multiple channels) will eventually lead to the development of advanced multimedia information services consisting of sound, pictures, text, and data.

Fast transmission combined with data compression techniques result in a significant reduction in the display time of a full-color picture. It also enables the transmission of data and presentation control information, such as pointing position and synchronization timing for displaying or changing pictures. Use of multiple channels in an ISDN makes possible advanced presentation forms such as visual information consisting of a sequence of still pictures accompanied by a voice presentation or background music and synchronized subtitles.

These presentation capabilities make information services more attractive than existing analog videotex services. Multimedia information consisting of voice and pictures can be easily developed using a personal computer with audio-visual input devices such as a video camera or an electronic still video camera.

3. Design policy

First, the basic system features and requirements are described.

3.1 Multimedia information on demand

In a service that provides multimedia information on demand, all data needed for presentation are provided to each terminal from an information center over N-ISDN. After inputting a request, the terminal user waits for the presentation of the information to begin. Thus information must be provided within a reasonable amount of time after the request. Therefore the terminal needs to receive data from the information center and replay data at the same time. If we use two B channels for each information item, our system can provide the following types of data.

- 7kHz sound
- full-color still pictures and subtitles
- pointing
- control data for synchronization

If we use the H_1-channel, moving-picture data can also be transferred.

3.2 Continuous data transfer

If continuous sound data and moving-picture data is fragmented, gaps between blocks appear[3]. Therefore these data are not fragmented in our system, and are used in synchronization control. Accordingly these data must be transmitted isochronously.

3.3 Economically flexible system construction

Our system is designed to transfer of various types data simultaneously and to control the timing during replay. It must be possible to economically change the CPU performance, data storage capacity and number of line connections of the information center according to the amount of traffic.

4. Features of system design

Our system consists of an information center, terminals, and a multimedia input/editing terminal (Figure 1). Table 1 lists the system specifications. Before describing them in detail, we outline the features of the system.

4.1 Terminal storage

The terminals in our system are equipped with data storage.

4.1.1 Advantages

There are two advantages of a terminal's having storage.

One concerns service availability. Even if the center or communication network is not available for reasons such as system trouble or a center being busy, service can continue to some extent using the information stored in the terminal.

The other advantage concerns service cost. The access traffic to the information center generally varies among information items. The difference in the access frequency among items depends the updating frequency. If the access traffic concentrates on information whose contents are not updated

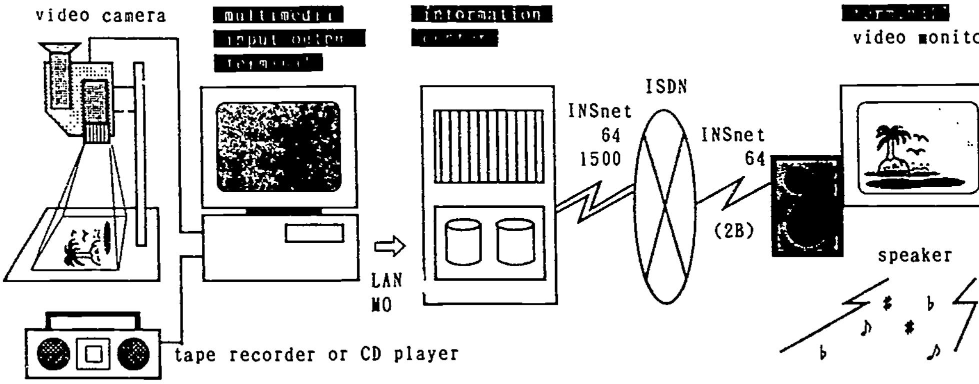
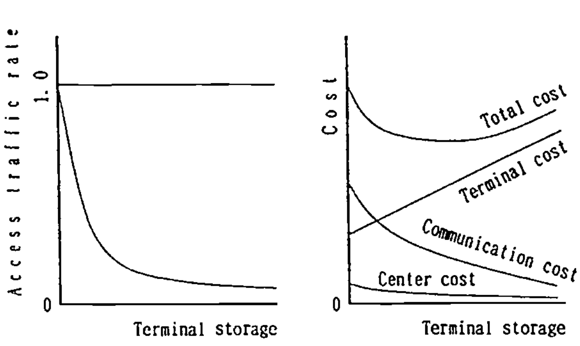


Figure 1: Architecture of the multimedia presentation system

Table 1: System specifications

Characteristic		Specification
visual	data type	full-color still picture, subtitle
visual	resolution	still picture: 640 pixels×400 pixels, subtitle: 640×200
visual	gradation	256 gradations RGB (3×8 bits)
visual	coding method	still picture: GBTC subtitle: MMR
audio	bandwidth	50Hz to 7kHz
audio	coding method	SB-ADPCM
network		INSnet64 (2B+D), INSnet1500 (23B+D, H11)



(1) (2)

Figure 2: Terminal storage effects

frequently, the traffic can be reduced by placing the heavily-accessed information in the terminal storage. In this way, only information not stored in the terminal storage need be retrieved from the center.

The access traffic to the information center decreases as the terminal storage capacity increases. To the extent that access traffic decreases, center cost can be reduced by using fewer communication lines, fewer ISDN communication boards, and less powerful CPUs. While the cost of center-to-terminal communication is lower, the terminal cost increases because of the added storage.

Figure 2-1 shows an example of the relation between access traffic and terminal storage capacity. There is an optimal capacity in the terminal storage concerning the total system cost (Figure 2-2). This optimal point depends on the costs of the system components. It moves toward higher terminal storage capacity for lower terminal storage cost. It moves toward lower terminal storage capacity for lower center equipment or communication costs.

4.1.2 Menu item search

If the menu information item is placed in the terminal storage, search for the item a user requires can be done locally, reducing center-to-terminal communication and the processing load on the center. The information menu is downloaded from the center when the terminal is set up and when the list is updated.

4.1.3 Updating information stored in a terminal

The information in the terminal storage that is reused least frequently is deleted when there is a shortage of available file area. The information items that are reused more frequently thus gradually accumulate in the terminal storage. Another approach is to delete the information which has remained unused for the longest time. Either updating method can be selected. If the time of information updating in the center is known, the updating algorithm can include a function for determining which of the two updating algorithms is the most appropriate.

4.2 Synchronization control

4.2.1 Synchronization of media

Replay of various types of data such as sound, still pictures, subtitles and pointing is controlled by synchronization control data. This control data is created w: :n the information provider combines the various data into multimedia information at the multimedia input/editing terminal. Control data for synchronization is composed of

- timing for change from a still picture or a subtitle to the next one, and
- the pointing position at each interval.

Timing is described in terms of the frame cycles of a terminal display (30 frames/s). The count is reset every four seconds. Pointing position data is provided every 1/30 s, so pointing position can be changed at 1/30 s intervals. When the frame count reaches the timing point in the synchronization control data, the terminal changes to the next still picture or subtitle.

In our system, sound data is transferred isochronously without framing. A specific bit sequence is added to sound data to mark the data start/pause/restart/end position in a 64kb/s bit stream. Frame counting starts when sound data begins to play.

4.2.2 Multimedia information transfer

When an information retrieval request is received at the center, the control data for synchronization (defined in the previous section) is sent to the terminal first. Then the various types of media data are transferred concurrently in real time over multiple channels to the terminal for replay.

Still picture data must be loaded into a VRAM (video graphic random access memory) in the terminal before the time for display. Decoding requires time, so at least two VRAMs are needed. Still picture data is transferred from the center to the terminal before the related sound data is transferred. Subtitle data is also transferred before the related sound data.

Lack of control data for synchronization or subtitle data is a serious detriment for replay, so control data should be transferred using an error-free protocol.

4.3 Center-to-terminal interface protocol

Our system offers the following two data transfer modes.

- The 64kb/s (or 1536kb/s) isochronous mode is used to transfer data to be replayed continuously without delay (for example sound data or moving picture data). There is no procedure in layer 2 to make the best use of the transfer capability provided by layer 1.
- A highly reliable mode for transferring data that must be error-free (for example control data for synchronization or subtitle data). There is LAPB protocol in layer 2.

One problem in using the isochronous transfer mode is that it is difficult to distinguish media data and the commands or responses that are used to control data transfer between the center and the terminal. Therefore, commands or responses for controlling data transfer in the isochronous mode are exchangeed over the related channel in the highly reliable mode. In some common file transfer protocols, such as FTAM[4] and

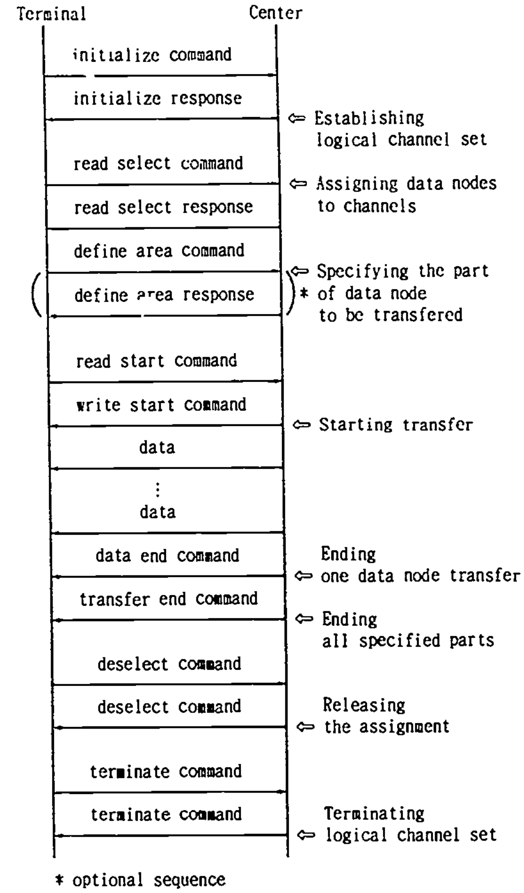


Figure 3: Command/response sequence for data retrieval in a control channel

FTP[5], it is possible to execute only inband control (commands or responses are exchanged over the same channel as used for data transfer). In our system, each channel is assigned to one of the following roles.

- Control channel ⇒ Commands or responses that control data transfers in all related channels are exchanged and data is transferred, sharing the time slots of the channel. This channel operates in the highly reliable mode.
- Data transfer channel ⇒ Only data is transferred. Either the isochronous mode or the highly reliable mode is selected according to the type of data.

Using this center-to-terminal interface protocol, multiple data transfer channels can be controlled by one control channel. An example of a normal sequence using this protocol is shown in Figure 3.

Data is transferred as a virtual unit called a data node. Each data node is identified by both the center and the terminal. Whole file systems, a single file, or a part of a file can be handled as a data node. The data to be transferred is specified by the data node name irrespective of its storage unit, so the protocol used in our system is more flexible than FTP or RCP (Remote CoPy).

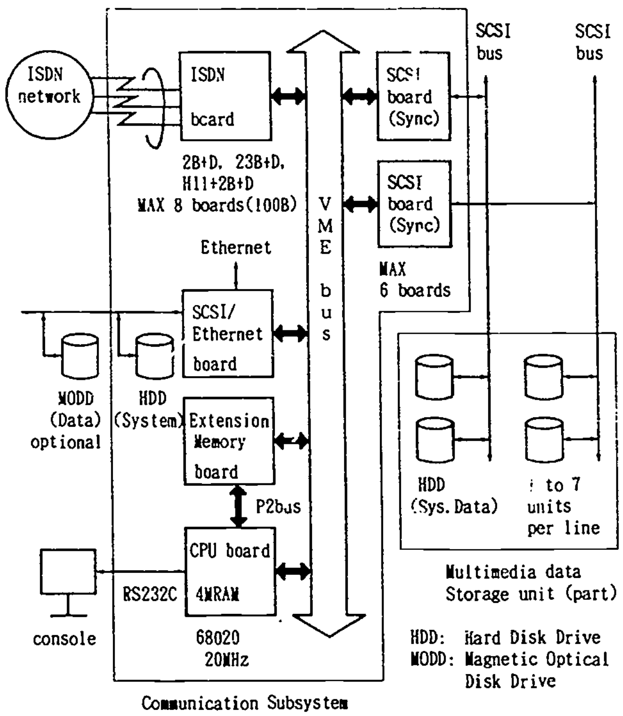


Figure 4: Communication subsystem hardware configuration

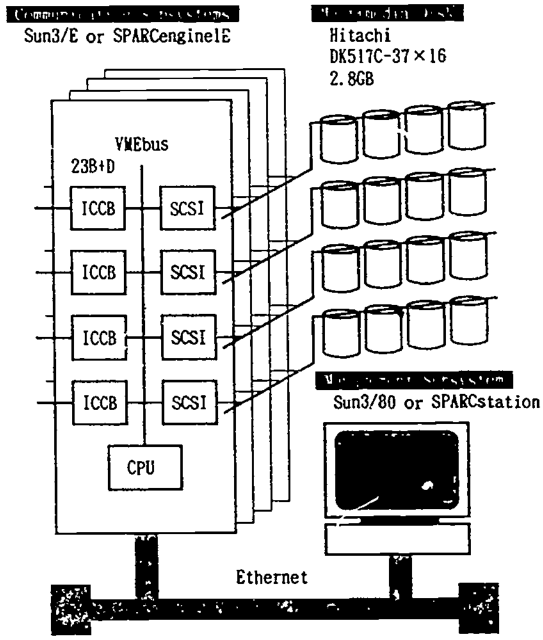


Figure 5: Hardware configuration of an information center

5. System Details

5.1 Information center

5.1.1 Architecture

The information center consists of from 1 to 4 communication subsystems (according to traffic) and a management subsystem. One communication subsystem is composed of three parts (Figure 4).

CPU part This is a commercial CPU board with an Ethernet interface.

ISDN line control part This consists of several ISDN communication boards, and can handle up to 100 B-channels.

Storage part This consists of several SCSI controllers and disks. Its configuration is multiple initiator, multiple target. Data is transferred in the synchronous mode.

The center can h. .e a modular structure, with the number of ISDN communication boards determined by the number of simultaneous connections; the number of SCSI controllers and disks depends on the quantity of multimedia data. Each part communicates with others through the VMEbus. The management subsystem controls all communication subsystems via Ethernet. Figure 5 shows a sample information center that consists of four communication subsystems and one management subsystem. Each communication subsystem has four ISDN communication boards and four SCSI controllers. This center can handle 368 B-channels and store over 40 GB of multimedia information (in 2.8 GB disks).

5.1.2 Software

The AP-level software is written in C and runs under Sun Microsystems UNIX. The information center needs to transfer data over 100 B-channels simultaneously and without delay. To achieve this performance on a standard UNIX system, the following programming techniques are used.

1. Lightweight Process[6]
   The center-to-terminal communication is asynchronous, so one method would be to create two data transfer processes, one for sending and another for receiving, for each ISDN channel. However if this method is adopted, the required performance cannot be achieved as UNIX has a high and variable schedule latency. Therefore our information center adopts a lightweight process. Lightweight processes can share a common address space, so the cost of creating tasks and intertask communication is substantially less than for an ordinary process.

2. Raw Disk I/O[7]
   Providing multimedia information on demand requires units of data larger than the block size for high-speed transfer between memory and disk. Thus, the ordinary "cooked"disk I/O of UNIX has two demerits:

   - As data is transferred to the buffer cache, the amount of I/O data that can be transferred at one time is limited.
   - If the amount of data is larger than the file system block size, the data consists of several file system blocks, which may not occupy sequential positions in a disk. Therefore, the disk head has to be repositioned a number of times during the data transfer from disk. If these blocks are contiguous, the

disk head must still be repositioned because of data swapping.

Therefore, raw disk I/O is used in our information center. This offers three advantages.

- First, a large amount of data can be transferred at once, because the buffer cache is bypassed.
- Also, a large amount of data can be stored sequentially on the disk.
- Finally, processes are locked in memory, so swapping out is never done after the data transfer is finished.

However, using raw disk I/O has the demerit that more advanced file system facilities such as directories and automatic file extension are not available. In our information center, file management facilities in which multimedia data are stored in disks are provided in the AP-level program. Multimedia data stored on disk is replaced outside of normal business hours (automatic file extension and garbage collection are not done).

3. Messages[8]
The AP-level software consists of three parts(Figure 6).

A path control block This block issues requests to an ISDN communication board.

A transport control block This block relates one control channel to data channels and controls data transfer in each channel.

Service functions This block manages the position of multimedia data stored on disk, checks user access rights, and so on.

A message facility is adopted for interprocess communications. It has a low overhead and high bandwidth because it has internal buffers (message queues) for each process.

4. VMEbus memory[9]
In a system where multiple I/O requests for DMA data transfer occur simultaneously, the aggregate size of the data transfer buffer often exceeds the 1 MB provided for DVMA by the Sun architecture. This is caused by three factors. One is the 1 MB DVMA space limit (Entries for only 128 pages are provided.) Another is that DVMA area one page greater than the buffer is allocated so as not to adjoin other allocated buffer pages. The third factor is that if the I/O buffers used in AP-level programs have different sizes, fragmentation often results. In this case, I/O requests for DMA data transfer are kept waiting until sufficient contiguous unused space is available.

Therefore, if there are many simultaneous connections (over 10 lines), memory is placed on the VMEbus and used like an extension DVMA space in our information center. For this purpose, in the center, a buffer for data transfer is mapped to the VMEbus memory by *mmap()* in AP-level programs. Also, special driver internal function calls, which are modified versions of *mb_setup()*, *mbrelease()* and *MB_ADDR()* obtained by adding a process to judge whether the buffer is in the system memory or in the VMEbus memory, are used in driver level programs.

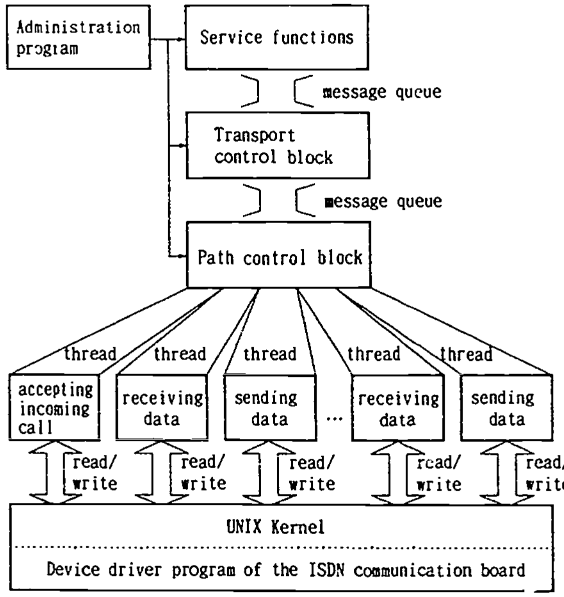


Figure 6: Software structures

5.1.3 ISDN communication board

Three kinds of ISDN comunication board, 2B+D, 23B+D and H_{11}+2B+D, are available. According to the system scale and the type of data provided, the appropriate boards can be selected and connected to the VMEbus. The line interface protocol provided in these boards is shown Table 2. Two data transfer modes using B-channel and H_{11}-channel, that is the 64kb/s (or 1536kb/s) isochronous mode and a highly reliable mode, are available.

Values such as the ISDN number, a sub-address, a bearer capability, high layer compatibilities and low layer compatibilities can be stored in the memory of this board and used for selective call acceptance and the default values for a SETUP message.

For the communication between a CPU and an ISDN communication board, the following three interfaces are used.

VMEbus slave interface — used when a CPU writes a command to an ISDN communication board memory and reads a response.

Interrupter — used when an ISDN communication board notifies a CPU that a response to the CPU is written in the board memory.

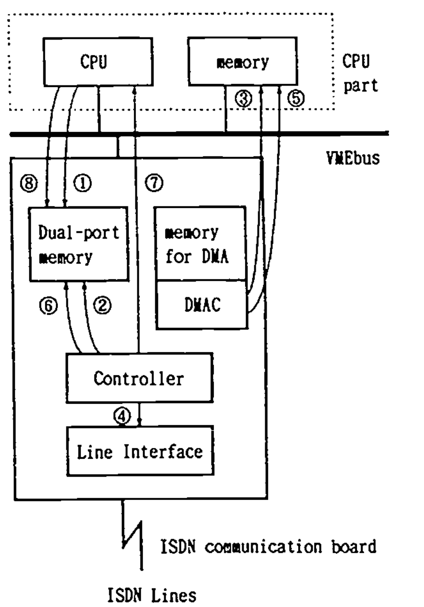
VMEbus master interface — used when the ISDN communication board reads data from a system memory or a VMEbus memory and writes to it.

This communication is illustrated Figure 7.

In an AP-level program, a request such as to connect an ISDN channel, to disconnect it, or to transfer data is issued through system calls to the device driver program of the ISDN communication board. If several ISDN communication boards are set up in one communication subsystem, this device driver selects the most suitable one. This device driver also has the following three characteristics.

Table 2: Interface protocol of the ISDN communication board

3	JT-Q931				
2	JT-Q921 (LAPD)	X.75 SLP (JT-X75 LAPB)		X.75 SLP (JT-X75 LAPB)	
1	JT-I430/JT-I431 (23B+D)			JT-I431	
Layer / Applied	Call control signal	CS reliable	CS isochronous	CS reliable	CS isochronous
	D channel	B channel		H1 channel	



① CPU writes a command on dual-port memory mapped to VMEbus address space.
② Controller reads a command.
③ DMAC reads data whose position is specified by the command from CPU memory.
④ Controller sends/receives data to/from ISDN Line through Line Interface.
⑤ DMAC writes data to CPU memory.
⑥ Controller writes response which specifies position of data written by DMAC.
⑦ Controller interrupts CPU.
⑧ CPU reads response from dual-port memory.

Figure 7: Communication between CPU part and ISDN communication board

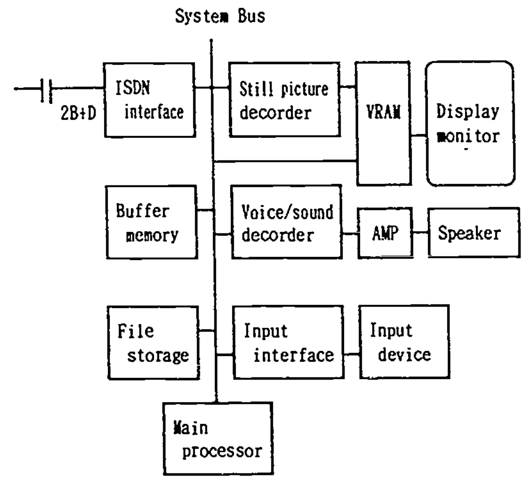


Figure 8: Terminal hardware configuration

1. Asynchronous I/O
   ISDN data transfer is much slower than the VMEbus. It is inefficient if an AP-level program that requests data transfer is kept waiting until the data transfer to ISDN ends. Thus, asynchronous I/O with the ISDN communication board is provided by the device driver supporting *O_NDELAY*, *select()* and *ioctl()* to determine which asynchronous command has been completed.

2. SCATTER/GATHER DMA
   The device driver can set several addresses to specify the positions of data in a CPU memory that are to be transferred to ISDN, if SCATTER/GATHER DMA is used. This function allows 64 kB of data to be transferred between the CPU and ISDN communication board with only one command and response.

3. Management functions
   This device driver has three management functions. One is holding the last issued command and response and the time of issue for each channel to indicate whether the channel or the ISDN communication board is active or hung up. Another is support for automatic configuration. The third is deactivating a specified ISDN communication board.

Up to eight ISDN communication boards can be installed in one communication subsystem.

5.2 Terminal

The terminal is a personal computer with an ISDN interface, a still-picture CODEC, VRAMs for the pictures, a sound CODEC, a speaker and storage equipment. Multimedia data transferred from the information center is stored locally. When a user requests the same data again, the terminal can replay it without connecting to the center. Figure 8 shows the terminal configuration. The terminal provides a number of facilities (Table 3). The contrcl software is written in C and runs under MS-DOS.

Table 3: Terminal Facilities

Category	Facilities
Operation interface	• displaying service menu • interpreting a user request (retrieve, start, stop, cancel, etc.)
Network control	• controlling center-to-terminal connection using ISDN CS - automatic rediall.ng when the center is busy - selection for call acceptance (checking information elements) - holding default values for SETUP message
Receiving and storing	• receiving data from ISDN • storing data in the terminal storage • loading data if data of a request is stored
Replaying multimedia information	• decoding still picture data, subtitle data and sound data • displaying still pictures, subtitles and pointing in synchronization with sound
File management	• file area management of the terminal storage - automatic deletion of least-accessed file
Maintenance	• receiving and storing maintenance data sent from a center - list or menu of information items - terminal setup information - logging data

5.3 Multimedia input/editing terminal

Multimedia data is stored in the information center as two files. One is sound data, and the other is a compound multimedia file consisting of still pictures, subtitles, pointing data and control data for synchronization. These two files are made at a multimedia input/editing terminal, by the following procedure.

1. Compress sound data previously recorded to a digitally coded sound data file using the SB-ADPCM CODEC[10].
2. Compress a still video frame previously recorded from a video recorder or a still video camera to a digitally coded picture data file using the GBTC CODEC[11].
3. There are two methods for handling a subtitle. In one, the subtitle is compressed to an MMR coded still picture. In the other method, the subtitle is handled as character code text. The subtitle data file can be made by either method.
4. While listening to the sound generated from the file, specify the timing for changing to the next still picture or subtitle, and specify the pointing position. The timing data is revised to provide a margin for transfer delay and decoding time, and then stored as a synchronization control data file. The pointing positions are sampled every 1/30 s and stored as a pointing data file
5. The picture, subtitle, synchronization control and pointing data files are concatenated to form a compound file (Figure 9).
6. The sound data file and the compound file are transferred via LAN or a magnetic optical disk to be stored in the information center.

Management	Synchronization Control	Pointing	Subtitle #1 ··· Subtitle #n	Still Picture #1 ··· Still Picture #m

——— Transfer order

Figure 9: The non-sound compound file format

The hardware configuration of the multimedia input/editing terminal is almost the same as a terminal with a video camera and a tape recorder. The control software is written in C and runs under MS-DOS.

6. Application to Karaoke

We are applying the multimedia presentation system to an on-line karaoke system for field trials. Over ordinary standalone karaoke systems, it has three advantages.

- First, it eliminates the laser disc or compact disc pressing cost, transportation cost and installation space.
- Second, users can sing new songs earlier.
- Finally, the information provider can know how many times each song is sung.

The information center currently consists of two communication subsystems and 12 HDs, and can store up to 2000 songs.

7. Conclusion

The number of ISDN subscriber lines has increased greatly, the services using it are mainly G4 facsimile, realtime face-to-face video communication, and file transfer. Multimedia information services are not so common. Several multimedia information systems have already been introduced, and most of them operate either as standalones or via LANs.

The multimedia presentation system is developed to provide multimedia information for public services. Using a modular structure for the center, it can be built economically. In this system, multiple channels are used simultaneously for center-to-terminal data transfer, the number of channels depending on the type of information provided.

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"Project Lindbergh":
Gateway to Public Information Networking

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1. ABSTRACT

This paper describes an innovative approach to the development and implementation of network architecture's for the Information Age. An overview of a study undertaken by Southwestern Bell with the assistance of several equipment suppliers and a subsequent test bed is discussed. Unique ways of approaching the movement of information for self-healing public networks are outlined.

2. THE PUBLIC INFORMATION NETWORK

2.1 "DIGITAL CITY" STUDY

In a recent study by Southwestern Bell Telephone; referred to as "Digital City," a plan to address the transition of the existing network to a public information networking architecture with inherent self-healing capabilities was undertaken. As used in this context, public information networking refers to the future network infrastructure that will provide access, transport, and interconnectivity for voice, data, image, and broadband communications.

One of the basic assumptions made in the Digital City study is that a public network provider has as one of its goals to become a public information networking provider. The needs of the customers of public network providers have become exceedingly more sophisticated. No longer does one expect to provide only locally switched voice services but also high bit-rate data transport as well as video and imaging services. These customers practically rely on the public network for day to day survival. For example, large end users such as financial and brokerage institutions and airlines can lose significant revenues due to network downtime. Estimates ranging from $2 million to $5 million per hour of network downtime for such firms have been widely publicized. For the network providers to achieve the objective of becoming a public information networking company, it must be recognized that the current public network technology, architecture, and rate structures do not allow the present network to adequately address the changes needed to provide public information networking.

The question that must then be asked is "How does one change the current network infrastructure into an information network infrastructure that can access and transport all kinds of information as easily as it accesses and transports voice services?" Self-healing is one of many key components that must be included within the public information networking. However, deploying self-healing networks for that sole purpose may not be the wisest of decisions. Various network topologies will provide self-healing capabilities. The key as demonstrated in the Digital City study is the ability of the public network provider to use a topology that provides ubiquitous access to a multitude of narrow and broadband services while providing self-healing capabilities.

One of the most common questions asked when addressing the transition of networks is, "What service demands will drive the deployment of this new network?" Will the transport of medical images be the driver? Is sufficient bandwidth available for the delivery of video or high definition television? But the most probing question is, "Will one have a public network infrastructure in place, in a timely fashion, to meet these needs." The information network can be compared to the highway system while information services can be compared to the cars and the trucks that run over that highway. The placement of a modern public information network infrastructure is a necessary step to allow information services to be networked ubiquitously across a metropolitan area and the world. The question then becomes, "Does one wait for the development of these new services or does one proceed with the implementation of a new network infrastructure?" Also, with the decision to proceed, do you begin with construction of nodal, transport, or access elements? The Digital City study answered some of these question with surprising results.

The vision of Digital City is to create the premier Information Age city of tomorrow by providing a modern public information network to an entire metro-market area using state-of-the-art technologies and concepts. Technologies that would be used include fiber optics, Signaling System 7, Integrated Services Digital Network(ISDN), Broadband ISDN(BISDN), packet switching, and Synchronous Optical Network(SONET) elements. The plan envisions the simultaneous deployment of these advanced technologies throughout a market area to make public information networking capabilities available ubiquitously.

3. FUNCTIONAL CHARACTERISTICS OF INFORMATION NETWORKING ARCHITECTURE

An information network architecture for the future should have the following:

- **Flexibility** - The network architecture must be service ready(i.e., it should be rich and robust enough to provide a wide spectrum of services at a moments notice). A network that provides ubiquitous access to nearly unlimited bandwidth to the customer is envisioned. This bandwidth will be provided on a demand basis as opposed to a dedicated circuit basis. The network will also need to be able to migrate and evolve with only minimal disruption in service. It also will have open interfaces which would make the resources of the network available to a variety of devices.

- **Manageability** - The network must be easily manageable. This would require on-line, real-time circuit provisioning and dynamic circuit setup and tear down for facility management. Switched (shared) resources will be managed via flexible and rapid routing techniques. This will maximize network utilization while minimizing forecasting and traffic engineering effort. In order to maximize manageability, there should be a maximal integration of services on a transport level to further simplify Operations, Administration, and Maintenance (OA&M).

- **Fault Tolerance** - The network, i.e., switching and transport, must be self-healing. All faults should be transparent to the customer.

- **Cost Effectiveness** - Most importantly, the network architecture must be cost effective and give excellent price performance. this implies among other things low unit cost, graceful growth and rearrangements, and the ability to drive distance elements out of the cost structure.

4. PHYSICAL ARCHITECTURE

The public network that many of us are familiar with provides a user with the ability to move information with relative ease. It can best be described as a point-to-point channelized traffic network. The nodes, in this case Central or End offices, are connected by high capacity trunks in a point-to-point architecture. This type of network is often referred to as a "Star-Mesh" topology(see Figure 1). In existence for over a hundred years, the "Star-Mesh" network performs its job quite well. The requirement to deliver voice or voice grade services places no undue burden on this type of network. The trunks that connect these nodes were originally and up until a few years ago based on metallic or copper technology. In fact, if it was not for operational and maintenance savings these trunks would most likely have remained metallic. However, with the need to move new, more bandwidth intensive types of information, i.e., imaging, video, and data, a new transport media becomes essential. The aim of the Digital City study and Project Lindbergh is to establish a fiber based transport infrastructure. Fiber, the medium of choice, is capable of handling large amounts of bandwidth at a very low cost. Once the initial physical fiber is deployed, it does not have to be reinforced when additional capacity is required. Therefore, the incremental facility cost associated with each DS0 channel is reduced as the transmission system speeds and utilization increase. Figure 2 illustrates this cost advantage of fiber facilities over traditional copper T1 facilities.

A 100 to 1 facility cost reduction per DS0 can be gained at high-fiber utilization levels. With the availability of higher bit rate (and more cost-effective) systems, coupled with a high utilization associated with ring architectures, analysis indicates further cost savings. This attribute, coupled with the self-healing capabilities offered ring architectures, led to structuring the target architecture around ring topologies.

The next question to be answered is the type of ring topology that is best suited for a given metropolitan area. Economic analysis indicates multi-ring configurations could yield significant cost savings over single ring architectures.

The key feature of the Digital City and Project Lindbergh architecture, as depicted in Figure 3, is that all the service elements and other network resources will be connected to the fiber backbone, "Transport Network." These elements include various switching elements, network data bases, service nodes, operations support centers as well as gateways to other networks and enhanced service providers.

The ring architecture will also be extended into the distribution network to serve selected end users. This architecture will allow for efficient transport of the entire spectrum of services from Plain Old Telephone service (POTS) to broadband. It is envisioned that this ring may ultimately be non-channelized, connectionless, and fully packetized for traffic that is today circuit switched. The endpoints of the network provide access to the network from customer or other networks. These points are defined as Access Nodes. Switching nodes provide for the connection of "circuits" and/or "channels." i.e., DS0, DS1, or DS3, on an automated basis, service nodes will provide, service features/capabilities based on a combination of software parameters (translations) and signaling information.

Until high-speed protocols (which would make multi-gigabit connectionless or clear channel single rings possible) become economical and feasible, the Focused Bandwidth concept, as shown in Figure 4, can be used to provide a multitude of services, such as ISDN and MANs, and manage large bandwidth networks. This is because the ring with focused bandwidth provides for the transport integration of all services. For example, Switched Multi-megabit Data Service (SMDS) as provided by MANs and their interconnection via BISDN or directly via the fiber node will be supported.(see Figure 5)

MAN nodes would communicate by means of dedicated DS3 (or SONET) channels on the ring (i.e., focused bandwidth). Packets or Cells will be transported on the ring transparently. In addition, focused bandwidth offers the ability to offer services ubiquitously. For example, in the case of ISDN, a customer can be anywhere in the market area and still be served from any one of a select number of offices merely by traversing the ring (see Figure 6).

In summary, the recommended architecture for Digital City and Project Lindbergh, shown in Figure 3, is a multi-ring "Transport Network" connecting smaller access rings. Switch Node, Service Nodes, enhanced service providers, and gateways with existing star-mesh networks. Focused Bandwidth will be used in an interim period for the delivery of both broadband and narrowband services.

5. IMPLEMENTATION STRATEGIES

Southwestern Bell is currently planning an ambitious trial of advanced telecommunications in the St. Louis area. The trial is called Project Lindbergh, echoing the technical achievements embodied in the Spirit of St. Louis and reflecting the intent to demonstrate telecommunication services and applications that have not been shown before.

This project is a combined effort of Southwestern Bell, a limited number of customers and various vendors of telecommunication's equipment. These vendors are in the process of developing prototype equipment that will deliver such technologies and services as Frame Relay, ISDN, and Broadband ISDN.

The trial uses fiber optics and advanced switches installed in the Southwestern Bell Telephone network to serve advanced applications of key customers. The spectrum of applications proposed for the trial extend from simultaneous voice and data connections to switched full-motion video and high resolution imaging.

It is expected that Project Lindbergh will last through 1994. Southwestern Bell customers who have announced participation in the project are

Mallinckrodt Institute of Radiology (MIR)/Barnes West and Monsanto.

6. CONCLUSIONS

The Information Age is upon us and some momentous decisions must be made. How a nation responds to the demands of the Information Age will impact its future competitiveness well into the next century. The new public communications infrastructure which must be built is closely analogous to a nation's highway and airport systems. Just as the transportation infrastructure was a key to leadership in the Industrial Age, the communications infrastructure will be the key to competitiveness in the Information Age.

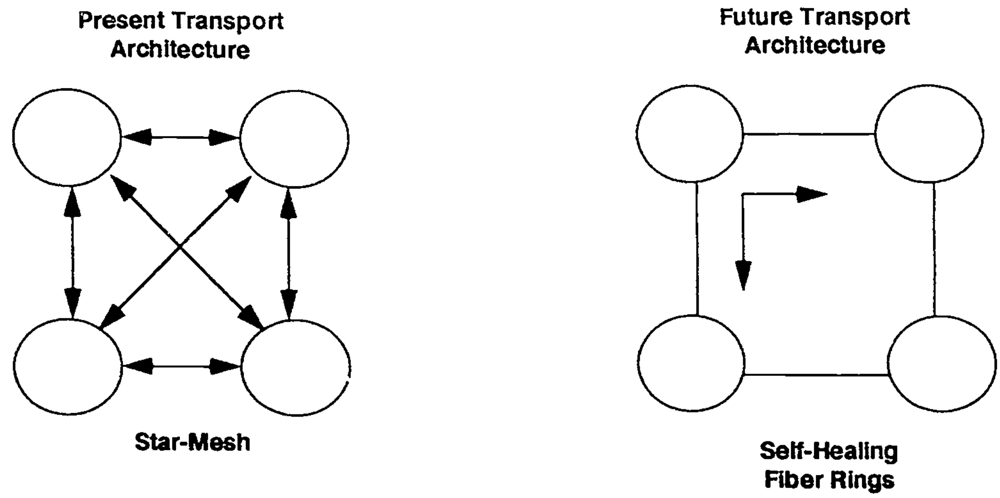

Fig. 1.Transport Architecture

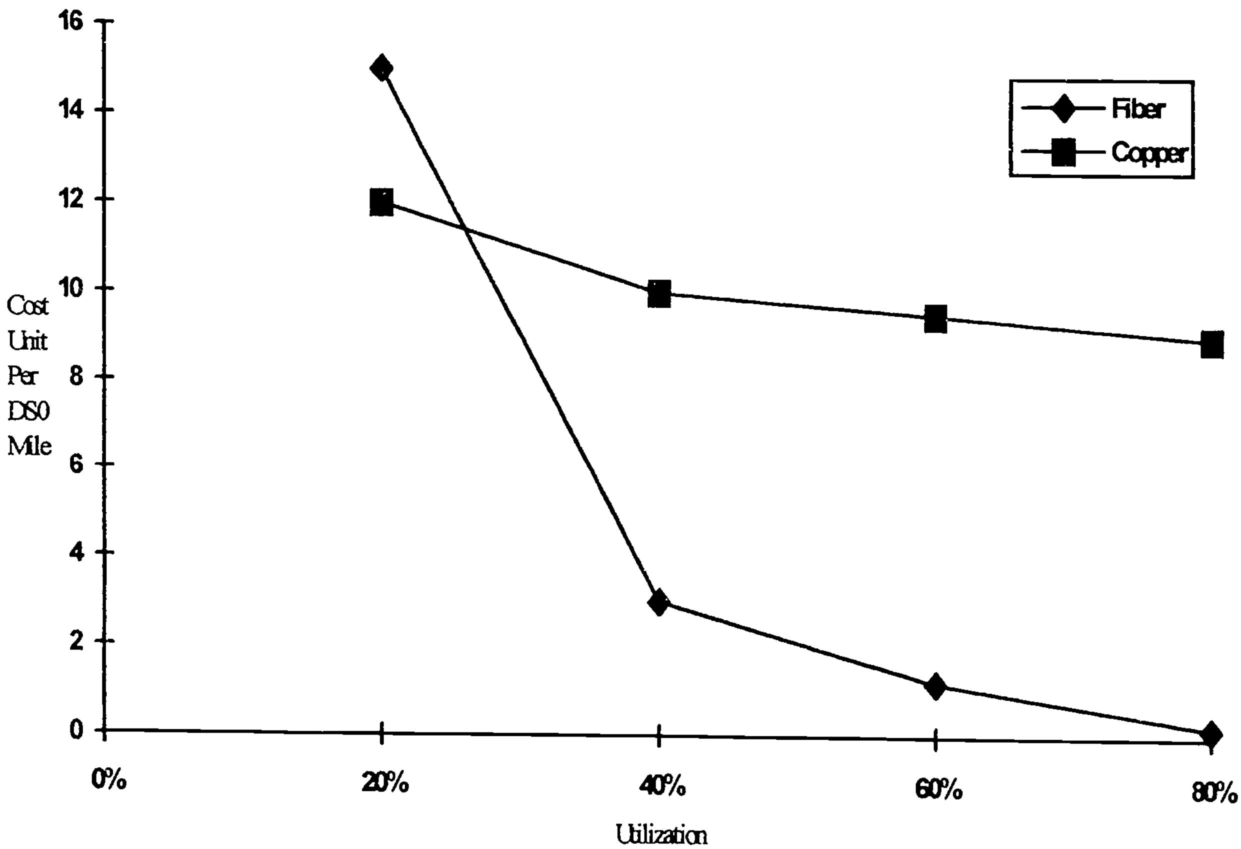

Fig. 2. Economic Trends - Fiber vs. Copper

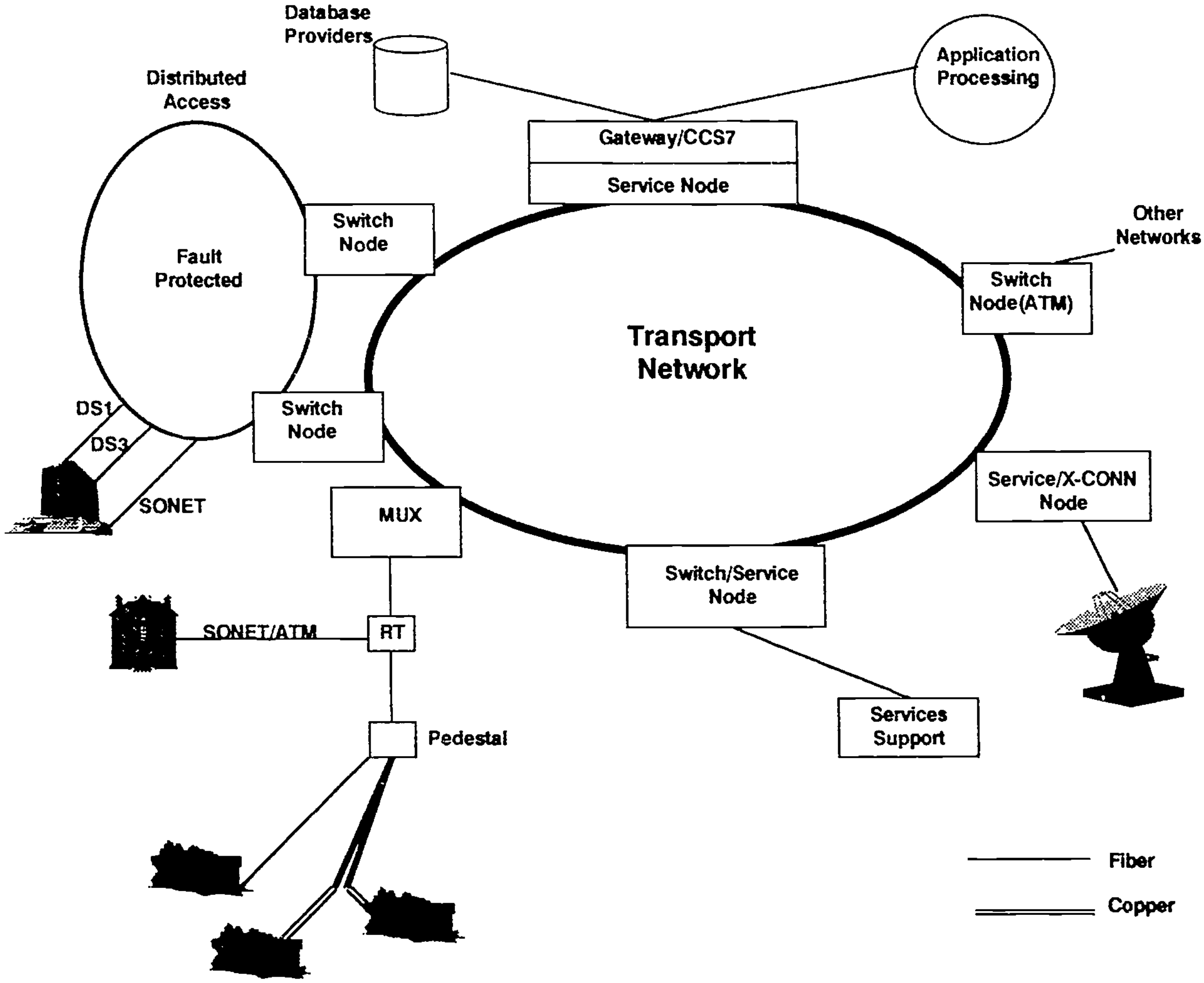

Fig. 3. Digital City Network Architecture

- Aggregate like traffic
- Smart Fiber Nodes
- Fast Provisioning
- Flexible Routing
- Evolvable

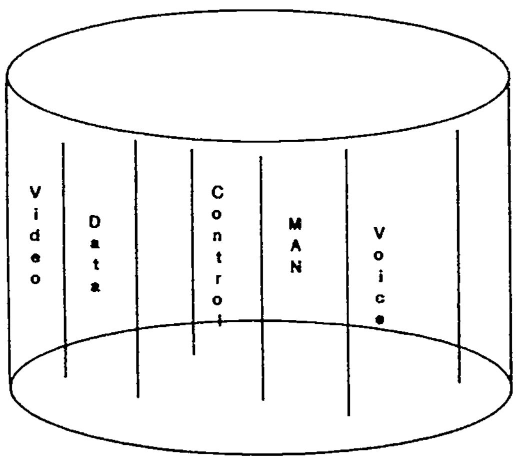

Fig. 4. Focused Bandwidth

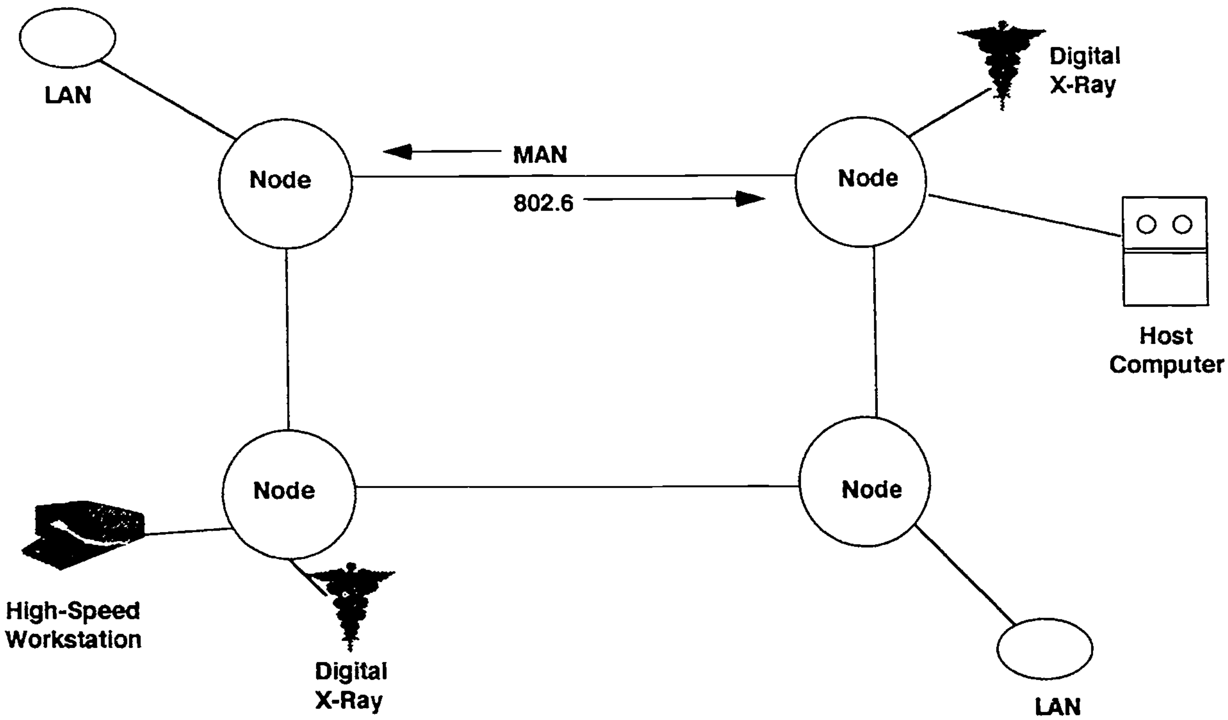

Fig. 5. Broadband Capability

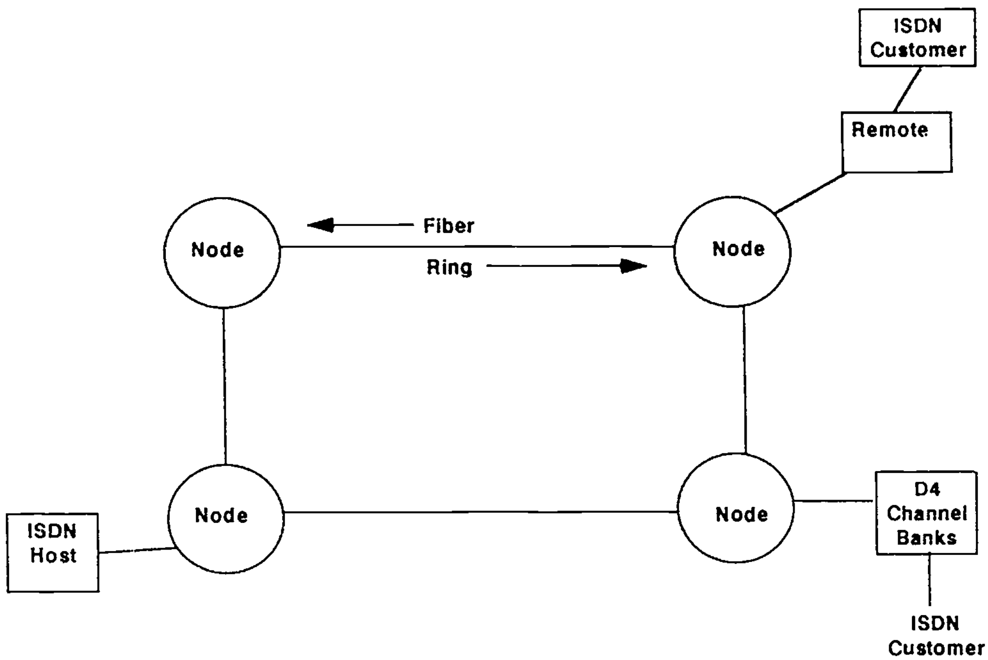

Fig. 6. ISDN Functionality

BROADBAND DELIVERY ACROSS THE LAST MILE

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ABSTRACT

This paper teaches the technique of transparently piggy-backing high-speed data over television signals for the purpose of cost-effectively overcoming the stifling broadband-access problem in the local loop (which is often referred to as the last mile of telecommunications, where this problem is naggingly critical), and the high cost of long-distance broadband transmissions, especially when operating in a bursty fashion.

An Innovative Multiplexing Technology for Television Signals

WavePhore, Inc., developed a cost-effective technique for transparently piggy backing high-speed data on television signals. This technique was named Data-Over-Video multiplexing. It is functionally similar to the conventional technique of transmitting data (e.g. TeleTex) during the vertical blanking-interval of television signals (VBI), except that it does such piggy-backing at high speed and without involving this interval or any other functionally significant part of this signal (Figure #1).

It accomplishes this piggy-backing by inserting data at baseband, while avoiding the VBI as well as the front and back porches of television signals. Thereby, it relies on technical principles developed by the telecommunications-industry over the years for the purpose of ensuring the efficient use of transmission capacities. Detail can be witnessed and discussed at WavePhore's headquarters in Arizona.

But unlike conventional transmission systems, this data is encoded by a proprietary (as well as patented) technique that makes the encoded data invisible to commercial television sets.

Transmission Options for Telecommunications

Today, telephone circuits reach virtually everyone in the industrialized world. These circuits[1] were originally designed to selectively interconnect any two telephone-subscribers by channels with a capacity of 3 kHz in spectral bandwidth, suitable for the transmission of electronic facsimiles of acoustical speech signals. Circuit-switching is the selection mechanism by which these channels can be physically interconnected on demand at switching-nodes (called switching-centers) for the duration of the connection.

Most contemporary telephone circuits are implemented from pairs of twisted copper wires, especially in the local loop which connects the subscribers with switching centers. Over short distances, these pairs are capable of supporting data rates into the MBit/sec range, using modern modulation and encoding techniques which are embodied in modems[2]. Bandwidth-restrictions are often spliced into these pairs. This is done mostly in rural areas for the purpose of improving transmission quality and reducing cost[3] But these non-contiguous pairs of wires can no longer support those higher data rates.

Exploiting the high bit-rate capability of pure copper pairs of wires, telephone circuits are being electronically enhanced to offer what is known as Integrated Services Digital Network (ISDN) service. This service provides a pair of 64 kBit/sec bearer-channels, plus an 8 kBit/sec data channel, amounting to a composite bi-directional throughput of 136 kBit/sec. It is accomplished by installing suitable modulation/multiplexing/encoding devices at both ends of each wire-pair interconnecting subscribers and switching centers.

Packet-switching is a different switching-mechanism. Here, messages (usually data[4]) are routed at switching nodes according to their destination-labels. This is akin to the postal service handling mechanical packages. It gave rise to value-added data-networks (VANs) transporting electronic packages. Today, such VANs are serving hundreds of sites and users across the nation by way of conventional telephone circuits. These VANs are eminently suitable for requesting information, authoring documents, and entering edit data from remote sites. But because of their reliance on telephone circuits which limit the data-rate to typically 2400 Bit/sec, they are quite inadequate for returning full pages of information, such as modern multi-media objects[5].

Only major facilities (e.g. universities and libraries) and high-density communication centers (e.g. cities) are interconnected by broadband circuits. These circuits may have a spectral width in the hundreds of MHz in order to equip them with the capacity necessary for transporting the expecting telecommunications traffic in various forms of multiplexing[6]. Such a capacity usually makes those centers hubs of broadband telecommunication. And their broadband capability allows them to operate telematic libraries as well as to become brokers for information they obtain from elsewhere.

But in the local loop, the only viable pervasive high-speed transmission-options are the television networks (i.e. over-the-air broadcasting, cable-television, as well as satellite circuits) which are intrinsically broad band and have achieved a level of pervasiveness comparable to that of the telephone. Some networks provide 6 MHz television channels (e.g. those used by over-the-air-broadcasting stations), others carry channels of hundreds of MHz in spectral width (e.g., cable-television). Importantly, these networks exist today even where the much slower ISDN services are not yet available. All other options of the local loop are not pervasive since they consist mainly of customized point-to-point circuits (such as micro-wave links) which are usually unduly expensive and costly to maintain.

How to Switch: By Broadcasting Labeled Messages

Virtually all existing television networks are of the broadcasting type. After all, these networks were originally designed to uniformly supply all subscribers with the same television signals.

But broadcasting media are also the fundamental mechanism for selectively interconnecting subscribers who are connected to these media (known as switching). This is accomplished by labeling each message injected into these media, where each label designates the intended destination, in combination with using receivers that filter out only the messages addressed to them.

Accordingly, broadcasting networks can intrinsically satisfy all types of interconnection requirements, from the point-to-point requirement of basic telephony to the point-to-multipoint requirement of broadcasting.

Application of WavePhore's Multiplexing Device for High-Speed Transmission Over Broadband Television-Networks

Most television-networks have transmission-capacities that lay idle. These idling capacities are usually only portions of television-channels (e.g. in the time-domain during the blanking interval, or in the frequency domain), rarely whole channels since these channels are becoming increasingly scarce. WavePhore's proprietary data-over-video technology cost-effectively harnesses idling portions of the frequency domain. And it does this in a uniquely broadband fashion, thereby providing a high-speed data-channel transparently on top of television signals with an area-coverage equal to that of these signals.

Today, data rates of about 400 kBit/sec have been realized. This is nearly three times the composite data-rate of ISDN. But it is available today, even where ISDN is not. And it offers the promise of achieving data rates of about 1.5 MBit/sec (i.e. T1) in the near future, which ISDN does not.

For sure, investments in broadband local loops will arrive with the installation of ubiquitous optical fibers and the provision of B-ISDN (broadband ISDN service). But this will take at least another decade and when it occurs, it will not instantly obsolete existing facilities because of the massive installed base of equipment depending on them. This ensures that applications of existing facilities will have a useful life way into the next century. And it provides an attractive (i.e., cost-effective) window of opportunity for the data-over-video technology.

Illustrative Applications of This Multiplexing Technology

We have been pursuing several applications of the WavePhore Data-Over-Video technology where opportunities for significant improvements through the pervasive high-speed delivery of data were identified. One of these opportunities is targeted at enhancing the educational process by delivering library-material in user-friendly facsimile form to wherever it is needed, and by adding the personal touch (of small classes) to lectures with mass audiences (e.g. televised lectures). This project is a joint venture between WavePhore, inc., of Tempe, Arizona, and the Arizona Department of Education. It was submitted to the National Science Foundation (NSF) for US government support. The other opportunity is aimed at the health-care field where high-speed delivery of imaging data can be critical to saving lives.

An Initial Application: Step Toward the Telematic Library

Liberating Stand-Alone Applications.

Most computer applications have their origins in stand-alone installations which operate in isolation from the outside world. Telematic libraries have not yet graduated from this stand-alone phase of development. With the emergence of high-performance multi-media applications, the need has intensified to provide access to these installations from remote sites, liberating them from their spatial confinement.

This need is fueled by the hard reality that computer-assisted activities are becoming an essential part of modern everyday life. They rely on the use of information contained in emerging telematic libraries, whose information is electronically combined to create composite products of enhanced sophistication. But as of yet, these libraries go largely untapped by remote means. A major reason therefore is the lack of telecommunication facilities by which bursts of high-speed data can be cost-effectively shipped into every corner of cities and out to remote areas.

User-friendly multi-media displays depend on broadband communication.

The man-machine interfaces of computer installation have become much friendlier since the early days of data processing. And people are beginning to expect this friendliness from all telematic systems. But it can be offered at remote sites only with difficulty because telecommunication services continue to lag needs[7]. This is one of the dominant reasons for the isolation of those installations.

The user-friendliness has two main components. One of them are foolproof "windows"[8] within which computer-responses to keyboard entries are embedded. On the frames of these windows, menus of available operators as well as functions are meaningfully listed by graphic symbols known as icons, by descriptors such and mnemonics, or by names. These interfaces are significant components involved with the telematic man-machine interactions which are growing in importance as computers unwittingly shape our lives.

The other component is the embellishment of responses to reflect the impact of computer-entries. This usually produces large amounts of response-data to even the simplest of entries from the keyboard. For example, the entry may be an edit command during an authoring process, a query during an information-retrieval task, or a change of one variable during a spread-sheet what-if analysis. The response thereto may be the appearance of a whole page of text impacted by the edit-entry, pages of text retrieved, or a new forecast produced by the change of the variable.

But this user-friendliness has a significant price attached to it, namely the need for transferring reams of high-speed data. High-speed communication links between the man-machine interfaces (e.g. display terminals) and the host computers are required to effect these transfers. While such links are present with stand-alone systems where most applications are developed, they are usually absent to remote sites because of the difficulty of installing them over distance. As a result, this user-friendliness is still largely confined to stand-alone systems, most notably personal computers as well as their higher performance cousins, the work stations.

Qualifying and Quantifying This Broadband Need.

Delivery of data in a user-friendly form depends on telecommunication infrastructures that are high-speed (i.e. broadband) from the source of information to the recipient of this information. But in the opposite direction, the data rate can be low-speed since it must mainly support inquiries as well as data from a keyboard.

Such asymmetrical man-machine interactions are an important subset of telematic functions. In turn, they involve a specialized subset of telecommunications which is clearly growing in importance. In this subset, recognizing the data-rate skewedness facilitates implementation of telematic systems.

In the direction toward user-friendly interfaces and from computers, the data-rate is determined by the large amount of data used for generating embellished windowed displays and the real-time need for responding to keyboard entries promptly. This calls for a data-rate capable of supporting effects of full-motion television, even through the average bandwidth requirement is much less than that, requiring data-rates in the MBit/sec range. This rarely attained peak-rate is necessary to accommodate such full-motion effects as flipping a page of information (i.e., switching between display scenes) in response to a keyboard input, or when showing a multi-media television episode. In fact, a data-rate comparable to that of real-time[9] High Definition Television (HDTV) is required if the user-friendly high-resolution responses are to occur in full real-time. Band-width-compression schemes that rely on removal of redundancies without compromise in user-friendliness can do little about this, making broadband circuits unavoidable under such uncompromising conditions. Only compression schemes that duplicate either effects by decomposing images into suitably chosen graphic primitives[10] or processes that produced the images[11] can reduce the amount of data needed to specify a display.

Backing off from the full real-time requirement is a frequently used compromise for reducing the bandwidth requirement. The best known application of this compromise is probably the facsimile machine which sends the picture-information slowly over an extended period of time. another are the full-motion compression devices which relax the data-rate requirement by statistical averaging. But his statistical processing delays each image to be displayed which can become quite annoying. Only extensive experimentation can reveal the acceptability of certain compromises which, in turn, can lead to new bandwidth-compression schemes. This makes the expeditious accessing of multi-media facilities from remote sites a matter of timely research and development.

In the opposite direction from those interfaces and to computers, the data rate can be low-speed since it must mainly support inquiries as well as data from a keyboard (such as requests for data or edit commands). The rates normally achieved on standard telephone lines (i.e. 1200/2400j/9600 Bit/sec) and other audio circuits are quite adequate for these purposes.

System Architecture.

In this application, a WavePhore multiplexing device is installed at the head-end of the local television distribution network covering each area to be accessed (Figure 2). No re-assignment of facilities is required since this device transparently piggy-backs data on television signals.

Each of those head-ends is then connected by a point-to-point broadband circuit to the nearest telematic source of multi-media information from whom information is ordered by way of a VAN network (such as InterNet). This source may be a telematic library (such as the comprehensive Library of Congress) which provides electronic facsimiles of documents as well as other mechanical carriers of information, usually on demand. It may include intermediary brokers (such as a local telematic library), which information they obtain from major libraries but save locally for quick access. By temporarily saving copies of information requested from within the region they serve, these local brokers can often supply regionally relevant information from their temporary smaller storage more expediently than distant information-sources can[12]. This advantage is accentuated by the fact that many requests are duplicates of previous ones because much of the information-needs are locally stimulated (e.g. by local news events, announcements, or class-assignments). Moreover, interconnected networks of such brokers relieves communication traffic, which relief contributes toward avoidance of disruptive traffic congestion.

In turn, each subscriber is equipped with a demultiplexing device by which he retrieves the requested data from television signals. This device may be directly connected to a personal computer. To serve many computer stations, it may be connected to a gateway of the subscriber's local-area network by which he also accesses the VAN used for ordering library material.

Fall-out From This Project

Among other benefits, this application will demonstrate that relevant broadband local distribution does not need to wait for technological breakthroughs nor massive investments in new infrastructures. Additionally, it will reveal how this technology can be used to best enhance accompanying television material[13] or to simply provide additional broadband information separately[14].

Another Promising Application: Medical Imaging

The clarity of images from CatScan equipment obviates the need to have CatScan images read by specialized radiologists. Elimination of this intermediary has made CatScan a quick-response diagnostic tool, provided the surgeon is on site where the images are displayed. This quick response may be critical for saving lives, such as in neuro-surgery.

This life-saving capability can be fully realized only if the medical images can be expeditiously received by the surgeons, wherever they may be at the time of the emergency. But to do this, a pervasive high-speed capability is needed for the delivery of these images, especially through the local loop where surgeons and hospitals are usually co-located.

In this application, a WavePhore multiplexing device is installed at the head-end of the local television distribution network covering the hospital-area to be accessed. The head-end is connected by a point-to-point broadband circuit to the hospital where the imaging equipment is located. In turn, a demultiplexing device is installed at each of the surgeons' offices by which they receive the images addressed to them[15]. To be most effective, these images are best electronically saved by these surgeons (e.g. by a commercial VCR) in order to provide them with the time needed for rendering reliable diagnosis.

CONCLUSION

Clearly, the Data-Over-Video multiplexing technique can cost-effectively overcome the stifling broadband-delivery problem of the local loop (which is often referred to as the last mile of telecommunications). It can also reduce the cost of long-distance broadband-delivery of data by harnessing existing resources that would otherwise lay idle.

We believe that many projects, responses to requests-for-proposals, as well as existing facilities could substantially benefit from this technique. Factoring this technology into these improvement-opportunities will undoubtedly stimulate innovations that may otherwise be deferred for lack of knowing of the availability of this technology.

1. These circuits were designed to have a spectral width of 3 kHz. Clearly, this width is two orders of magnitude less than the width carved out by the data-over-video multiplexing technique. But since this width is indicative of the transmission capacity of circuits, this reveals that this data-over-video technique has a transmission capacity that is two orders of magnitude larger than that of traditional telephone circuits.

2. Conventional modems support data-rates of 300, 1200, and 2400 Bit/sec over the switched telephone plant. Modems with equalizers that correct transmission distortions typically achieve 9600Bit/sec. Asymmetrical digital subscriber line (ADSL) modems achieve 1.5 MBit/sec, but only for short pairs of copper wires without bandwidth-restricting insertions.

3. Loading coils are inserted into these pairs for the purpose of improving their transmission-quality for speech-signals over greater distances. Frequency-band limiting multiplexors are inserted to reduce cost by subdividing broadband cables instead of stringing separate wires. These inserts seriously impede the data-rates achievable over those pairs of copper wires.

4. This data can be representative of samples of analog signals, such as speech or video. But according to the Nyquist sampling-theorem, these samples completely specify these analog signals, provided the rate of sampling exceeds twice the inverse of the cut-off frequency of these signals.

5. High-speed VANs have been experimentally demonstrated. Some of them use a priming-mechanism at each switching node during the call set-process for the purpose of expediting the forwarding process for each packet there. This priming set-up remains in effect for the duration of each connection, similar to circuit switching. Because of this similarity, this scheme is known as "virtual circuit-switching".

6. The multiplexing techniques used are usually of the frequency-division or time-division type.

7. Only the ubiquitous optical-fiber network can finally put an end this chase, at least for a while. Until then, data will continue to be frequently shipped in bulk by mechanical means, such as magnetic tapes, floppy disks, and compact optical disks.

8. Invented by Xerox Data Systems and commercially pioneered by Apple computers, Inc.

9. Commercial HDTV is a one-way television service with no real-time requirement. Furthermore, adjacent video-frames of HDTV differ only slightly most of the time (after all, adjacent frames usually have the same background). These two realities allow the application of averaging schemes that reduce bandwidth. This is not possible with user-friendly multi-media applications because they have a fierce real-time requirement and adjacent frames will be completely different most of the time!

10. One of these primitives are the so-called Fractionals. They rely on the fact that many of nature's appearances are random combinations of the same features in different sizes and with different orientations.

11. E.G., manipulations of graphic primitives, such as the movement of the chalk when writing on a blackboard.

11.

12. In this instance, these brokers act akin cache memories which have been successfully used in computers for speeding up their performance.

13. For example, to provide a capability for replaying lecture-segments and supplying explanations on demand.

14. For example, for the high-speed delivery of information requested by way of a value-added network (such as InterNet).

15. Such a filtering capability by addresses is essential to eliminate clutter of irrevelant data that would otherwise obscure essential images.

THE MARKETING CHALLENGES OF TELECOMMUNICATION SERVICES IN THAILAND

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ABSTRACT:
The rapid growth of the Thai economy indicates a great demand for telecommunication services. This paper presents an overview of past, present and current trends in the telecommunication service industry in Thailand.

1. INTRODUCTION

Thailand is located in South-east Asia, which has an area of 513,115 square kilometers and a population of approximately 56.6 million (Sept. 1991). The most important ethic minority are Chinese. Other minority groups include Malays, Kampucheans, non-Thai hill tribes and some Vietnamese. Thai is the national language and Buddhism is the national religion. Thailand is an agricultural country. However, with the advent of industrialization in the country,the export and tourism industries contribute to the main revenue of the country.

Thai average GDP growth rate during 1981-1987 was 6.1 percent but during the years 1988-1990 it was 13.2, 12.0 and 10.0 percent respectively (see Table 1).

TABLE 1 : THAILAND'S ECONOMICS PERFORMANCE

YEAR	% GDP GROWTH	FOREIGN TRADE VOLUME (bil.baht)	POPULATION (mil.per.)	OUTGOING OVERSEA TEL. CALL (mil.min.)
1986	4.9	477.4	52.7	19.4
1987	9.5	640.0	53.6	27.7
1988	13.2	899.3	54.5	42.4
1989	12.0	1.159.6	55.5	64.7
1990	10.0	1.421.1	56.3	89.9
1991	8.2	1,688.1	56.9	NA

NA : Not Available

The rapid economic growth has caused a shortage in infrastructure telecommunication service.

This paper describes the past and present status of telecommunication services in Thailand and also the Thailand s ability to fulfill the demand for telecommunications and it's progress to date.

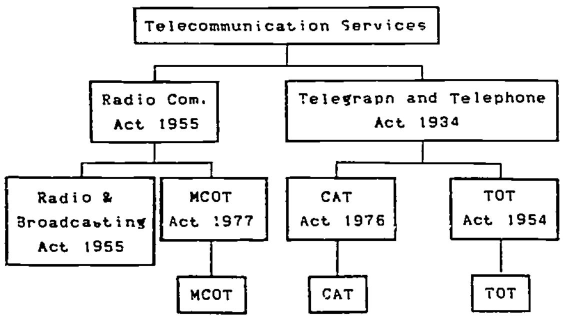
2. TELECOMMUNICATION SERVICE SCENARIOS

2.1 TELECOMMUNICATION SERVICE STATUTES

Telecommunication services in Thailand are governed by the statutes of the Radio Communication Act 1955 and the Telegraph and Telephone Act 1934. The Radio Communication Act 1955 has policies for radio communication services and the use of radio frequencies. This Radio Communication Act 1955 is also related to the Radio and Broadcasting Act 1955 and the Mass Communication Organization of Thailand Act 1977. The Mass Communication Organization of Thailand Act 1977 controls the Mass Communication Organization of Thailand (MCOT) which provides broadcasting services to the public in general.

The Telegraph and Telephone Act 1934 has policies concerning the telegraph and telephone services which are a government monopoly for the benefit of the general public. This Act is also related to the Telephone Organization of Thailand Act 1954, by which the Telephone Organization of Thailand (TOT) was established and the Communication Authority of Thailand Act 1976, by which the Communication Authority of Thailand (CAT) was established.

FIGURE 1 : COMMUNICATION STATUTE STATUS IN THAILAND



2.2 TELECOMMUNICATION PROVIDERS

At present, telecommunication services in Thailand are provided by two state enterprises - Telephone Organization of Thailand (TOT) and the Communication Authority of Thailand (CAT). These state enterprises are under the control of the Ministry of Transport and Communications. This Ministry also controls the Post and Telegraph Department (PTD) which is responsible for controlling and supervising radio frequency usage.

TOT services are mainly domestic telephone services, related services and also including long distance calls to neighbouring countries such as Malaysia, Loas and Myanmar. CAT services are postal services, international and some domestic telephone services. Hence these two organizations are in competition with each other in some areas of service such as mobile telephone and pager service. Table 2 and 3 present list of services provided by these two organizations.

TABLE 2 : THE TOT'S SERVICES

Telephone Services :
- Domestic Call Service
- Neighbouring Countries Call Service (Malaysia, Loas and Myanmar)
- Wide Area Call Service
- Public Coin Phone (Local & STD)
- Public Card Phone (Prepaid card)
- Public Train Phone (Coin Box)
- Rural Public Long Distance Call

Radio & Mobile Telephone Services :
- Multi-Access Radio Telephone
- Multi-Access Radio Mobile Telephone
- NMT 470 Cellular Mobile Telephone
- NMT 900 Cellular Mobile Telephone
- "Phone Link" Service (Pager Servic)
- "Page Phone" Service (Pager Service)
- "Fonepoint" Service (CT-2 Service)

Data & Lease Circuit Services :
- Trunk circuit and Inter-City Service (Lease Cercuit)
- DataNet Service
- ISBN Service (Voice, Data & Image Via Satellite)

Audio-Visual Service :
- Teleconference Service

Planned Services :
- ISDN Service
- Videotex Service
- Trunk Mobile Telephone Service
- Credit Card Public Phone Service
- Teleport Service

TABLE 3 : THE CAT'S SERVICES

International Telephone Services :
- International Subscriber Dialing Call (ISD)
- International Operator Assisted Call
  * Station Call
  * Personal Call
  * Collect Call
  * Credit-Card Call
- Toll Free Call Service
- Executive Telecard (CAT ETI)
- Public Credit Card Phone

Domestic Telephone Services :
- Radio Telephone Service
- Trunk Mobile Telephone Services
- Public Radio Communication Service
- HF Radio Telephone
- VHF Mobile Radio Telephone
- UHF Mobile Radio Telephone
- AMPS 800 A Cellular Mobile Radio Telephone
- AMPS 800 B Cellular Mobile Radio Telephone
- Private Radio Communication
- Video Signal Conversion Service
- Telecommunication Mobile Unit
- Maritime Mobile Radio Service
- "Pack Link" Service (Radio Pager)
- "Easy Call" Service (Radio Pager)

Data & Lease Circuit Services :
- Domestic & International Lease Circuit
  * Telegraph-Grade Leased Circuit
  * Press Bulletin Service
  * Voice-Grade Leased Circuit
- International DATEL Service
- International Database Access and Remote Computing Service (IDAR)
- Super Telex (Domestic & International)

Telex Services :

- Domestic Telex
- International Telex
    * Marine Mobile Service
    * Private Telex
    * Public Telex

Telegraph Services :

Phototelegraph Services :
- Domestic & International Service
- International Broadcast Service

Document Facsimile Services :
- Bureaufax (Domestic & International)
- International Telefax

Other Services :
- International Program Transmission Service
- International TV Transmission
- ITU Cards Communication Service
- Monetary Service

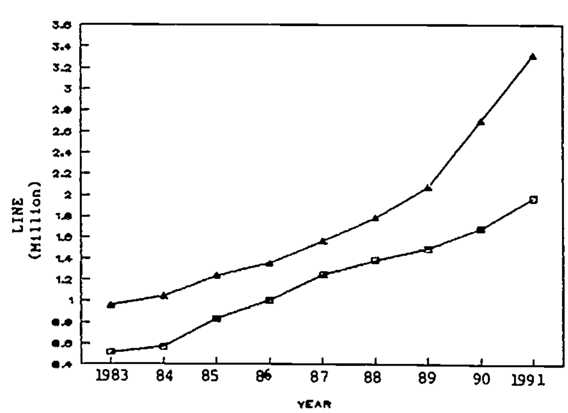
Planned Services :
- International ISDN Service
- Teleport

2.3 TELEPHONE SERVICES

2.3.1 BASIC TELEPHONE SERVICE

TOT is responsible for providing basic domestic telephone service. Despite rapid economic growth, government policy regulates budget stringently, TOT cannot cope with the rising demand from the public. In 1991, the waiting list numbers up to more than 1.3 million customers. Figure 2 shows the development of basic telephone service compared with the demand in the past.

FIGURE 2 : DEVELOPMENT OF BASIC TELEPHONE



At the end of 1991, Thailand had 1.9 million telephone lines. The penetration rate of 2.74 line per 100 population is extremely low.

TOT plans to increase the penetration to 10 lines per 100 population in 1996 according to the Seventh National Economic and Social Development Plan 1992-1996 (7 th NESDP 1992-1996). At present, TOT along with two private companies, namely Telecomasia Co.,Ltd. and Thai Telephone and Telecommunication Co.,Ltd. plan to install two and one million telephone line projects in the Bangkok Metropolitan Area and the provinces. Those two projects, together with TOT's own projects, will be completed in 1996. There will be about six million lines throughout the country. These lines will serve the demand and respond to the 7 th NESDP 1992-1996 successfully. The following table shows TOT s demand forecast till the year 1997.

TABLE 4 : TELEPHONE DEMAND FORECAST

YEAR	DEMAND FORECAST (mil.line)	POPULATION (mil.per.)	D/N
1992	3.16	57.99	5.46
1993	3.76	58.81	6.41
1994	4.47	59.62	7.50
1995	5.24	60.43	8.67
1996	6.11	61.24	9.99
1997	7.08	62.02	11.43

D/N : Penetration per 100 population

THE TWO - MILLION - PHONE - LINE PROJECT

On August 2,1991, TOT granted a 25-year concession to Telecomasia Co.,Ltd. to install and operate the network in Bangkok Metropolitan Area with exclusive rights for the first five years. This project will invest about 80 billion baht. Telecomasia Co.,Ltd. can provide the first lot of telephone lines in October 1992 and the rest will be finished by the year 1996.

THE ONE - MILLION - PHONE - LINE PROJECT

On July 2,1992, TOT also granted a 25-year concession to Thai Telephone and Telecommunication Co.,Ltd. to install and operate a network in provincial areas with the same exclusivity rights as Telecomasia Co.,Ltd. The total investment of the project is estimated to be about 40 billion baht. The company will complete the installation in the year 1996 with the first lot of 220,000 lines in early 1994.

TOT'S OWN PROJECT

To achieve the target by the year 1996, TOT will do a special project to install 300,000 telephone lines throughout the country. This project will start in 1994 and be completed by 1996.

When all of these projects are completed, TOT will have around six million telephone lines throughout the country, a penatration of approximately 10 lines per 100 population.

2.3.2 PUBLIC PHONES

2.3.2.1 COIN PHONES

TOT provides public coin telephones on a twenty-four hour service accommodating the public at all levels. The most up-to-date model introduced is a multi-size coin public telephone which can accept four kinds of coins- the small, medium sized one baht and the new five baht as well as ten baht coins. These public phones can communicate within the immediate locality and long distance within Thaiand and to Malaysia. There are 27,266 public coin telephones now in service.

2.3.2.2 CARD PHONE

TOT has granted a ten years concession to a private company, Advanced Information Systems Co.,Ltd., to provide pre-paid card phones to the public. It launched the service on May 4,1991. There are 948 installed sets in service throughout the country and there will be 11,500 sets by the year 2000 according to the contract.

2.3.2.3 CREDIT CARD PHONE

The credit card phone is an international public call via International Subscriber Dialling (ISD) system. Users can use VISA, MASTER, JCB or DINERS card. This service is provided by CAT. There are 10 sets in service and there should be 40 sets throughout the country by the end of 1992.

2.3.3 ISDN SERVICE

Thailand plans to launch the ISDN (Integrated Service Digital Network) service on a commercial trial around the second quarter of 1993. One thousand five hundred Basic Access Interface (BAI) and 100 Primary Rate Interface (PRI) will be deployed on an overlay basis in the metropolitan area and some major cities.

2.4 WIDE AREA TELEPHONE SERVICE

Wide Area Telephone Service both for domestic and international calls has been in service since 1990. At present, the service can be subscribed to only in the Bangkok Motopolitan Area and the ten major cities. There are about 100 customers in the network-about 80 in the Bangkok Metropolitan Area and the rest scattered in ten major cities.

2.5 CELLULAR MOBILE TELEPHONE SERVICE

The mobile phone has been very popular since its launch in 1986. It is not only handy and comfortable while travelling but also for situation where telephone services are not being provided. TOT and CAT are the two organizations which provide this service.

On July 8,1986 TOT introduced the first Nordic Mobile Telephone System with 470 MHz.(NMT 470) nationwide and also on February 25,1987, CAT introduced Advanced Mobile Telephone System with 800 MHz. (AMPS 800A) predominantly in the city area. At present subscriber number is around 50,000 and 45,000 respectively.

In September 1989, TOT granted a concession to Advanced Info Service Co.,Ltd. (ADVANC) to introduce Nordic Mobile Telephone 900 MHz. (NMT900) service. There are now around 80,000 subscribers. This system will be developed into a Grobal System Mobile Phone (GSM) in early 1994.

In November 1991, Total Access Communications Co.,Ltd. (TAC) with a concession granted by CAT, launched another services names "World Phone" system (AMPS 800B). There are now around 55,000 subscribers. This system will be also developed into a digital system in 1994.

At present, the total number of subscribers is around 230,000 and is expected to reach 275,000 by the end of 1992. The table below shows the market share of each system.

TABLE 5 : CELLULAR MOBILE TELEPHONE SERVICES

SYSTEM	OPERATOR	INAUGURATION	SUBSCRIBER
NMT 470	TOT	Jul.1986	50,000
AMPS 800A	CAT	Feb 1987	45,000
NMT 900	Advanced Info Service Co.,Ltd. (20yr.concession :TOT)	Sep 1989	80,000
AMPS 800B	Total Access Communication Co.,Ltd. (15yr.concession :CAT)	Nov 1991	55,000

2.6 PAGER SERVICE

The one-way incomming telecommunication service or pager is one of the most popular services in Thailand now. "Paclink",the first digital pager service was brought in by Pacific Telesis Engineering Co.,Ltd. in 1986 under a concession granted by CAT.

In June 12,1990 and December 21,1990, TOT permitted two other providers, Shinnawatra Paging Co.,Ltd. and Hutchison Telecommunications (Thailand) Co.,Ltd. granted concessions to provide services under the brand names of "Phonelink" and "Pagephone" respectively.

In June 1992, Matrix Telecommunication (Thailand) Co.,Ltd. with a concession from CAT,launched a service, named "Easy Call". At present, TOT is considering granting a concession to another private company to operate other systems in the near future.

The total number of pager subscribers currently is about 200,000 and is expected to reach 350,000 by the end of 1992.

Value-added services such as voice mail box and financial news are avaiable from these services. In the future some operators may cooperate with operators in other countries so that the services can communicate not only in Thailand but also from foreign countries.

2.7 TELE - POINT (CT - 2) SERVICE

The one-way outgoing telecommunication service (Tele-Point or CT-2) called "Fone Point" in Thailand was also granted a concession by TOT to Fone Point (Thailand) co.,Ltd. launched its service in August 15,1991. The service is only for Bangkok Metropolitan Area. After one year, the number of subscribers is 3,246 and expected to reach 15,000 by the end of 1994. Now 1,640 radio base stations for transmitting signals are in operation. These will be expanded to about 4,000 by the end of 1992 to improve service.

2.8 DATA COMMUNICATION SERVICES

Data communication services are provided by CAT,TOT,and private sector operators granted concessions from government agencies. Some of these networks serve not only voice and data transmissions but also images such as Integrated Satellite Business Network (ISBN) and Integrated Serviced Digital Network (ISDN).

The providers of data communication services are summarized in the following table.

TABLE 6 : DATA COMMUNICATION SERVICES

SYSTEM	OPERATOR	INAUGURATION	SIGNAL
DataNet	Shinnawatra Datacom (10yr.concession :TOT)	1990	Data
ISBN	Acumen (15yr.concession :TOT)	1991	Voice Data Image
ISDN	TOT,CAT	1993 P	Voice Data Image
Samart Link Samart Net	Samart Telecoms (15yr.concession :PTD)	1990	Data
SatLink Datasat Datacast	Compunet (15yr.concession :PTD)	1990	Data
Thaipak	CAT	1989	Data

P : Planned

2.9 AUDIO - VISUAL COMMUNICATION SERVICE

At present, an audio-visual conference service is provided by TOT. In the near future, TOT will also introduce other new services such as videotext and audiotext.

2.10 TRUNK MOBILE SERVICE

Now this service is provided by CAT. TOT will launch this service at the beginning of 1993.

3. TELEPORT

It is very essential that both domestic and international telecommunication services demand be met in order to cope with the economic growth of Lam Chabang and Map Ta Phut Industrial Estate area in the Eastern Seaboard of Thailand. The teleport project was set up by the Government to manage the high speed telecommunication demand in that area. TOT and CAT are joint by responsible. CAT will install an International Transit Switching Center (ITSC 3), with a capacity of 3,000 circuits and TOT will install two ISDN Public Switching Exchanges at Lam Chabang and Map Ta Phut. Each has a capacity of 5,000 ordinary telephone lines and 1,500 BAI and 100 PRI ISDN line. These service will be introduced to users in mid 1993.

4. LONG DISTANCE TRANSMISSION PROJECTS

Several long distance transmission projects are being developed by both CAT and TOT. For example, along major railways and underwater fiber optic systems. These systems are being developed as a disaster backup system and to integrate the local telecommunication networks scattered around the country. These projects are summarized in the table below.

TABLE 7 : LONG DISTANCE TRANSMISSION PROJECTS

SYSTEM	CAPACITIES (circuits)	OPERATORS	YEAR OF AVAILABLE	LENGTH(km) /ROUTES
DOMESTIC				
Submarine Fiber Obtic	8.000	Jusmine Submarine Telecommunication (20yr.concession :TOT)	1994 P	1.200/ Rayong - Southern part of Thailand
Railway Fiber Obtic	36.000	Com-link (20yr.concession :TOT)	1992	3.000/ Along major railway
Satellite Network	1.5 Transponder	Acumen (15yr.concession :TOT)	1992	-
INTERNATIONAL				
Submarine Fiber Obtic	7.560	CAT	1995 P	Thailand - Malaysia - Singapore
Submarine Fiber Obtic (APCN)	NA	CAT	NA	Thailand - Malaysia - Singapore- Indonesia- Hongkong - Philipine- Taiwan - Japan - Guam
ITSC 2-3	6.000	CAT	1993 P	-

APCN : Asia Pacific Cable Network
ITSC : International Transit Switching Center
P : Planned
NA : Not Available

5. THAICOM SATELLITE PROJECT

The first satellite project to be launched by the Thai government is named "Thaicom". The government has granted a concession to Shinnawatra Satellite Co.,Ltd. to operate the service for 30 years with exclusivity for the first eight years.

This project is devided into two parts. In phase one, two satellites will be launched- one in October 1993, and the second one, a backup, will be launched within the following year. Around 2008, two more satellites will be launched in phase two. Each satellite is equiped with 12 transponders that can fully serve the demand.

Thaicom cannot only utilize long distance service-voice, data and image, but also can provide very wide area broadcasting which is very economical and efficient.

6. THE FUTURE

Base on past experience, the Government can not respond to private sector demands for telecommunication services. The working processes of various government agencies are to be considered and the Government has set up a policy to improve working efficiency. Sections of the policy are described below:

6.1 The Government is studying ways to divide the Ministry of Transport and Communications into two Ministries, the Ministry of Transport and the Ministry of Communication and Aviation to make working procedures and other conditions more flexible. The Ministry of Transport will supervise and control the State Railway of Thailand, the Highways Department, the Land Transport Department, the Harbour Department and the Port Authority of Thailand. The Ministry of Communication and Aviation will supervise and control CAT, TOT, the Thai Airways International, the Civil Aviation Department, the Airport Authority of Thailand and the Meteorogical Department.

6.2 A policy to transform State Enterprises is being introduced. TOT is in the process of selecting a private consultant conduct a study. The TOT Act will be amended in order to enable privatization to be completed under the Eighth National Economic and Social Development Plan 1997-2001.

6.3 To be more flexible, Bureau of Telephone Services Co-project has been set up by TOT. It is a one stop service to control and coordinate with Telecomasia Co.,Ltd. and Thai Telephone and Telecommunication Co., Ltd..

Moreover, Bureau of Private Sector Coordination was established to control and coordinate with concession companies for example,Paging Service, Cellular Mobile Phone Service and ISBN service.

6.4 TOT is studying a plan to set up its own factory to produce telecommunications equipment to cope up with expansion project. In this project, TOT will buy licences or technology from telecommunication manufacturers to produce its own gear. The factory will produce the telecommunications equipment to serve TOT's Eight Development Plan under which the number of telephone connections will reach 12 million lines in the year 2001.

7. CONCLUSION

With the trend of changing telecommunications policy towards liberalization, the telecommunication service industry in Thailand will continue to move toward private sector involvement which will lead to more efficient operation. More investors will be attracted to participate in this telecommunication service industry. With this trend in mind, liberalization of the Thai telecommunications service industry would significantly benefit the nation as a whole. The more advanced technologies will be utilized to develope a major Thai telecommunication industry. Hence, consumers and bu.iness communities as well as Thai society will gain from this improvement.

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Maximizing Revenue for Inmarsat Signatories

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Abstract

Inmarsat Signatory participation in the Coast Earth Station business has been moderate at best. Less than one third of the 67 Signatories to this mobile satellite consortium have Land Earth Stations (LES). The new digital standards now being introduced offer new opportunities to all Signatories. This paper explores the possible reasons for the low participation and proposes a novel approach to alleviate the problems identified. The technological and commercial implications of the authors' concepts are discussed, in the context of revenue maximization for Inmarsat LES owners. A new, low-cost LES design will be explored along with Mobile Earth Station (MES) features that would help maximize revenue for each owner. A possible operational scenario covering technical issues is presented.

Introduction

Inmarsat, the International Maritime Satellite Organization, operates a global satellite system for mobile communications in the L-Band frequency spectrum (1.5 - 1.6 GHz). Headquartered in London, Inmarsat has 67 member countries. The government of each country is a "Party" to the convention which established Inmarsat, and each Party nominates a "Signatory" to represent its commercial interests in the Organization. Originally formed to provide services to maritime users, Inmarsat's charter was expanded to provide aeronautical and land mobile services by 1989.

The Inmarsat mobile satellite services are provided using four regional Inmarsat owned satellites, seven in-orbit spare satellites and Signatory owned Land Earth Stations (LES). The LESs are interconnected to the public providing global connectivity. User terminals place calls to the Land Stations that are terminated into the terrestrial wire-line or mobile networks.

A hallmark feature of the Inmarsat system is its "pay-as-you-go" philosophy. Users pay a per-minute charge for telephone and on-line data calls and a per-byte charge on store-and-forward data messages. This operational philosophy has great advantages for many users and as of this writing more than 25,000 mobile earth stations (MES) are in service worldwide.

A drawback to the Inmarsat system has been the level of participation by the Signatories. As mentioned above, 67 members have invested in the ownership of Inmarsat. The real participants, however, are the 22 Signatories who own Land Earth Stations. Compare this with the INTELSAT system, which has 19 satellites, 124 Signatories, 180 countries with Gateway Earth Stations, and Domestic satellite service to 40 countries. This contrast underlies several structural issues which are mainly technological in nature and therefore a manufacturer's challenge to solve.

Structural Issues

Inmarsat's basic structure allows for any and all Signatories (and non-Signatories) to invest in Land Earth Stations and to provide mobile satellite services to any mobile user. Unlike INTELSAT where each Signatory puts up a half-circuit and thus both share in the user revenue, the Inmarsat architecture tacitly encourages competition among Signatories for user minutes. The downside that may not have been envisioned by the founders is that small Signatories have not been able to easily capture the revenue originating from the mobile users in their countries. This has been due to several factors:

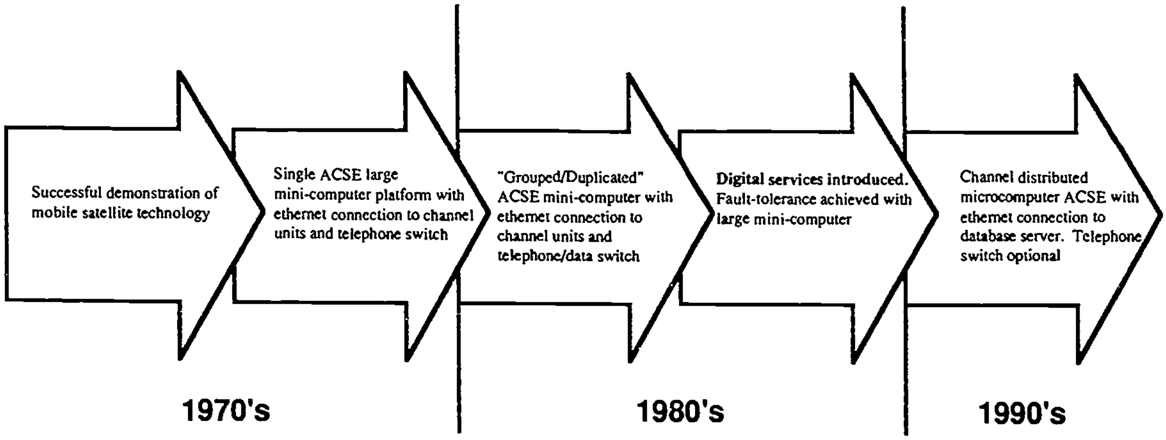
- the mobile nature of the terminals.
- the relative ease by which local PTT bypass is achieved by a user.
- the high cost of the Inmarsat Coast Station.
- the belief that the grade and the cost of service would be better through the larger Signatory earth stations.
- the inability of smaller Signatories to effectively market mobile communications services globally.

As marketing deficiencies are not normally technological in nature, no discussion is presented here. Marketing must, however, be considered as an essential ingredient in Inmarsat service.

Another significant reason for lack of participation is that non-seagoing nations haven't seen Inmarsat service as a necessary development priority and even though the changes of the mid-to-late 1980's gave hope, the needed low-cost telephony services were just not available until the advent of Inmarsat-M. This low bit-rate, fully digital telephony terminal sends and receives voice at 6.4 Kbps, fax and data at 2.4 Kbps, and utilizes very small (40cm) directional phased-array antennas. The economics of the "M" mobile earth terminal is such that the cost per-minute and the price of the hardware is approximately half of that previously available. Maritime, land mobile and semi-fixed versions of the Inmarsat-M are products which are to be introduced in the very near future.

Scientific Atlanta

Since Commercial Mobile Satellite Services were Introduced, we have been Through Three Generations of Technology



NSP 175

Mobile Satellite Systems
Network Systems Group

A novel, third-generation LES architecture has been developed at Scientific-Atlanta which may aid developing nations in the provision of domestic and international mobile satellite services. The concept consists of two fundamentals:

LES Technology and Integrated Network Design.

Technology

Technology in the Inmarsat-M network plays the key role in revenue enhancement. The major area of new development centers around cost optimizing the Inmarsat-M LES.

The technology available today must be enviable to Inmarsat network designers in the late 1970's. Secure microprocessors, Digital Signal Processing ICs, and other low-cost electronic components have enabled mobile satellite terminals to produce millions of instructions per second. In the early design of the LES, large redundant minicomputers working with a tandem telephone switch were required to handle the call and frequency assignments. Today, that entire process can take place on a single-chip microcomputer. This advance has led to the design of an LES that ultimately will be available at less than half the cost of current designs. What allows the LES to be so cost-effective is a wholly distributed architecture. The accompanying tables give an overview of the major developments in Inmarsat LES design and where benefits are accrued with the wholly distributed architecture.

The Scientific-Atlanta Inmarsat M/B land station design is based upon intelligent channel units with operations that resemble mobile earth stations. Each channel handles its own call setup and interconnection to the terrestrial network. Minimal centralized control functions eliminate overloading problems and increase system reliability.

To reduce operational expenses, the proposed land earth station can be configured such that one common database (RDBS) can be accessed by several LES stations, providing centralized billing, operator services and commissioning. Although this architecture is not yet used in the M network, Inmarsat uses it in the Aeronautical service. Great expense can be saved by eliminating the database servers in an LES. The database server functions cannot use off-the-shelf database packages like Oracle or Ingress and must be custom for Inmarsat service. With the Access Control and Signalling Equipment (ACSE) on a chip and no mandatory tandem telephone switch, the LES now consists entirely of channel and signalling units. With this design approach, all Signatories can afford an LES. Later we will discuss a possible operational scenario with this architecture.

Integrated Network Design

The Inmarsat-M network can be significantly enhanced beyond its baseline design by each LES owner in the following areas:

- Signatory Participation
- Signatory Bypass Control
- Greater Revenue Sharing.

Signatory Participation

Signatory participation begins with a low-cost, affordable LES. The fully distributed ACSE design allows the Signatory to purchase only the ACSE needed to support the number of installed channels. This straightforward approach is a significant departure from previous Inmarsat LES designs. The channel cost had previously been minimized to facilitate later expansion. Now a trade-off can be made that optimizes channel unit cost for 50 channels or less that allows small Signatories to achieve a similar per-channel fixed cost basis with a much smaller LES.

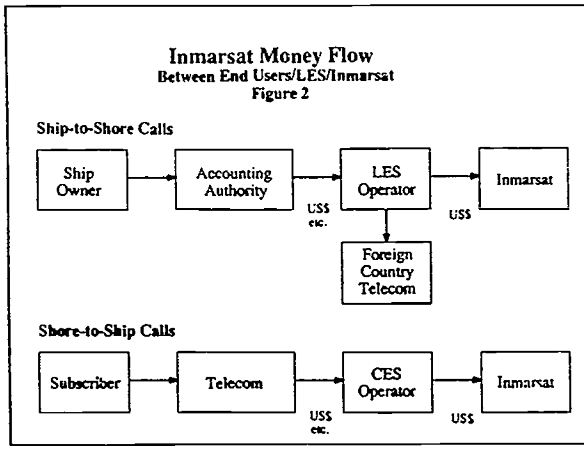
A major advance in the Scientific-Atlanta LES design has eliminated the need for a telephone switch to be supplied with the LES. Previously, much of the call setup process was done in a custom software version of a commercially available telephone switch, leading to unnecessary expense. A custom version tandem telephone switch is extremely difficult to maintain from a software standpoint. Additionally, as the switch manufacturer upgrades his software, new revisions must be purchased to take advantage of the new features and services. This is especially true with the coming changes in CCITT signalling; SS7 is still undefined and as the switch manufacturers finalize their interfaces, some LESs may incur major software redesigns to accommodate SS7 changes.

Bypass Control

The heart of Signatory Bypass Control lies in the design of the Mobile Earth Station. With a programmable MES personality, LES owners can effectively control bypass in their area of influence. The Scientific-Atlanta MES uses an Electronic Key which can be programmed as the terminal is imported into the Signatory country. Alternatively, the Signatory may purchase pre-programmed MESs and lease them at entry points and urban areas. The "Key" is programmed to hold primary and backup LES IDs. This restricts the MES to access only programmed LES stations. If tampering is detected, the chip rapidly erases itself, making the MES useless. Deciphering the key is virtually impossible with more than 10^{19} possibilities. With these features, the Signatory has effective bypass control of traffic. However, implementation of this capability needs to be considered in the context of the Inmarsat operating agreement.

An additional Inmarsat-M feature is the provision of a debit card reader on the MES. The LES operator could sell $25, $50, $100, and $500 cards at the same locations where terminals are programmed or leased. The MES could be made to disallow cards after a fixed period of time—a two to four week period, for instance. Although not a requirement for bypass control, this feature should also enhance revenue similar to what debit cards have done in the public telephone service.

No security system is undefeatable. However, with modern digital IC techniques the LES operator has a very high chance of capturing the traffic it has a right to. No longer is

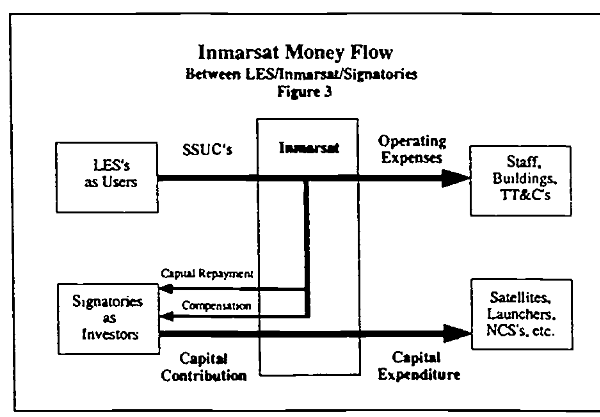


the Signatory at a disadvantage when negotiating transit agreements with foreign Signatories.

Greater Revenue Sharing

Revenue sharing in the technological sense comes from possible operational scenarios utilizing a Remote Database Server (RDBS) architecture. With RDBS, no longer does the LES-less Signatory need to focus on transit agreements, he only needs to negotiate a billing agreement with one of the more capable LESs to provide full, seamless coverage. A look at Inmarsat's member structure can give a clearer picture.

Inmarsat membership economics are complicated due to the Signatory capital contributions to satellite procurements. However, LES ownership is more straightforward. First, a look at the revenue flow from both land-fixed and mobile satellite users. **Figure 2** shows that the revenue from land-fixed calls is somewhat like IDD calls where the subscriber pays the local telecom authority on a monthly basis for the calls placed. On the mobile-originated calls, often an Accounting Authority (AA) becomes the biller to the end user. The AA pays the LES operator for the minutes that his



subscriber used. The LES operator then pays both Inmarsat and another telecom authority for termination into that country. In the case where a routing or transit agreement is

CES/LES Design Characteristics

	Basic Architecture	Channel Expansion	Telephone/Data Switch Interface	Configuration and Operation	Initial Capacity
First Generation	1:1 redundant ACSE (Hot Standby) mini-computer with ethernet connection to telephone switch and channel units.	Limited beyond original expansion capabilities of CPU and telephone switch.	Telephone/data switch integrated into design. Custom software by CES/LES vendor resident in switch to handle call processing tasks.	Central man-machine interface.	Expensive. Expansion capability must be purchased up front.
Second Generation	Grouped (parallel processing) ACSE mini-computers (Bit synchronous, fault-tolerant) dumb-channel units, ethernet connection to the telephone switch and channel units.	Limited to "Groups" of channels. Expansion costs non-linear. Telephone switch expansion limited to same vendor and same model switch.	Telephone/data switch integrated into design. Custom software by CES/LES vendor resident in switch to handle call processing tasks.	Multiple operating systems. Several terminals must be accessed for single configuration change.	Similar in cost to first generation but less expensive to expand.
Third Generation	Fully distributed processing ACSE microcomputers on each channel. Hot standby database servers. Ethernet connection to DB server and channel/signalling units.	Limited only to mobile ID database storage at DB server. 500 channels practical limit.	Call processing done at channel unit level. Any vendor tandem switch can be used for most applications.	Single windows-like UNIX-based operating system for MMI and database management.	Buy exactly the ACSE processing power needed.

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Mobile Satellite Systems
Network Systems Group

signed (i.e., a LES is not in the country where the mobile user originated the call), the LES operator will also pay that telecom authority.

Figure 3 shows how the payment flows between the LES operator and Inmarsat including capital contributions. The floating per-minute rate Inmarsat charges each LES operator for the satellite circuit is the SSUC.

The economics of establishing an M/B (digital voice, fax, data and telex) LES are shown in the Table below. As can be seen in the following paragraphs, an Inmarsat LES is primarily fixed-cost dependant and like an empty airliner, non-variable cost businesses are extremely sensitive to the upfront costs.

	CAPITAL COSTS	ANNUAL COSTS
LES Cost (existing 11m Ant.)	$3.5 million	
Building & Land	$0.5 million	
Depreciation		$0.4 million
Maintenance & Spares		$0.2 million
Admin. & Marketing		$0.25 million

The per-minute charges would break down as follows:

LES cost per-minute	$3.25/min
Termination charges	$0.25/min
	$3.50/min

A per-minute user charge of $5.50/min. earns **$2.00.** Under the assumptions in the Table, an Inmarsat LES breaks even at 400,000 minutes per year. A first or second generation LES is at least 20 percent greater. Under a RDBS scheme, a further 15 percent savings can be had.

A likely operational scenerio for a Signatory who desires to offer Inmarsat services directly with a lower capital investment would be as follows:

- The Signatory would acquire an LES with the distributed architecture that included only the required signalling and voice channel units.
- The Signatory would then negotiate a billing arrangement with one or more of the full featured LES owners. This arrangement would not be like the typical transit agreements in place today. With today's transit agreements, the Signatory with an LES processes all the calls on behalf of the Signatory and/or Telecom Authority (transit partner) without an LES. The minimum subscriber/end user rate is generally set by

the Signatory with an LES and the transit partner receives a 10 percent or less commission on the traffic generated.

In some cases the service provider will actually direct bill the service consumer on behalf of the transit partner. However, in many cases, the transit partner is the billing entity and the end user rates are increased further to cover administrative costs.

Under the scenario where the Signatory has now purchased its own third generation LES, the traditional transit agreement is no longer required. Only a billing partner is needed. The billing partner would forward monthly billing tapes to the Signatory, thus becoming an information service similar to a credit verification company. The Signatory can then determine its own subscriber rates based on the SSUC from Inmarsat and its own operational costs. The Signatory would now be motivated to develop its own in-country market as an Inmarsat Service Provider supported by the ability to offer competitive subscriber rates.

Conclusion

The third generation LES design has many integrated network features that enable revenue maximization. Developing countries could be the first Inmarsat Signatories to benefit from this new architecture. However, several operational issues must be addressed at Inmarsat and between Signatories in order for low-cost LES designs to be fielded.

Service Consequences: Evaluating The Role of Insurance

By William L. Mayo
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The space insurance industry represents a resource not only for risk management, but also for business and financial management issues and technical expertise. In other words, the space insurance industry can provide more than protection against catastrophe, it can also serve as a valuable business-advisory resource.

Over the last several years, the topic of space insurance has been scrutinized from almost every angle, while little, if anything, has been discussed about the potential impact of insurance on the deployment of new satellite-based services. However, the insurance industry clearly represents a stable financial resource that continues to invest in the success of the international space industry as it works to introduce new and innovative services.

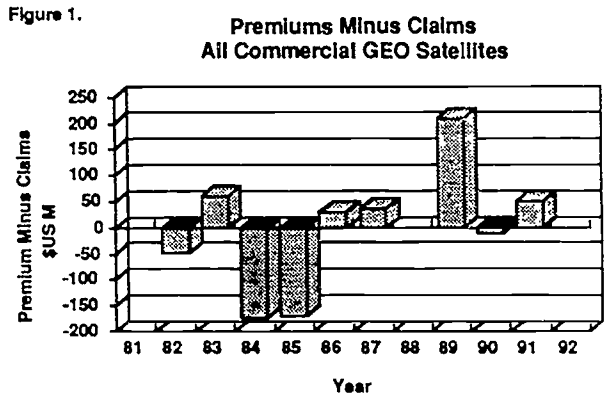
Perhaps the time has come to view space insurance from a new and different perspective, rather than segmenting it in terms of launch, in-orbit and transponder coverage. The greatest impediment to the growth of the commercial space industry is not the cost of insurance, but rather the limited access to space which commercial ventures now experience. Launching satellites has been -- and will continue to be -- a high-risk proposition; and the cost and risk associated with launching and operating satellites must be evaluated realistically. However, the elimination of insurance would not mitigate the risk of failure; rather it would make the financial risk much greater and far more damaging in the face of catastrophe. Machiavelli, who was quite the political analyst of his day, may have inadvertently captured the relationship between innovation, growth and risk, when he wrote, "There is nothing more doubtful of success nor more dangerous than the creation of a new system." Although, this observation was made centuries ago, it has applicability to the space industry today, and in particular to the role of the space insurance industry.

In our lifetime we have witnessed the implementation of a host of "new systems" in space. Mankind now benefits from numerous new services -- satellite cellular, vehicle location and tracking services, corporate information networks, satellite news gathering and distance learning -- to name just a few. One of these new services, satellite cellular, promises to bring the telephone service to emerging nations around the world to help improve their infrastructures so they can begin to attract investment, bringing jobs and brighter futures to their citizens. What is more, the space industry promises even greater innovations in the future. Looking ahead through 1995, in the Pacific Rim approximately 11 satellite launches are planned, bringing the promise of improved communications with the rest of the world, as basic telephone service becomes available to people who have not had it before. The space insurance industry is, and will continue to be, a key partner in the delivery of satellites and their services.

To understand the impact of satellite and launch vehicle insurance, and operation and service interruption insurance, on the introduction of new satellite-delivered services, you need only understand the basic premise of insurance: sharing the risk. When launching and operating satellites, it is possible to do so without purchasing insurance; but if any part of the launch or satellite itself fails, the satellite operator bears the total cost as a result of assuming the total risk. However, when insurance is purchased, the risk and cost of failure is shared. Without such risk sharing, and consequent cost sharing, there would be little innovation. This very same premise underlies the formation of INTELSAT and Inmarsat; i.e., sharing the capital requirements, sharing the operating expenses, and sharing the risk of operating worldwide networks to introduce a multitude of services.

The insurance industry has played a significant role in the maturation and profitability of the space industry. Understanding the role insurance has played in the development and commercialization of space requires a look at the history of insurance coverage over the last ten years (Figure 1).

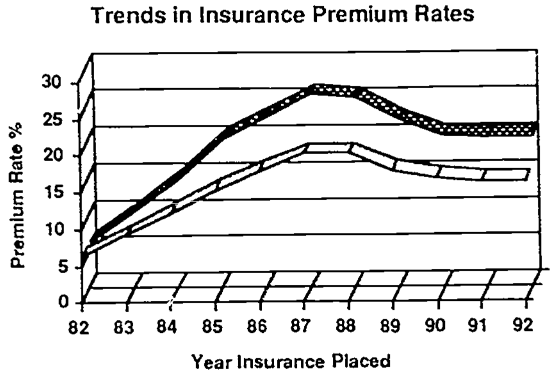
Figure 1.



As seen in the graph (Figure 2), the insurance industry has continued to support the space industry even during the mid-80's when sizable losses occurred. In the two-year period, beginning in 1984, the insurance industry sustained losses of over $600 million. The insurance industry continued to support the space industry even in the face of losses with the belief and assurance that the industry would be successful. The increased role of the underwriters and brokers for the space industry now includes serving as technical advisors.

A brief look at the current insurance market helps to understand why premium rates are between 17 and 18 percent. Today, the launch failure rate is one out of seven launches. When the failure rate improves, the market capacity will increase and may allow for a decrease in

Figure 2.



premium rates. The global satellite insurance capacity is around $360 million and represents twenty-five companies from nine countries.

Countries	Capacity $US
Spain	$ 8 million
France	$62 million
Germany	$53 million
Italy	$45 million
Scandinavia	$16 million
United Kingdom	$58 million
United States	$96 million
Japan	$10 million
Australia	$11 million

How can an entrepreneur withstand loss and continue to evaluate risk without the insurance industry's involvement? The insurance industry has demonstrated its support over the past decade, and has permitted space industry participants to replace capital assets and continue operations in a time when they otherwise would have faced catastrophic financial circumstances.

The role of the insurance industry has grown with investors in the space industry. In many cases the insurer provides the technical expertise necessary to evaluate risk for the individual space venture. Insurance brokers today are involved in the earlier stages and view their role as helping to assess and minimize risk.

Additionally, the international space industry is conducting research to support new and innovative developments that include such ventures as small launch vehicles, low-earth-orbit satellites, materials processing and space infrastructure activity.

The space insurance industry now seeks to demonstrate its sophistication by serving as liaison between the clients, underwriters and the technical experts in reviewing the complexity of individual business ventures, presenting a thorough understanding of the risk and the best plan for risk management. The space insurance industry represents a resource not only for risk management, but also for business and financial management issues and technical expertise. In other words, the space insurance industry can provide more than protection against catastrophe, it can also serve as a valuable business-advisory resource.

In reality, the utilization of insurance by the space industry can result in a reduction of costs and investment related to space ventures. The budgeting of insurance premiums results in a reduction of initial capital available in the event of a failure and eliminates the need for funding the replacement costs of failures. Additionally, insurance serves to raise the level of confidence within investors.

In addition to the role premium rates play in determining costs associated with new ventures, the insurance industry is utilized as experts in the area of risk management. At its simplest, risk management entails identifying risks, evaluating risks and dealing with them, then implementing a program to manage these risks. While this approach might appear simplistic to some, it is important to emphasize that the space industry wrestles with multitudinous global, legal, political and financial issues; thus making risk management a complex process.

Now that we have reviewed the role of insurance in the areas of premium rates and risk management, let us discuss the role of insurance in a business advisory capacity. The space industry, in particular the insurance industry, is already very much an international business. Risk of sizable proportion is, in most cases, handled by insurers in multiple countries, presenting opportunities for the insurance industry to gain experience with business ventures around the globe. Today, as we look at trends toward privatization of PTT's around the world, it is easy to recognize the role the space insurance industry can play in understanding the global business opportunities that exist and continue to emerge. The value of insurance for the PTT's has increased as the privatization has continued simply because of the increased accountability for their operations.

The space insurance industry represents a proven path for success in supporting the continued growth and introduction of new services for the space industry.

As noted, the value of the knowledge which the space insurance industry has accumulated should not be overlooked as new service opportunities arise. These new ventures need to rely on the space insurance industry for financial support, capitalizing on this extensive body of technical and global business expertise to insure continued success for the commercial space industry. I ran across a humorous anecdote which better illustrates my point: A woman called an insurance agent and said, "I want to insure my house. Can I do it by phone?"

AGENT: "I'm sorry, but I have to see it first."

WOMAN: "Then you had better get over here right away -- because it's on fire!"

When you consider insurance from this extreme, it seems essential to the long-term viability of a new business initiative. Even more important, however, is that insurance affords a new business the opportunity to succeed by providing a means of risk management through a variety of insurance options.

The Roles of Copper and Fiber in the Evolution to Broadband

A Network Planning Perspective

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1. ABSTRACT

Much has been discussed about the future of broadband. This paper describes some of the considerations a telephone administration must take into account in dealing with early service demand. For the downtown business district, the use of fiber is economically viable now. For residential areas, and for businesses in residential areas, the cost of fiber to a specific location is prohibitive. In particular, this paper describes how an embedded telephone administration could make effective use of the existing copper network to introduce broadband services, before it is economic to evolve to fiber.

2. INTRODUCTION

The future belongs to fiber. Given adequate demand, fiber is clearly the technology of choice whenever there is a requirement for bandwidth in excess of that needed for voice. When there is inadequate demand, and there is not, and is not likely to be a need for additional facilities, it is still less expensive to provide a single T1 or E1 service over repeated copper. Two new, copper based technologies promise to reduce the cost of serving the low demand market. These are High Speed Digital Subscriber Line (HDSL) for two way T1 (1), and Asymmetric Digital Subscriber Line (ADSL) for one-way T1.

As will be discussed below, HDSL and ADSL can be used to effectively serve the initial demand for new services. Once an adequate demand exists, fiber systems can be introduced. Evolution scenarios for both business and residential services are presented which allow growth with minimal up front risk. The future use of fiber in the loop systems is also described to handle demand as the new services attain adequate penetration.

3. BRIEF TECHNOLOGY DISCUSSION

A separate paper by Robert Lawrence (2) will describe the technologies in greater detail. Some points are necessary here, however, for greater understanding of the rest of the material.

Ordinary voice telephony is usually delivered as a baseband 3 Khz signal. This signal is transmitted over analog copper facilities from the central office to the end user's premises. The transmission loss of this facility increases with increasing frequency and distance. Historical outside plant design results in adequate transmission of frequencies up to about 3 KHz without the use of electronics to about 18 Kilofeet (Kft)(3). When ISDN was being designed, it became apparent that we would need to transmit about 160 Kbps (kilobits per second) over existing copper plant. No matter which encoding scheme was adopted, it was clear that both more than 3 KHz was needed, and new technology would be needed to transmit the ISDN bitrate in whatever spectrum could reasonably be used. The technology that emerged to meet this need was digital signal processing (DSP). This technology uses combinations of amplification, time slicing, and echo canceling to overcome the imperfections of typical outside plant copper, and allows the ISDN 2B1Q signal to be transmitted over existing copper two wire facilities without the need for pair selection, circuit design, repeaters, or conditioning (e.g., removal of bridged tap).

In about 1988, Dr. Joseph Lechleider at Bellcore (4) showed that by using even more sophisticated signal processing, even more bandwidth was possible(5). The result was HDSL. HDSL allows T1 to be transmitted over two ordinary copper pairs at distances up to 12 Kft, again without the need for pair selection, circuit design or conditioning. In subsequent discussions with NYNEX, it became apparent that while HDSL has great appeal for business customers, it has limited value for residential customers. The problem is that we don't have the luxury of two pair to each dwelling. The second result then was ADSL.

Over one pair and without disturbing the ordinary voice service (either 3 KHz analog or ISDN 2B+D), ADSL allows the transmission of 1.5 Mbps from the central office toward the home, with a 9.6 or 16 Kbps upstream data path. While this asymmetric capability is not capable of providing all of the services that full duplex T1 could provide, it can provide a number of interesting residential services including the following:

- VCR quality video using the Motion Picture Experts Group compression technique(6)
- high speed data base services from a remote host
- interactive games from a host
- remote access to computers at a distant location with virtual transparency (telecommuting)
- over ISDN, teleconferencing with either a higher quality image from a central location and an H.261 (at 2x64 Kbps) upstream, or 12 windows of the same video quality downstream as the upstream signal.

A number of vendors are already able to provide HDSL, while ADSL is currently available only for experiments, but will be available in trial quantities later this year (1993).

4. HDSL for BUSINESS SERVICE

There is considerable demand in the business environment for high capacity services. This is driven by both quantities of voice services and by data and video requirements. There are several ways to provision T1. The original technology was to use two copper pairs for each T1 and place . peaters approximately 6000 feet apart. The second choice is to use one of a number of fiber based solutions. When the business either has its own multiple T1 demand, or is located in an area with other companies with T1 demand, the economic facility of choice is usually fiber. HDSL enters the equation in two ways.

First, HDSL can be used to reduce the interval between order and circuit availability. This is because the only work needed to provision HDSL is the identification of two spares and installation of a box at each end of the circuit. There is no required design, installation of repeater cases, cable splicing, etc.

Second, HDSL has a role when there are not too many lines. Using current vendor quoted prices, Figure 1 shows a comparison of HDSL with conventional T1.

The figure shows that when the need is for one T1 line, HDSL makes sense (on a first cost basis) whenever at least one repeater is needed. Conventional T1 has significant economies of scale in that repeater cases, power, etc. can be shared. As a result, it would only make sense with a customer with two lines if two repeaters were required. For more than three lines, the distance limitation of HDSL (12 Kft.) cuts in before economic rove in. Not shown in this chart is the cost of fiber. Our studies show that fiber makes sense as soon as three repeaters is needed, regardless of the number of lines.

As an aside, the vendors pricing for HDSL seems higher that optimum for building and establishing a market for the product. There is no doubt that in quantity a device with the amount of signal processing required should not cost more that a few hundred dollars per end. By pricing to recover develop ment costs quickly, they are preventing a more robust market from developing.

5. ADSL for RESIDENTIAL SERVICE

Before discussing broadband applications, it is worthwhile discussing fiber in the loop (FITL) for plain old telephone service (POTS). The economics of FITL is getting more attractive by the day. NYNEX concluded several years ago that it no longer made any sense to install copper in feeder plant. Our current choice is to use Optical Digital Loop Carrier (ODLC) for all feeder relief. One system we have approved is Optilink 2000 from DSC. Fiber in the distribution plant is not quite economic for all applications. For some applications fiber to the curb (FTTC) is already less expensive than copper. We have looked at several systems in trial including Raynet and BBT.

NYNEX has also been studying residential broadband service for several years. We concluded early on that fiber technology was the correct choice when sufficient demand exists. The problem we addressed is how we can economically provide increased bandwidth to the early adopters in order to build enough of a customer base to attract developers of services that would use the bandwidth. Our early market studies indicated that the single residential service with demand obviously sufficient to begin the broadband revolution was Video-on-Demand (VOD). We define VOD as having the following characteristics:

- access to a large library of movies
- availability of full VCR features (pause, rewind, fast forward)
- quality comparable to VCR tapes.

This service description lead us to consideration of 1.5 Mbps, and Motion Picture Experts Group video compression (at less than 1.5 Mbps). We recognized that this service (and many similar residential services) is inherently asymmetrical. That is, the signal from the network to the home has to be video capable, while the return has to simply be able to track customer signals representing menu choices, start, stop, etc. As discussed above, discussions with Bellcore lead to the evolution of ADSL from the HDSL work.

ADSL is at an even earlier stage of development than HDSL. Bellcore is now in the process of testing three different technologies for ADSL. We have been quoted between $5000 and $8000 per pair (CO and end user ends) for trial quantities. Again, in quantity, prices in the $300 - $400 per pair range appear achievable.

ADSL, as currently defined does not reach all of our customers. The technical limitations are:

- up to 18 Kft. of copper cable
- up to 3000 feet of bridged tap
- no load coils.

These limitations result in an ADSL reach of approximately 60 - 80% of NYNEX loops. To increase the reach we need to make it possible for:

(1) building ADSL into the remote terminal of ODLC systems, and

(2) solving the same problem for fiber to the curb.

Besides increasing the reach of ADSL, integration into ODLC and FTTC will reduce the cost as well.

6. EVOLUTION - Business Services

The evolution for business services is straightforward. HDSL makes sense immediately for two applications. They are quick start and single T1 service. In the quick start case, HDSL will shorten the interval between service ordering and service. As such, it will result in revenue as well as satisfied customers. Careful study is required to determine whether the HDSL should be left in place or removed in favor of a permanent fiber (or even conventional copper - where there are spare pairs) solution. The decision will be based on the cost of HDSL, the number of T1s, anticipated growth, etc. Since HDSL is confined to devices at each end of the circuit, it is possible to reuse the equipment for quick start elsewhere.

For thin routes, the HDSL would be planned to stay in place until new orders are received. At some future date the accumulated demand may suggest new fiber facilities.

7. EVOLUTION - Residential Services

The evolution for residential service is somewhat more complex since residential systems which integrate 1.5 Mbps with POTS do not yet exist. However, the vision we at NYNEX have is as follows:

(1) ADSL will allow universal availability of new broadband services. (Initially only for customers within 18 Kft. of the central office, soon for customers within 18 Kft. of an ODLC remote terminal as well.) Universal

means availability to all, not provisioning to all. That is ADSL will help satisfy the demand of early adopters when the demand is dispersed.

(2) The economics of FTTC will improve over time for POTS alone. Technology will evolve for the smooth integration of 1.5 Mbps demand with POTS. When this occurs, the economic prove in for FTTC in areas with any significant broadband penetration (even when already met by ADSL) will be immediate.

8. CONCLUDING REMARKS

Providing new service has always been expensive for the early adopter stage. When customers are thinly dispersed, the cost of high bit rate service, in particular, has sometimes been prohibitive. High Bitrate Digital Line and Asymmetric Digital Line technology provide a means to reduce the cost of satisfying the demand of early adopters, and, thereby encouraging the demand for these services from others. Further, the existence of a customer base served by these technologies, along with the understanding that nearly any customer can order and receive high bitrate service on short notice, will encourage application developers to develop for T1 bit rates. It is, after all, the applications that customers want that cause them to order the telephone company service in the first place.

NOTES

1 This paper discusses the American T1 (1.5 Mbps) rate as a reference. The conclusions are equally applicable to E1 (2 Mbps) with certain caveats. First, cost of providing E1 over conventional repeatered copper may be somewhat higher that T1 because of the increased bandwidth required. Second, the effective range of the new technologies may be somewhat reduced, again because of the increased bandwidth.

2. Robert W. Lawrence, **Technology Enablers for Residential Broadband Services in the Telephone Company Loop Environment,** PTC '93, session 2.3.5.2.

3. The actual historical design rules were quite complex and involved the use of multiple gauge cable as well as loading coils. Some designs actually complicate the ability to provide higher bandwidth services. These issues are not covered here.

4. Bellcore is formally Bell Communications Research, and is the research and development consortium jointly owned by NYNEX and the other six regional telephone companies formed when the Bell System was split up.

5. see, for example, J. W. Lechleider, "Line Codes for Digital Subscriber Lines", **IEEE Communications Magazine**, Vol. 27, No. 9, September 1989, pp. 25-32.

6. The Motion Picture Experts Group operates as a committee of the International Standards Organization (ISO). They have been looking at image compression for several years. They are very close to a standard for sub-T1 rate video compression (MPEG-1), and are also working on a higher bitrate standard (MPEG-2). The MPEG-1 standard appears to result in video quality approximating that achieved with conventional home video cassette recorders.

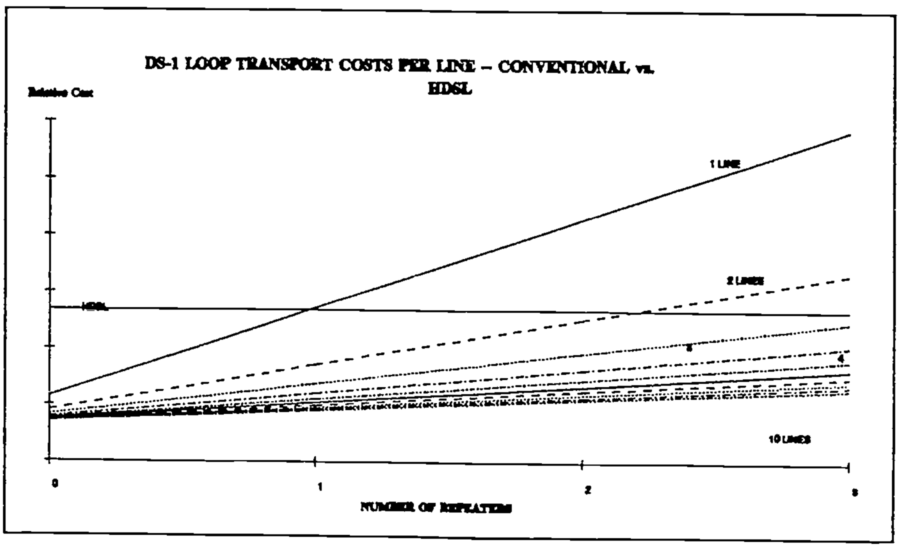

Figure 1 - Relative Cost of Conventional T1 and HDSL

MAMI: The New Direction of Interactive TV

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1. Abstract

MAMI-1 is the first prototype based on the MAMI concept of a multiple-access server for moving picture information. Three users can simultaneously access moving pictures randomly on one storage system through MAMI-1. By improving MAMI-1, many more users will be able to do that. MAMI will be beneficial in achieving interactive TV. Further, MAMI will add a new direction called indirect communication to interactive TV.

2. Introduction

Recently, the multimedia personal computer (multimedia PC) has become popular. Users can enjoy text, audio, still image and moving picture information on this PC.

Multimedia information is usually delivered on a CD-ROM at present. This is due to the CD-ROM's excellent characteristics including a large capacity for storing moving pictures, low cost because it is mass produced, and delivery through established distribution networks.

However, multimedia has not spread to home use because multimedia PCs are very expensive and moving picture quality on multimedia PCs is poor compared with broadcast TV and VCRs. Recently, new hardware has become available with features that allow multimedia PCs to handle full screen (about 640 x 480 pixels), full motion (30 frames/sec), and full color (24 bits/pixel) moving pictures. However, this new hardware is too expensive for ordinary home use, and there are few multimedia software titles in the market compared with music and movie software titles. Therefore, multimedia's acceptance for home use will occur in the future. When that happens, the multimedia PC will have a different name because it will be regarded simply as an electric appliance like a TV set. In this paper though, it is called a multimedia PC.

To accelerate the spread of multimedia to ordinary home use, some telecommunication, CATV and broadcasting companies have released concepts of interactive TV like "Video On Demand" and "News On Demand". The MAMI concept of a multiple-access server for moving picture information was described in the last PTC[1]. It will still be necessary to develop an interactive TV.

MAMI-1 is the first prototype based on the MAMI concept. In this paper, the MAMI concept is briefly described again, an outline of MAMI-1 is presented and a new direction of interactive TV by MAMI is proposed.

3. Multiple-Access server for Moving picture Information -- MAMI

The concept of a multiple-access server for moving picture information called MAMI was proposed in the last PTC. Multiple-access makes it possible for a user to access any shared moving picture information within a reasonable time.

3.1 The concept of MAMI

Figure 1 shows an example of the MAMI concept when 3 users are accessing the same program, an image time bar of moving picture data. Users access the moving picture information randomly in terms of time and place. By using buffering technology, moving picture data blocks are dispatched from the storage system at a transfer rate of V MB/s. A user receives a moving picture constantly and continuously at only v MB/s. Thus, ideal V/v multiple-access can be operated in this system.

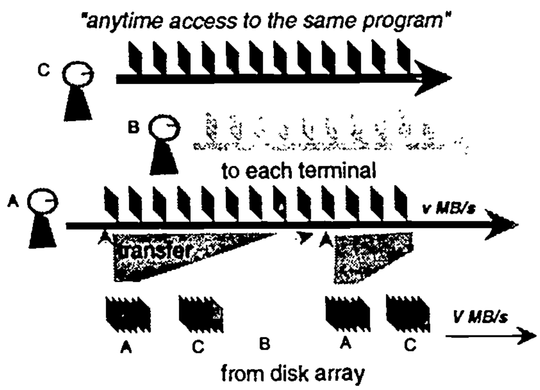

Figure 1. The concept of MAMI

As a result, in the MAMI system, the effective transfer rate difference between V and v is of fundamental importance. Therefore, in the MAMI system, a very fast transfer rate from storage system is required to make it possible for several users to access simultaneously. However, only an improvement in transfer rate from storage is not enough for more users to access the shared moving picture information. The file access sequences in almost all storage systems at present are scheduled by the first-come, first-served algorithm (FCFS), and the most significant problem with FCFS is the increase in queue length and waiting time for service. Furthermore, moving picture data cannot be reproduced at a constant velocity when the FCFS algorithm schedules the access to shared moving picture data. Therefore, in the MAMI system, scheduling technology based on the periodic hard-real-time concept[2] is applied to the sequence control of storage access to solve this problem as shown in Fig. 2.

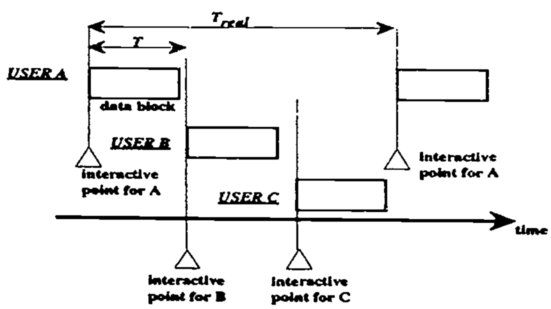

Figure 2. Time chart for MAMI scheduling

T_{real} is the real reproducing time in transferring data and also the minimum interactive period for a user in the moving picture data. It means that a user waits for the next interactive point to jump the access point on the moving picture. Therefore, a shorter T_{real} can improve the random access capability for a user. On the other hand, a multiple-access capability MAC can be concretely described using the hardware parameters

$$MAC < \frac{T_{real}}{T} = \frac{T_{real}}{T_{acc} + \frac{L(T_{real})}{V}} \qquad (1)$$

where T_{acc} is the maximum access time of the storage system including one-rotation time and the maximum seek time, V is the transfer rate from or to the storage system and $L(T_{real})$ is the transfer data length in T related to T_{real}. By deciding each parameter in this way, all users can access "full-randomly" at each interactive point.

3.2 Prototype MAMI-1

A prototype MAMI-1 system based on the MAMI concept has been constructed[3]. Reproducing from any point on any stored moving picture is possible in this prototype merely by mouse-clicking the icon, even if another user has accessed the same data, as long as the number of users who can simultaneously access the same moving picture information is limited to 3.

3.2.1 Configuration of MAMI-1

MAMI-1 hardware consists of four components, a schedule controller, client interfaces, a disk system connected through a VME bus, and client systems connected to client interfaces through SCSI interface cables as shown in Fig. 3.

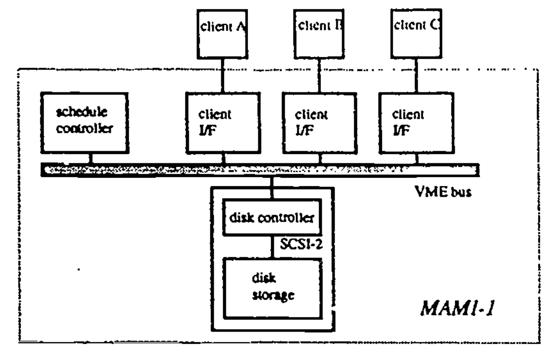

Figure 3. MAMI-1 hardware configuration

One of the most important parts of MAMI-1 is the schedule controller. The schedule controller has a system watch that is used for hard-real-time management of client I/Fs. It generates a "tablet" by hard-real-time scheduling and sends it to each client I/F through the VME bus. The client I/F that receives the tablet can access the disk array. The schedule process running on the real-time operation system controls the authority to access the disk array during the permitted time span by circulating the tablet. After sending the tablet to a client interface requesting disk access, measuring the progress time is begun with checking the excess dead-line time decided by the hardware performance of the disk system. The commands will certainly be completed during the permitted time span if no errors occur.

The SCSI control process for the client interfaces has 2 main functions. One is emulating RAM as a standard disk with minimum access time overhead. The other is pre-fetch, making it possible to access the next data block effectively with the permission of the schedule controller. Both of these functions make it possible to maintain a constant data flow to the user terminal/monitor during sequential reproducing of moving pictures.

3.2.2 Performance

The client interfaces function as RAM disks through the SCSI interface, and the average transfer rate from the general-use CPU board to the client through the SCSI protocol controller is approximately 1 MB/s, including 0.6 msec as the access time. This is sufficient performance for reproducing a moving picture with a full screen (640x480 pixels), full motion (30 frames/sec) and full color (24 bits/pixel) using the latest video boards having real-time video compression and decompression functions.

The burst transfer rate of MAMI-1's disk system, connected to a disk system controller with a Fast SCSI-2 interface, can be as high as 5 MB/s. However, the mechanical delay time overhead, the seek time and the rotation delay, makes the effective transfer rate V decrease to approximately 3 MB/s when L is 1 MB and a MAC of 3 is actually achieved in MAMI-1. The deadline time in the hard-real-time scheduling is fixed at 1/3 sec. The average utilization of the disk array is 0.6 when MAC=3.0. No block exceeding the deadline time during the 6 hours of running showed any appreciable effect from the real-time scheduling on the schedule board.

The response time of random access to moving picture at a user terminal is approximately 1.5 seconds including the software delay due to setting the minimum interactive period to 1 second in MAMI-1.

3.3 Improvement of performance

Two significant factors, the multiple access capability MAC and the response time for random access at a user terminal, should be improved to make a more practical MAMI-1. In particular, quick response is very important in accessing moving pictures interactively and it should be improved to less than 0.5 seconds. To decrease the response time for random access, the minimum interactive period T_{real} should be shorter. However, equation 1 shows that a shorter T_{real} causes a smaller MAC in the same system.

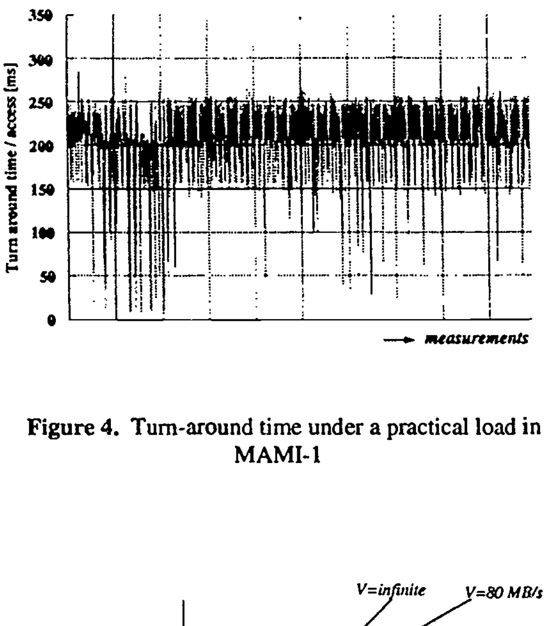

Figure 4. Turn-around time under a practical load in MAMI-1

The first approach solving this problem is an improvement in the scheduling method for disk access. The MAMI-1 scheduling method is based on hard-real-time in the worst case with a maximum seek time and one-rotation latency. As shown in Fig. 4, the turn-around time, the time defined from the read command reception to data transfer completion, is much less than the worst case of 333 ms. By using a new scheduling method for average cases with the disk arm scheduling algorithm[4], T_{real} can be shorter while keeping MAC values.

The second approach is improving the storage performance. As previously mentioned, the wide transfer bandwidth is sufficient, at first, to improve MAMI's multiple access capability. Disk array technology, recently introduced and can improve disk system reliability[5], is basically suitable for MAMI, especially from the viewpoint that MAMI requires a high speed transfer rate. With this parallel technology, the synchronized disks have no speed limitations.

However, just increasing the transfer rate cannot produce a larger MAC under conditions where the minimum interactive period T_{real} is around 0.5 seconds as shown in Fig. 5(a), and, thus, it is necessary to decrease the Tacc. Recently, the trend to down-size portable work stations has been accelerating the development of disks such as 1.8 inch or smaller. These small disks have the potential for decreasing the access time because of their narrow recording areas, making seek times shorter and rotation speeds higher. Figure 5(b) shows that configuring a disk array with these small disks makes possible a greater MAC with a less than 0.5 seconds response time.

3.4 MAMI-1 building block feature

It is of great importance not only to enlarge the MAC, but also to increase the number of user terminals concurrently connected to single server system in larger scale server systems simultaneously serving many users with moving pictures. Therefore, the MAMI building block feature was designed to be capable of expanding according to system scale. In the experimental system, the 3 by 3 building block feature, meaning 3 MAMI-1s with 3 MACs controlled by a system controller capable of accepting requests from nine users at the same time, is constructed as shown in Fig. 6.

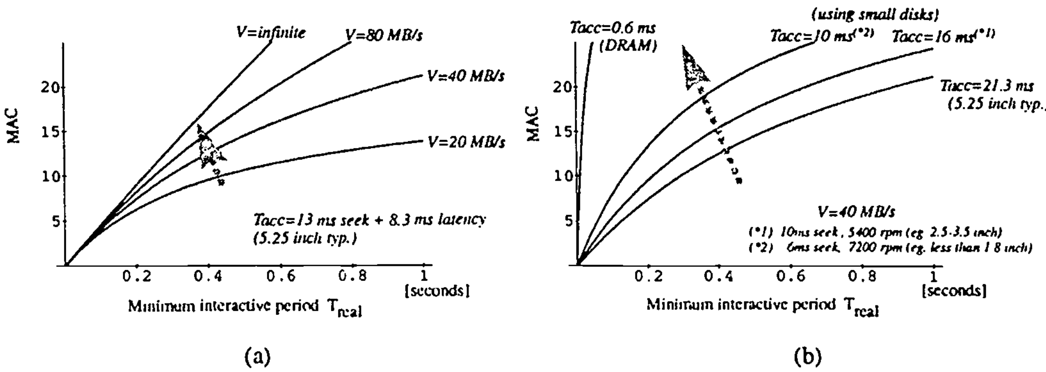

Figure 5. Improvement in MAC dependence on T_{real}

The system controller always knows all moving picture locations as files in MAMI-1 systems and supervises the status of each MAMI-1. On specifying the file name at the user terminal, the free client I/F board to access the specified moving picture is selected by the system controller. The connection between the client I/F board and the user terminal is made under its control. It is not necessary for users to know how many client I/Fs can be included in the whole server system. The Ether Net used to send control information from user terminals to the system controller and the SCSI switcher in Fig. 6 will be replaced with the B-ISDN network in the near future.

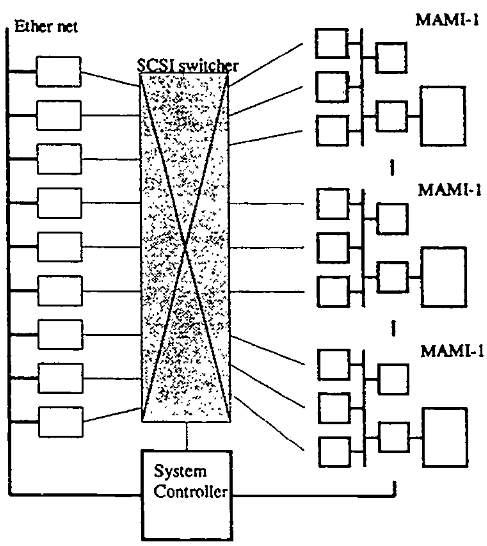

Figure 6. System configuration of the 3 by 3 building block feature

4. A New Direction of Interactive TV by MAMI

Multimedia consists of all media types, text, audio, still images and moving pictures. It is made up any two or more conventional media or by combination of media. Conventional movies and television broadcast are not recognized as multimedia, although they can include all media types. At least, computers, especially personal computers, by which any medium can be handled, are necessary for multimedia. It has become easier and easier to put movies, for example, NTSC video images, on a personal computer screen. Thus, movies can be enjoyed on a personal computer screen. This, however, is not a multimedia system; something is lacking.

This something is the interaction between the users and the information. A multimedia system must provide the user some interaction with the information it serves, so this interaction is vital in a multimedia system. It can, thus, be said that multimedia, in the strict sense, is a short expression of interactive multimedia.

Now, when interactions by common software is considered, and it does not matter whether it is multimedia software or not, there is some interaction with data, data that might be prepared in advance, or produced by the software during its processing, or produced by a user through using the software. All of this is data in the broadest sense, and only the most suitable data is chosen. Thus, it can be said that choosing suitable data is the interaction. This meanings that it is necessary for the interaction that a computer's storage systems have random access capability from the view-point of storage systems.

This philosophy can be applied to multimedia. Multimedia information must be stored in storage systems having random access capability. This random access capability is necessary for multimedia.

4.1 Interactive TV with MAMI

There are 3 methods of obtaining moving picture information with audio from a distance. These are, from electric waves through space, from CATV through metal or optical wires and from packaged media.

The original meaning of "tele-vision" was that viewers could see the distance. Viewers know a picture on the television is somewhere in the distance and they cannot expect to interact with someone in the distance through space from their own communication experiences.

It is, therefore, necessary for multimedia that PCs handling multimedia have storage systems with random access capability. A conventional television broadcast would not, however, be suitable as interactive TV if its information were to be stored in random access storage systems because it serves its information through space and anyone who wants it can get at the same time as anyone else. "Through space" and "to anyone" emphasize that a television broadcast is not suitable as interactive TV.

Now, there is packaged media with random access capability like CD-ROMs for achieving interactive TV. This is the only solution for interactive TV at present. There is multimedia information on CD-ROM. This takes a long time to be delivered after it is recorded. The information is in the CD-ROM drive next to the multimedia PC, and so, it is hard to feel that the picture from a CD-ROM is a scene from somewhere at a distance. Interactive TV from packaged media is not "television" in the strictest sense. It is "interactive" because it is not a "television."

From this point of view, the "television" cannot be interactive, but the metal or optical wires of CATV have the potential for making CATV a true interactive TV. With CATV, information is obtained from over the metal or optical wires, and these wires can be also used for communication among specified people. In this case, "over wire" and "to specified people" characterize CATV's potential as being suitable for interactive TV. A picture from CATV can give the impression that it is a scene from somewhere at a distance. Therefore, to make CATV a true interactive TV, there must be a random access storage system for each user at the CATV station. This might be impossible because there would have to be as many random access storage systems as there are subscribers. It would cost very much and would take a long time to copy information from one individual sources to other storage systems.

MAMI-1 has shown the feasibility of the MAMI concept, and the MAMI concept will be able to make CATV a true interactive TV.

4.2 Indirect Communication

From another point of view, it can be considered that interaction is a kind of communication and that any communication is accomplished with frequent interaction. Also, whatever is done with frequent interaction is something like communication. It is necessary for two communicators to have something shared between them. If there is nothing shared between two people, they cannot communicate at all.

Considering video games, they can make players interact with computer systems very frequently. In case of single player games, a player gives some action to the world which the video game prepared, and this world returns some action to him. Here, the player is having frequent interaction with the video game. Thus, the player and the video game are communicating with each other. This phenomenon will be understood more obviously when video games that are played by two or more people on the same field are considered, for example, tennis, soccer, and baseball games.

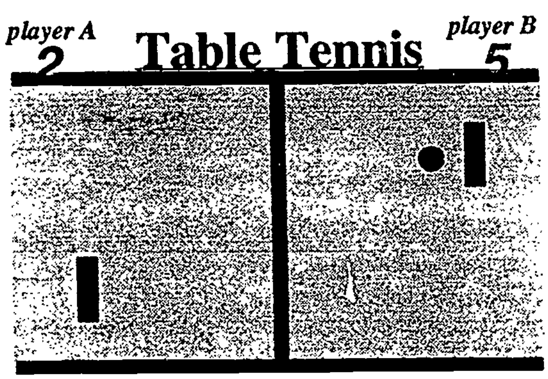

Figure 7. An example of Video games.

With a table tennis game played by two people (Fig. 7), the two players play in a world that consists of a table, balls, rackets, and reflections on the floor. One player has frequent interaction with the video game, and at the same time, he is interacting with the other player through the world of table tennis. They are communicating together through the shared world that the video game prepared. This phenomenon is called "indirect communication."

Indirect communication has two steps. 1) One person who is communicating with someone else knows the existence of something shared between them, but neither recognizes that they are most certainly communicating with someone. This is one kind of situation that is seen in the example of video games played by two or more people, that is explained above. This is indirect communication. 2) People know only the existence of something shared but they do not know the people beyond it. and of course, they do not know they are communicating with anyone. This is even more indirect communication.

4.3 Indirect Communication through MAMI

The capability of sharing information is one of the most noticeable characteristics of MAMI that was described previously. People can be made to accomplish indirect communication through natural moving pictures with audio and they will be controlled by software. In order to achieve this indirect communication, it will be necessary to add features by which MAMI can know and control the information addresses players are enjoying. This will be done as in Fig. 8 after MAMI's performance has been improved and MAMI has more MACs.

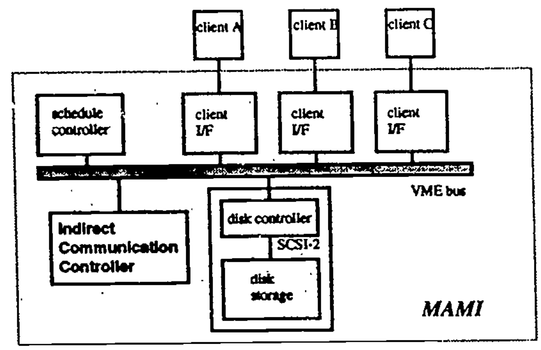

Figure 8. The Indirect Communication Controller (ICC) in MAMI

Some examples of more indirect communication through MAMI are given.

1. A person is enjoying multimedia software through MAMI. He is thinking that it is similar to that on a stand-alone multimedia PC. However, the software has some control points he does not know about. The indirect communication controller (ICC) chooses the way for him without his knowing with seeing what kind of action the other players are taking with the software. He is indirectly communicating with other people.

2. This situation can be applied to linear movies. A person is enjoying a linear movie. He is thinking that it is a kind of conventional linear movie, but it has a tree structure in the direction of time passage with some control points (Fig. 9). At these points, the software on the ICC chooses the way for him without his knowing it. It is accomplished by the information which address in the movie other people are enjoying. Of course the information such as what day it is and what time it is can also be used. This is more indirect communication, too.

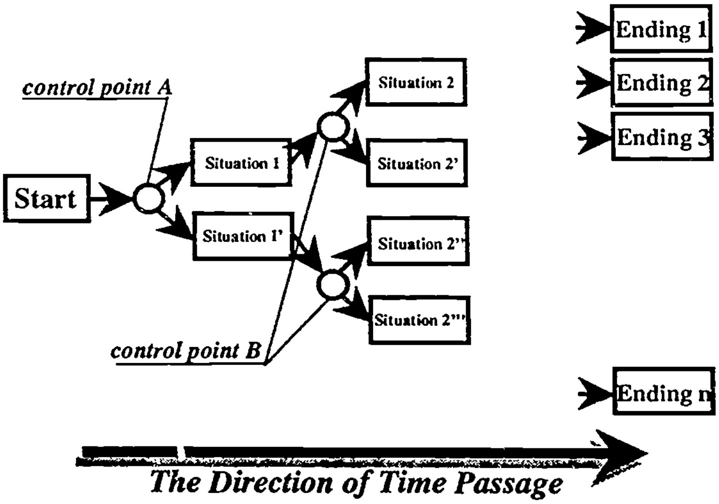

Figure 9. An example of information in indirect communication

5. Conclusions

MAMI-1 is the first prototype based on the MAMI concept of a multiple-access server for moving picture information. Three users can simultaneously randomly access moving picture information in one storage system through MAMI-1. By improving MAMI-1, many more people will be able to do that and MAMI will be necessary for achieving an interactive TV. Further, it was shown that MAMI will add a new direction called indirect communication to interactive TV.

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CALLING ALL TELEVISIONS?
THE CONVERGENCE OF THE CABLE TELEVISION AND TELEPHONE INDUSTRIES IN THE UNITED STATES

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Technological, historical, political, regulatory, and economic forces are creating growing incentives for cable and telephone industries in the United States to operate in each other's bailiwicks. These forces appear to be combining to cause the convergence of the cable television and telephone industries. Several different scenarios may lead to such convergence. Convergence could be effected by means of competition, co-option, cooperation, coercion, or a combination thereof. Ultimately, however, consumer preferences, based on need, convenience, and cost, will establish the pace and scope of convergence and the extent of the integrated telecommunications market.

1.0 INTRODUCTION

When I was a child in the mid-1960s, my family went to see the New York World's Fair. As a four-year-old, I was excited and impressed by the gleaming images of Tomorrow presented at various pavilions. General Motors offered a ride into the future in their big, bright, American-made cars. The City of New York provided a tour of a clean, modern, easily accessible metropolis. Walt Disney brought the children of the world together in song, proclaiming in unison that "it's a small world after all." And AT&T declared that "the technology of tomorrow is here today," as evidenced by its latest invention, the Picturephone.

More than a quarter of a century later, the hyperbole of those predictions stands in stark contrast to present realities. The American car industry has lost much of its luster. The "Big Apple" is not the shining traversable city it hoped it would become. The world has grown smaller via high-speed transit and communications, but the gulf between the "haves" and "have nots" of the world has grown wider. And we're still waiting for the Picturephone.

Clearly, predictions, once pronounced, may not always resemble reality, once achieved. It is with this understanding that this paper considers the advent of fully-integrated communications technology in the United States.

It appears that the long-heralded "convergence" in the provision of voice, data and full-motion video communications technologies is finally about to become an actuality in the U.S. Still, questions remain: Who are the players in the converging telecommunications industries? What forces are causing the convergence of these services? How will such convergence occur? Will the general public be willing or able to partake of these technologies? This paper addresses each question in turn.

2.0 THE PLAYERS

The players interested in the convergence of cable television and telephone communications technologies come from many formerly distinct realms of the communications industry. Participants from the mass-appeal news and entertainment media include: Owners and operators of cable television systems; the publishers of print media; broadcast television networks; television stations; programming production companies; videocassette retailers; advertisers; the music industry; and the movie industry.

Participants from the "common carrier" network transmission business include: Telephone companies created by the breakup of the Bell system (the Regional Bell Operating Companies ("RBOCs") and local telephone companies); long distance telephone companies (including AT&T, MCI, Sprint, and a host of nondominant interexchange carriers); competitive access providers (entrepreneurial local and/or interexchange companies providing alternative means of interconnection with the local phone system); telecommunications equipment manufacturers; cellular and paging licensees; companies interested in providing personal communications services ("PCS"); satellite manufacturers; and satellite transmission service providers.

The computer and data processing industries also are centrally involved in the convergence of technologies. Interested parties include: Manufacturers and designers of mainframe computers, personal computers and semiconductor chips; computer hardware and software vendors; data processors; distributors of consumer electronics; and video game creators.

Others involved in the shaping of the broadband digital network include: Federal and state regulators; municipal franchising authorities, educators; the banking industry; alarm and home security providers; and, of course, business and residential consumers.(1)

3.0 THE FORCES CAUSING CONVERGENCE

3.1 The Technological Engine

Technological innovation has progressed to the point that audio, video and data services can now be provided over fiber optic cable, coaxial cable, and even over twisted copper wire pairs. Nevertheless, it is the deployment of fiber optic cable that represents the most dramatic change in the communications infrastructure. Today, both telephone networks and cable television systems use coaxial cable as their primary distribution lines. Coaxial cable contains 1 GHz of technical capacity. However, electronic radio signals carried on coaxial cable are subject to substantial signal loss. An amplifier must be installed approximately every 2,000 feet to boost the signal. Amplifiers contribute noise and signal distortion, which reduce channel capacity. Coaxial cable systems deliver approximately 75 video channels.(2) Fiber optic networks, on the other hand, conveying digitized pulses of light, can carry signals for 20 miles without amplification. Decreasing the number of amplifiers on the network significantly reduces noise and distortion and increases channel capacity to 150 video channels.(3)

Fiber optics, coupled with technological advances such as digital switching, digital compression, and changes in systems architecture from "tree-and-branch" to "star" configurations, offer both the cable and telephone industries the ability to carry extensive two-way voice, data, and full-motion video communications into the home or office. However, local telephone companies remain hamstrung by a vestige of their past -- the use of twisted copper wire pairs to transmit messages "the last mile" into the residence or business. These wires have only 4 KHz of capacity, a paltry amount compared to the "broadband" 1 GHz capacity of coaxial cable. This difference in the "drop" wire to the customer has lead several industry analysts to predict that the cable television industry is better positioned than local telephone companies to provide integrated communications services to consumers.(4) However, it should be noted that Bellcore has developed technology to transmit one channel of high-quality video-on-demand service transmitted at 1.5 Mbps over ordinary copper telephone lines.(5)

3.2 Historical Evolution

The historical walls between the telephone, television, and computer industries are being eroded at an ever-quickening pace. One element in the convergence of these industries has been the growing ubiquity of cable television and telephone distribution plant. Currently, 93 percent of U.S. households have telephones, while 60 percent of America's homes are served by cable television.(6) According to William Johnson, President of Scientific Atlanta, 90 percent of all homes in the U.S. will be passed by fiber optic cable by the year 2000.(7) This means that by the end of the century, most homes will have two "wires" connecting them to increasingly sophisticated communications service providers.

Another factor in the evolution toward convergence has been the increasing addressability of cable television systems. Traditionally, telephone networks have provided two-way communications between end users (so-called "interactive" communications), while cable systems have offered one-way service (so-called "passive" communications) to their subscribers. Although cable subscribers could switch channels on their television sets, they could not "talk back" to the cable headend, which transmitted all of its service offerings simultaneously "downstream" to the home. Now, however, with the deployment of fiber optics and the advent of digital switching and addressable converters, cable television companies will become increasingly able to "flip the paradigm" to provide interactive, multimedia communications between the customer and the headend.(8) Some expect even more drastic changes over time. According to Nicholas Negroponte, Director of the Media Laboratory at the Massachusetts Institute of Technology, television and telephone services are in the process of trading places, with television services migrating from the airwaves to delivery via cable, while telephone services switch from copper wires to mobile wireless services such as cellular telephones.(9) Whether this role reversal actually comes to pass, it appears that from a technical standpoint, audio, video and data communications in the future will be transmitted as digitized "bits" of information.

3.3 The Political Agenda

President-elect Bill Clinton and Vice-President-elect Al Gore have made the creation a national telecommunications infra-structure a high priority for the new Administration. During his campaign, Clinton said that a national communications network "could do for the productivity of individuals at their places of work what the interstate highway of the 1950s did for the productivity of the nation's travel and distribution system."(10) As a Senator, Vice-President-elect Gore was at the forefront of legislative activity in the area of telecommunications. He introduced the High Performance Computing Act of 1990, which became law in December 1991, to fund the development of high-performance computer software and hardware over a five-year period.(11) In 1992, Gore introduced a bill seeking to provide the technologies developed under the High Performance Computing Act to hospitals, schools and businesses.(12)

The new Administration is not alone in having a vision of the telecommunications network of the future. The American political climate over the past three Administrations has encouraged competition to replace the monopoly model in the provision of telecommunications services

There is currently a vigorous debate over the propriety of establishing a telecommunications system by legislative fiat. Senator Conrad Burns (R-Montana) has enunciated "a vision of a broadband fiber optic network linking every home, school, hospital and business by the year 2015." Senator Burns notes that Japan will complete its deployment of fiber optics by 2015 and argues that the U.S. "simply can't afford to be left behind."(13) A competing vision of the future is offered by Kenneth Gordon, Chairman of the Maine Public Utilities Commission and President of the National Association of Regulatory Utility Commissioners. According to Chairman Gordon, no one has a clear view of what the country's telecommunications system will look like five or ten years from now. Therefore, it is the marketplace, rather than regulators and legislators, that should decide the proper course of action. Chairman Gordon considers it "critical is that there be a flexibility and an openness to choices, and that we avoid getting ourselves locked into particular visions, such as fiber-to-the-home by 2015 . . . ."(14)

One recent piece of legislation worth noting is the Cable Television Consumer Protection and Competition Act of 1992 ("the Cable Reregulation Act").(15) The Cable Reregulation Act, enacted by Congress over President Bush's veto, calls for the regulation of cable systems' basic service rates where effective competition does not exist.(16) Interestingly, however, the Cable Reregulation Act leaves unregulated that portion of cable service offered on an addressable, "a la carte" basis to subscribers. Thus, it appears likely that cable service will continue to move toward personalized "custom-tailored" service offerings in an attempt to avoid further regulation.

3.4 Regulatory Reevaluation

The cable television industry, historically subject to only ancillary federal regulation, and telephony, historically permitted to operate as a monopoly utility and traditionally exempted from content-based regulation, would appear to be well-positioned to capitalize on the telecommunications deluge of the digital Information Age. However, the pace of deregulation has slowed and, as in the case of the Cable Reregulation Act discussed above, even reversed course. The regulatory climate has shifted significantly toward head-to-head competition between cable television and telephone service providers. This movement is engendering an attempt to create a "level playing field" between the two industries.

Historically, carriers of audio, video and data signals have been subject to differential regulatory treatment based on the means their signals were disseminated. Broadcasters transmitting audio and video signals over the airwaves were licensed, due to the scarcity of spectrum. Broadcast licensees were public trustees, charged with the responsibility of exercising editorial control in the public interest over the content of their transmissions. Telephone companies, on the other hand, provided wire "pipelines" for the transmission of audio and data communications on a common carriage basis. They operated as public utilities, and were required to file tariffs to ensure that their rates were nondiscriminatory, but they maintained virtually no responsibilities or control as to the content of such transmissions.

This hard and fast distinction between broadcasters and common carriers began to break down with the evolution of cable television service from a community antenna retransmission service to a provider of original <u>and</u> retransmitted audio and video programming. Cable system operators act as editors, gatekeepers, <u>and</u> common carriers, depending on whether particular channels are classified as basic or premium service, leased access, or public, educational or governmental access channels. The courts have found themselves continually hard-pressed to justify the FCC's jurisdiction over cable service as "reasonably ancillary to the effective performance of the Commission's various responsibilities for the regulation of television broadcasting."(17) Indeed, some argue that the government should abandon content regulation entirely and adopt the common carrier model with respect to cable service.(18)

One area in which the Federal Communications Commission ("FCC") may seek to impose consistent rules on both industries concerns home wiring. In a forthcoming rulemaking proceeding implementing the Cable Reregulation Act, the FCC has been ordered to establish rules regarding the ownership and use of wires installed by the cable operator after the subscriber cancels cable service. The FCC is likely to seek comment on the extent to which such rules should parallel the FCC's rules on telephone inside wiring. This rulemaking proceeding must be completed by February 2, 1993.

The FCC also has sought to revise the current restrictions prohibiting telephone companies from providing video service and owning cable television systems. In two recent decisions, the FCC modified its rules to enable local telephone companies to compete in the video marketplace through the provision of video dialtone service on a nondiscriminatory common carrier basis without obtaining a cable television franchise. The FCC also loosened its rules regarding the purchase of financial interests in cable systems by telephone companies, and recommended to Congress that the statutory telephone company-cable television cross-ownership restriction (47 U S.C. § 533(b)) be repealed.(19) The FCC had previously ruled that the telephone company-cable television cross-ownership restriction did not apply to long distance interexchange telephone companies.(20)

The FCC clearly is inclined to open the market to all potential providers of advanced telecommunications services. The FCC recently modified its technical rules to facilitate the introduction of advanced home automation and communications systems, including security and energy usage monitoring devices.(21) The FCC also is expected to adopt a digital standard for High Definition Television ("HDTV") service in February 1993, which should spur the marketing of HDTV to the public as well as the creation of programming in that format.

3.5 Economic Factors

One major reason for convergence is that while both industries are deploying increasing amounts of fiber optic cable in trunk, feeder and distribution plant, fiber is becoming ever more economical. The cost of fiber optic cable has steadily declined since 1982, and the material price of fiber cable is expected to continue to decrease at an average of 5 percent each year from 1990 to 1998.(22)

Concurrently, the cost of microprocessor chips is coming down in reverse exponential value. Thus, it will be cheaper in the future to put "smart" converter boxes into cable subscribers' homes. It also will be easier for cable systems and telephone companies to provide vast quantities of memory and computing capacity at their respective headends and central offices. Increased availability of storage space for digitized information is a prerequisite to provide the level of video-on-demand service that digital compression will make possible.

Both the cable and telephone industries also continue to increase their ownership interests in emerging communications technologies such as cellular and personal communications systems. In addition, leading companies in both industries are participating in domestic experiments and overseas joint ventures combining cable television and telephonic functionalities. These investments have expanded potential revenue sources, while increasing the potential rivals' knowledge regarding the operation of each other's businesses. However, overseas operations continue to be a drain on the financial resources of RBOCs such as Pacific Telesis.(23)

4.0 POTENTIAL CONVERGENCE SCENARIOS

4.1 Competition

As noted above, the digitization of communications will turn audio, video and data signals into technically indistinguishable bits of information. While technological convergence appears likely, it is far less clear whether direct competition between the cable and telephone industries actually will be allowed to take place in the U.S.

The historical, political, regulatory, and economic forces which have brought these industries toward each other also could act to keep them apart. For example, strong political opposition to convergence is coming from the entrenched print and broadcast media and the movie industry, which seek to maintain their holds on the text and video markets. Consumer groups and local franchising authorities, having just regained regulatory control over cable television systems' basic service rates, would not react favorably to a proposal to let cable systems loose in the free market again in the near future. Nevertheless, technology remains the dominant factor driving these industries toward convergence. Thus, it appears likely that the cable and telephone industries will continue to move closer to some semblance of competition.

The emergence of standardized protocols for reception and interconnection are likely to increase competition between cable and telephone companies for large-volume customers such as data processors. Although politicians may differ as to the proper pace and means to by which to modernize the country's telecommunications infrastructure (and who should pick up the tab), it is unlikely that the new Administration will put up roadblocks to increased competition. As noted above, it is increasingly difficult to justify different regulatory structures for industries becoming technically indistinguishable. A movement toward regulatory reciprocity is likely to continue gathering momentum, perhaps culminating in a lifting of the restrictions imposed on RBOCs in the Modified Final Judgment(24) in the near future, or at least a transfer of power from Judge Greene to the FCC. There may also be a wholesale revisiting of the regulation of common carriers under Title II of the Communications Act of 1934.(25)

Most importantly, it is far from certain whether either industry wants to take on the other head-on. For one thing, the economic stakes are enormous, and both industries could do very well for themselves by sharing the market rather than expending vast resources trying to knock each other out of the ring. In addition, there remain vast differences in the markets for cable television, telephone and computer services. As one observer noted, there's a big difference between the technically sophisticated "nerd" using a personal computer to access databases and the "couch potato" skimming cable programming channels with a remote control device.(26) Marketing strategies targeting the demographic continuum between these two extremes will be critical factors in the success of the cable industry's entry into interactive programming and the success of the telephone industry's entry into video service provision

4.2 Co-option

One way to accelerate convergence is for a company in one industry to buy its way into the other. This is precisely what AT&T has done with its buyout of NCR and its proposed purchase of a substantial share of McCaw Cellular Communications. AT&T has built upon its dominance in the long-distance telephone business by purchasing a major data processing company and becoming a co-venturer with the leading proponent of wireless communications AT&T thus is well-positioned to reinforce and expand its lead in the provision of audio, data and image processing services.

Under the co-option scenario, statutory and regulatory restrictions prohibiting the cross-ownership of cable systems by telephone companies would be removed. Antitrust restrictions preventing remonopolization would be eased. The prohibitions on manufacturing placed on RBOCs in the Modified Final Judgment also would be lifted. Free market forces would be permitted to operate to their fullest extent.

For a number of reasons, this scenario is unlikely to occur. It would be a massive technological undertaking to forge all of the existing communications networks into one centralized organization. Such a development would buck the historical trend of the past fifteen years away from monopolization of the communications market. There would be serious political ramifications once it became apparent that one company was trying to become "Big Brother." Numerous regulatory obstacles described above would have to be rolled back for unfettered market forces to operate properly. From an economic standpoint, it would be too costly for Tele-Communications, Inc. ("TCI") (the largest cable service provider), AT&T or IBM to attempt to buy each other out.

4.3 Cooperation

In this scenario, cable, telephone, and computer companies form strategic alliances, enter into partnerships, and create research consortia to combine their resources and thereby bring about convergence in a coordinated manner. Cooperative ventures are taking place already. For example, TCI recently signed a letter of intent with AT&T and General Instruments to purchase one million fully addressable television converters for the purpose of providing digital video technology to satellite dish owners in the summer of 1993 and to cable system subscribers in early 1994.(27) Sammons Communications, an operator of multiple cable systems, and New Jersey Bell recently announced plans to jointly deliver video dialtone programming beginning in 1993 using fiber optic technology supplied by BroadBand Technologies.(28) Many cable companies have joined forces to create CableLabs, a research and development laboratory similar in design to Bellcore, the telephone research facility. The federal government also has fostered cooperation by creating Sematech, a research and development consortium founded in conjunction with various members of the domestic semiconductor industry.

A spirit of cooperation, whether voluntary or politically engineered, could result in an unprecedented level of coordination between the telecommunications industries in developing America's fiber optic infrastructure. Ideally, cooperation could lead to an efficient division of labor and services offered by each segment of the telecommunications industry. Each company could concentrate on the market and products it knows best, while the consortium takes a more holistic view, creating a synergism between existing technologies and future needs and applications.

It should be noted that strategic alliances do not always work out. Such cooperative ventures are often entered into for the wrong reasons. Weaknesses in the participants may be ignored. The partners may be incompatible in terms of relative size. There may also be a lack of attention paid to internal continuity in managing the partnership after the deal is announced.(29) Still, if all participants enter into cooperative ventures with their eyes open and retain their cooperative spirit during the life of the alliance, cooperation can pay off sizable economic and political dividends.

4.4 Coercion

Under this scenario, players are required to combine their resources to achieve centrally determined goals. This mandatory teamwork approach may result from strong political, regulatory or economic forces acting upon decisionmakers in the public and private sectors. MITI, the Japanese technology ministry, stands as the most powerful and successful example of this approach. Another example is Sematech, created in response to the hue and cry over the impending demise of America's semiconductor industry. There may be instances where private companies urge the government to take action to resolve longstanding obstacles to competition, as in the establishment of a digital standard for HDTV by the FCC. Some, such as Senator Burns and Henry Geller, would push the federal government to issue a mandate requiring the construction of a national fiber-to-the-home infrastructure by 2015.(30)

The creation of convergence by governmental mandate is certainly a possibility. Such a development arguably would favor the telephone companies, which have been eager to install fiber beyond feeder trunks but have met with public criticism in attempting to shift the brunt of installation costs from shareholders to ratepayers.(31) In recent months, however, the cable industry has begun to get the message out that they are already in position to provide a broadband pipeline.(32) The recent demonstration by Digital Equipment Corporation and Microsoft of their multimedia capabilities via Ethernet and cable hookups at the Western Cable Show provides further basis for the speculation that the computer industry is still weighing its economic and technological options.

Computer companies may play a decisive role in the public debate over the extent of governmental involvement in the creation of a broadband digital network. The computer industry, with its expertise in data processing, sits squarely at the fulcrum between the cable and telephone industries. Indeed, the computer industry conceivably could engage in an economic squeeze play of its own, dictating to both the cable and telephone industries the parameters it requires for interconnectivity.

4.5 Combination of the Above

The most likely means by which convergence will occur is a combination of the scenarios described above. Neither the cable nor the telephone industries are monoliths. Their participants are not likely to operate in lockstep with the most readily familiar competitors within their industries, for fear of being left in a position of parity, which may be viewed as a competitive disadvantage. There are too many legal obstacles to unfettered competition, but the FCC is certainly poised to permit direct competition on a carefully circumscribed basis.(33) Co-optive strikes and cooperative ventures have been undertaken, while the battle lines for debates on further governmental intervention are still being drawn. In the end, a melange is likely; a mixture of little bit of everything.

5.0 WHAT WILL CONSUMERS WANT?

Consumers seemingly take to high-speed communications services like ducks to water, once a critical mass of relative ubiquity becomes apparent and prices recede to an acceptable level. Witness the rapid growth of the market for cellular telephones, facsimile machines, and laptop and notebook computers. There remains a significant obstacle to the deployment of fully integrated communications services: The age-old chicken-and-egg problem in regard to testing the extent of consumer demand vis-a-vis constructing platforms by which to provide such services: Which comes first?

It appears that deployment of fully integrated communications technology will have to precede effective testing of consumer preferences. As one cable industry participant recently observed, companies investing in a broadband digital network and concerned about consumer demand must take to heart the message of the movie "Field of Dreams:" "If you build it, they will come."(34)

But will they stay? This question raises the central issue as to the development of advanced telecommunications services: A myriad of new technologies and applications are being created by the convergence of the cable and telephone industries, but what services will consumers want? Technology alone will not create a sustainable customer base.

As James Beall of The Prodigy Services Company recently stated, every new product "must provide something incremental of added value to consumers."(35) The seemingly endless rivers of information that will flow into consumers' homes and businesses via digitization threaten to overwhelm end users. Consumers' needs should be identified and specifically addressed. The public should be educated about the systems being installed and the services provided.

There are several critical inquiries that the cable and telephone companies must answer affirmatively, or they risk missing their target market. Do the services offered bring added convenience to customers' lives? Is the interactive systems deployed in home or businesses relatively easy to operate? Will the new services accomplish specific tasks faster than existing technologies? Are these new services being offered at prices consumers will be willing to pay on a long-term basis? No one wants to invest in a technology that turns out to be a mere curiosity. For example, the "need for speed" was the original purpose behind the rollout of the telephone companies' Integrated Services Digital Network in 1986, but six years later, the technology is still derided for failing to live up to its potential; according to one joke, the initials "ISDN" are said to stand for "It Still Does Nothing."(36)

6.0 CONCLUSION

Technological convergence is coming, with the introduction of fiber optic cable, digital switching and digital signal compression. The government is likely to "get out of the way" to enable its deployment. No one industry is likely to emerge as the dominant digital pipeline, given the relative ubiquity of cable and telephone lines. The private players have an opportunity to create an infrastructure of lasting value to American consumers. Ultimately, however, consumers will decide for themselves the extent to which convergence serves them.

(1) See Communacopia: A Digital Communication Bounty 4 (1992).

(2) Kaplan, "Cable Television," in Communacopia: A Digital Communication Bounty 9 (1992).

(3) Id. at 13.

(4) See Gilder, "Cable's Secret Weapon," Forbes, Apr. 13, 1992, at 80-84; Morris, "Telecommunications Services," in Communacopia: A Digital Communication Bounty 27 (1992).

(5) Morris, "Telecommunications Services," in Communacopia: A Digital Communication Bounty 30 (1992).

(6) Gilder, supra note 4, at 80.

(7) Remarks of William Johnson at the Western Cable Show, Dec. 3, 1992.

(8) Remarks of James Albrycht at the Western Cable Show, Dec. 2, 1992.

(9) San Jose Mercury News, Oct 25, 1992, at 24A.

(10) Gov. Bill Clinton, quoted in Communications Week, Nov. 9, 1992, at 78.

(11) High Performance Computing Act of 1991, 15 U.S.C. §§ 5501 et seq. (1991).

(12) Information Infrastructure and Technology Act of 1992, S. 2937 (not enacted).

(13) Burns, "Taking The Lead At Home And Abroad," Phone +, Jan. 1992, at 25.

(14) Gordon, "Policymakers Should Enable Private Decisionmakers," Phone +, Jan. 1992, at 26-27.

(15) Cable Television Consumer Protection and Competition Act of 1992, Pub. L. No. 102-385, 102 Stat.1460 (1992) ("the Cable Reregulation Act").

(16) Cable Reregulation Act, § 3, 47 U.S.C. § 623 (1992).

(17) U.S. v. Southwestern Cable Co., 392 U.S. 157, 178 (1968).

(18) See Geller, Fiber Optics: An Opportunity for a New Policy? 23 (1991).

(19) Telephone Company-Cable Television Cross-Ownership Rules, Sections 63.54-63.58, Memorandum Opinion and Order on Reconsideration, 7 FCC Rcd. 5069 (1992); Telephone Company-Cable Television Cross-Ownership Rules, Sections 63.54-63.58, Second Report and Order, Recommendation to Congress, and Second Further Notice of Proposed Rulemaking, 7 FCC Rcd. 5781 (1992).

(20) Telephone Company-Cable Television Cross-Ownership Rules, Sections 63.54-63.58, First Report and Order, 7 FCC Rcd. 300, 306 (1991).

(21) Amendment of Part 15 to Enable the Widespread Implementation of Home Automation and Communication Technology, Report and Order, 7 FCC Rcd. 4476 (1992).

(22) Geller, supra note 18, at 10.

(23) "The Baby Bells' Painful Adolescence," Business Week, Oct. 5, 1992, at 126.

(24) United States v. AT&T, 552 F.Supp. 131 (D.D.C. 1982), aff'd sub nom. Maryland v. U.S., 103 S. Ct. 1270 (1983) ("Modified Final Judgment").

(25) 47 U.S.C. §§ 201 et seq.

(26) Remarks of Rob Glaser at the Western Cable Show, Dec. 2, 1992.

(27) Remarks of Dr. John Malone at the Western Cable Show, Dec. 2, 1992; San Francisco Chronicle, Dec. 2, 1992, at A1.

(28) Broadcasting, Nov. 23, 1992, at 4.

(29) Farabelli, "Forming Successful Telecommunications Industry Strategic Alliances," TeleStrategies Insight, Nov. 1992, at 4.

(30) See generally Burns, supra note 13; Geller, supra note 18.

(31) See, e.g., Alternative Regulatory Frameworks for Local Exchange Carriers, 33 Cal. PUC 2d 43 (1989).

(32) See Gilder, supra note 4.

(33) See notes 19-20, supra.

(34) Remarks of Mark Coblitz at the Western Cable Show, Dec. 2, 1992.

(35) Remarks of James Beall at the Western Cable Show, Dec. 3, 1992.

(36) Churbuck, "The Copper Wire Gets Fatter," Forbes, Oct. 12, 1992, at 140.

Harnessing Telecommunication Technologies for Enhancing National Competitiveness and Quality of Life: The Singapore IT2000 Project

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1. ABSTRACT

In April 1992, Singapore announced its national IT strategy, codenamed IT2000, that would support its continuing economic and social development well into the 21st Century. This paper discusses the major tenets of the IT2000 plan, and the process by which the plan was developed.

2. INTRODUCTION

In the past decade, increasing emphasis has been placed on information technology (IT) as a key enabler in Singapore's efforts to achieve greater productivity and international competitiveness. To better exploit the potential of IT, the government of Singapore has undertaken a number of national IT planning exercises, of which the most recent is IT2000. The goals of IT2000 are to "create new national competitive advantages and enhance the quality of life in Singapore"[1] through the further development of Singapore's IT infrastructure and strategic applications.

The process by which this large-scale planning was conducted is likely to interest many, particularly those who are concerned with national IT planning, or with increasing their industry's competitiveness through cooperative IT planning among firms within the industry. In describing the planning process and the context, we seek to provide the reader with an understanding of how national consensus on the IT2000 plan was forged, and how such a large-scale planning effort was managed.

We were able to document the IT2000 planning process in our role as academic observers. We had no involvement in the design of the planning process, nor in the process choices made during its execution. Our understanding of the process has been built on interviews with many persons closely involved in the planning process, press releases and other documentation, participation in the actual planning sessions, and questionnaire survey of industry participants of the planning process.

To provide a context for understanding the IT2000 planning process, we present an overview of the surrounding circumstances in the next section.

3. THE CONTEXT FOR IT2000

Singapore is a small island nation with very limited natural resources. It's early economic history centred around its development as a British trading port midway between India and China. Today, the population of three million are its prime resource as it strives to further develop the financial, commercial, manufacturing, tourist and other sectors to spur its continued economic growth.

The Singapore economy can be considered to be capitalistic in nature. However, unlike many Western capitalistic economies, the government plays a key role in setting overall industrial policies, and in particular leading the way in newer areas identified as being crucial for national economic growth. The area of IT is a prime example.

In the early 1980s, IT was identified by the government as a key enabler in moving Singapore into high value-added products and services. A ministerial Committee on National Computerization was formed to spearhead the first national IT planning effort. Its report contained four important recommendations: development of a large number of IT professionals, computerization of the civil service, development of a computer software industry, and establishment of a National Computer Board (NCB) to coordinate the implementation of Singapore's IT policies.

By 1985, the government felt that Singapore had the components of an IT infrastructure and industry, but that they needed to be integrated. A second national IT planning effort was undertaken under the leadership of a committee comprising representatives from the NCB, Economic Development Board, Singapore Telecoms and the National University of Singapore. The results of this planning effort are noteworthy for its focus on the encouragement of IT application in the private sector, the development of industry-wide networks, and promotion a local IT industry. The TradeNet EDI system is an example of what came out of the 1985 plan.

IT2000 may be seen as the third in a series of five yearly national IT plans. Its focus appears to be on deepening the use of IT in industry through the development of a national information infrastructure, implementation of strategic applications for key industrial sectors, and in making IT a part of everyone's lives. The last area of focus is a new one, and opens up many social issues which previous IT planning efforts did not. Yet, the new focus on bringing IT to the people was not surprising given that IT2000 was also seen as the IT community's response to the government's recently published national agenda, entitled "The Next Lap." In this slim glossy volume, the new political leadership of Singapore outlined its aspirations for a Singapore that would be "more prosperous, gracious, and interesting over the next 20 to 30 years."[2]

4. THE IT2000 PLANNING PROCESS

IT2000 was initiated, coordinated and executed by the NCB, in its role as the government agency responsible for formulating and carrying out national IT policies. The NCB's competence and corresponding reputation has grown significantly in the decade since its formation. This in no small way contributed to its ability to undertake the massive effort associated with IT2000.

The groundwork for IT2000 was laid in 1990 by a small team of NCB managers who visited corporations, universities and cities in the United States that were conducting large scale IT planning projects. They were unable to find any planning projects that were on the scale of IT2000, and became convinced that they would have to chart new territory in designing the planning process for IT2000. A review of the existing planning methodologies and discussions with a firm of U.S. consultants led to the conclusion that these were too detailed, and too specifically tailored for organizational-level project and budget-based types of planning. IT2000, on the other hand, was being conceived as a broad-based, sectoral planning effort.

In designing the IT2000 planning process, the NCB planners decided that the approach would be based on the following pragmatic principles:

1) It would rely on demand-pull; where an understanding of industry's actual needs would drive the development of the necessary infrastructure and applications.

2) It would be a multi-agency effort, with participation from industry and academia.

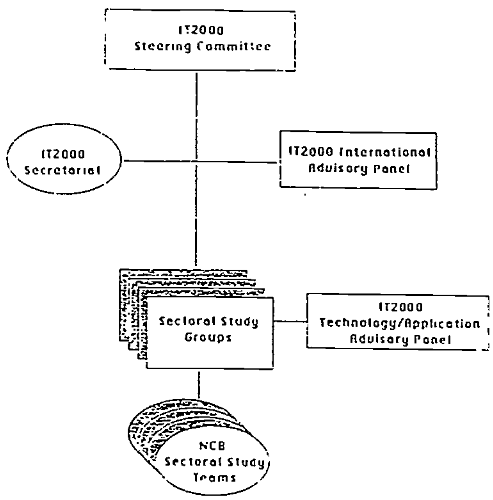
3) The output of the planning process would be actionable projects, that would feed the next phase of systems engineering.

A major part of the planning effort was organized by industry sectors. Eleven sectoral groups (see Table 1), each comprising representatives from industry (of whom one was appointed the sectoral group chairperson) and academia, as well as a five-person NCB support team, were formed. There were about 15 senior managers from industry in each group. These industry participants were usually industry leaders, and many were also known for their vision and support for IT. Their role was to review and validate the strategic applications for their sector. The role of the NCB support team was to work closely with the chairperson in facilitating the planning process, to provide secretariat and background research support for the sectoral meetings, and to write the sectoral report.

Table 1: Sectoral Coverage in IT2000	
1.	Construction and Real Estate
2.	Education
3.	Financial Services
4.	Government
5.	Healthcare
6.	IT Industry
7.	Leisure and Tourist Services
8.	Manufacturing
9.	Publishing and Media
10.	Retail/Wholesale/Distribution
11.	Transportation

A structure to manage the planning process was also created (see Figure 1). At the top of the structure is the IT2000 steering committee, comprising the chairpersons from the sectoral groups and representatives from Singapore Telecoms, other government bodies and tertiary institutions. This committee was chaired by the chairman of NCB. The IT2000 secretariat, a small group of NCB planners, was the main designer and coordinator of the planning process.

Figure 1: IT2000 Project Structure



The overall phases of the of the IT2000 planning effort were:

1) Development of the planning inputs: the IT2000 scenario (IT trends, the national agenda, and socioeconomic trends), and a planning methodology for the sectoral groups.

2) The sectoral group planning meetings: where industry and academic participants met with the NCB support team to discuss strategic IT applications for their sectors. The deliverable was a report from each sectoral group.

3) Analysis and consolidation of the sectoral reports.

The deliverable was a report to the cabinet as well as a public document outlining the IT2000 plans.

Within the sectoral group planning phase, there were also a number of distinct stages:

1) All groups began with a presentation from the IT2000 secretariat on the vision behind IT2000 as well an overview of the main phases of the planning process.

2) Group participants' initial views on desired strategic applications for their sector were sought and discussed.

3) The NCB support team presented their background research on key IT and sectoral trends.

4) More brainstorming among participants on strategic applications, and attempts to consolidate the list of applications.

5) Discussion of feasibility of the applications identified.

6) Evaluation of the initial draft sectoral report containing sectoral analysis and list of recommended strategic applications.

All sectoral groups met five times over a period of four months, for two to three hours per meeting. As the sectoral planning process guidelines were broad, there was much leeway for the NCB leaders of each sectoral group in implementing the methodology. For example, some NCB support teams spent significantly more effort in attempting to build a model of the sector using functional decomposition techniques than others.

Despite the variation within the sectoral group planning processes, the final report from each sectoral group was very similar in structure and scope, as the format was closely specified by the IT2000 secretariat (see Table 2). These sectoral group reports were consolidated by NCB to form the overall IT2000 report which was approved by the cabinet, and publicly endorsed by the Prime Minister, Mr. Goh Chok Tong, in September 1991, during the NCB's 10th anniversary celebrations.

Table 2: Contents of Sectoral Group Reports
1. Overview and economic profile of the sector
2. Current IT application profile and used within the sector
3. Impact of industry and IT trends worldwide
4. National aspirations and a vision for the sector
5. Descriptions of potential strategic IT applications
6. Descriptions of the major infrastructural issues that should be addressed before the proposed strategic applications may be implemented.

5. THE IT2000 PLAN

The IT2000 Report has two major recommendations: the development of a National Information Infrastructure (NII), and the implementation of sixty strategic applications identified by the eleven sectoral groups. The components of the NII, presented at a relatively high level of conceptualization, are the:

"Conduit, (which) refers to the physical 'pipelines' that carry information. Examples of such pipelines include voice and data lines, broadcast and cellular transmission.

Content refers to information that flows through the conduit. Examples of such information include multimedia courseware, entertainment programmes, government database records and payment instructions.

Compute refers to the processing of content in the NII. Examples of such processing include user authentication, billing, and processing of permit documents. The three components of the NII are under the purview of several government agencies and involve the private and public sectors."[3]

The report also states that the NII is aimed at helping Singapore to achieve five goals:

1. Developing a Global Hub: The NII will turn Singapore into a highly efficient switching centre for goods, services, capital, information and people.

2. Boosting the Economic Engine: The NII will boost the competitiveness of every sector of the economy, especially those that increasingly rely on information as a key factor of production.

3. Enhancing the Potential of Individuals: IT2000 will enable individuals to enhance their potential through lifelong learning, be more efficient in performing needed tasks, and have more time available for cultural and creative pursuits.

4. Linking Communities Locally and Globally: The NII will extend the personal reach of Singaporeans, develop their global mindset, and help to create electronic communities of people with similar interests, cause or goals.

5. Improving Quality of Life: The NII will enrich the lives of Singaporeans by increasing discretionary time, generating more opportunities and choices in leisure, kinship, work and civic spheres of life.

The sixty strategic application projects were compiled from the eleven sectoral reports. The projects seek to increase the overall efficiency and competitiveness of each sector. They are not meant to endow any particular firm or group of firms within the industry with competitive advantage. The nature of the applications may best be illustrated by some examples. In the retail, wholesale and distribution sector, one major proposed application was the development of a centralized automated warehousing facility. In the transportation sector, there was a proposal for a smart airport to cater to needs of travellers and cargo shippers for the next decade.

At present, the NCB is working on the specifics of implementing the NII and the first few of the strategic applications. Some important changes have already been undertaken to facilitate the implementation process. The ministerial Committee for National Computerization has been reconstituted to include representatives from the Singapore Broadcasting Corporation and Ministry of Information and the Arts, potentially major players in the "conduit" and "content" components of the NII. Equally important, the NCB has been reorganized, with a new division, the National Information Infrastructure Division, being formed. This new division has two departments; Planning and Infrastructure, and Application and Promotion.

Much of the work involved in fleshing out the details of the NII and in implementing it, requires expertise which is scarce is Singapore. The NCB therefore has launched a recruitment drive, particularly for those knowledgeable in policy development, information technolgy architects, and experts in specific technologies for a number of R&D projects.

6. CONCLUSION

The success of the IT2000 planning effort cannot be fully evaluated until at least some of its major recommendations have been implemented. However, many of NCB's key objectives in undertaking this national IT planning effort have been realized, and by this measure, IT2000 can be considered a success. The key objectives of the planning included obtaining widespread and high-level support for the resultant IT masterplan, generating a set of strategic applications, identifying likely IT champions for each sector to facilitate implmentation, and acquiring a better understanding of the eleven sectors studied. The planning effort has therefore made the climate for implementing the IT2000 plans more favourable. A large part of the success of the planning effort must be attributed to the commitment of the government to an industrial policy that strongly supports IT, to the existence of a competent and powerful coordinating body such as the NCB, and to the "national planning climate" that makes it possible to obtain the time and cooperation of more than 200 industry leaders.

7. REFERENCES

1. A Vision of An Intelligent Island: The IT2000 Report, National Computer Board, Singapore, 1992.

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3. A Vision of An Intelligent Island: The IT2000 Report, National Computer Board, Singapore, 1992, pp 23.

Propulsion for Activation of Community in the Region with PC Networking Services

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1. ABSTRACT

Office automation in Japan has been implemented in and between companies through personal computer networking. Vendors are exploring ways to expand computer use, especially into local communities, under the auspices of the Japanese government. As an example, this paper introduces the "new-media community center" concept being promoted in Nishinomiya City.

2. BACKGROUND

2.1 NISHINOMIYA CITY

2.1.1 HISTORY AND GEOGRAPHY

Nishinomiya, a 998.52-square-kilometer city in southeast Hyogo Prefecture, lies between two of Japan's most important ports, Osaka and Kobe. Seventy percent of Nishinomiya's population of 421,267 (1985 national census) people are aged between 15 and 54. The population is characterized by a high degree of mobility due to its location between Osaka and Kobe, which it serves largely as a bedroom suburb.
The city is famed for its shrine to the god of happiness, its history as a stopover on an ancient route that served Western Japan, and the purity of its water, which is used for brewing of SAKE (rice wine).
Most major surface traffic between Eastern and Western Japan passes through Nishinomiya, via national highway and railways, making it an important passenger and freight connection.

2.1.2 SOCIETY AND INDUSTRY

As a suburb, Nishinomiya is a patchwork quiet of residences and industrial plants. In addition to SAKE brewing, local industries include food and drink, sundries, and other retail goods. Commerce -- and purchasing power -- remains largely in Osaka and Kobe, despite Nishinomiya's numerous tourist attractions and ten universities, all of which attract large numbers of people. Agriculture accounts for only a small part of the city's employment, with most farmers also having part-time jobs. Dairy and multiple-crop agriculture account for the majority of work. As a whole, the city's population is cosmopolitan and sensitive to changes in lifestyle and fashion.

2.2 INTRODUCTION OF THE "MEDIA-ORIENTED COMMUNITY CENTER" CONCEPT

In July 1987, Nishinomiya was designated by Japan's Ministry of International Trade and Industry (MITI) to participate in a "New-Media Community Center" project. Metropolitan and national administrations have actively promoted the development of local and regional information-oriented systems since fiscal 1984, typified by the MITI project and the "Teletopia Concept" promoted by Japan's Ministry of Post and Telecommunications. The original objective of the MITI project was to construct and implement systems and networks that meet the needs of local communities in industry and social interaction and to evaluate the operation of these systems and their effect on the communities where they were introduced.
The next objective was to expand these systems into well-balanced nationwide networks.

2.3 ROLE OF INFORMATION IN LOCAL SOCIETY

Nishinomiya's comparatively high standard of living and the relative sophistication of its citizens made it a potentially good candidate for introducing an information system. In turn, an information system could provide Nishinomiya's citizens with a much-needed sense of community.
This involved several areas of activity: First, given the citizens' sensitivity to trends in lifestyle and fashion, an information system could provide Nishinomiya's population with the up-to-date social and material indicators they would presumably find useful and meaningful.
Second, an information system could tie together, modernize, and give new life to the city's geographically scattered, outdated, and outmoded commercial facilities.
Third, an information system could revitalize the city's industry by encouraging technological exchange among different business fields, streamlining the distribution system, and introducing advances that would help sophisticate industry.

2.4 INFORMATION AND MEDIA APPLICATIONS

Through a series of questionnaires, the city administration learned that some 38.5% of the local populace had access to or used personal computers and word processors; family game computers and related equipment raised this figure to 60.5%. In considering the nature of the media and information to be exchanged, a personal computer network seemed the most practical to promote because it processed both information searches and two-way communications equally well -- making it useful both

commercially and privately.
Generally speaking personal computer networking in Japan falls far behind, in scope and sophistication, the telecomputing and videotex applications used in the United States, for example. PC networking in Japan has mainly involved grass-roots electronic bulletin boards, business information networks, and commercially useful media such as online shopping. Electronic shopping currently has one of the highest media profiles among popular applications and is heavily promoted over communications media such as television.
Given Nishinomiya's relatively compact geographical organization, construction of a network and operation of a prototype system were easy, which made it practical for the city administration to launch it information-oriented pilot project.

3. NEW-MEDIA COMMUNITY CENTER

Under the twin slogans "improving community life" and "revitalizing local industry," Nishinomiya opened the "Nishinomiya New-Media Community Center," (NMC) in September 1989. (See Figure 1.)

A UNIX-system minicomputer running TELENOTES II, a software package, served as the heart of the system. The system provided electronic mail, a bulletin board service, electronic conferencing, and databases that use is stereotyped. The system operator uses an easy-to-understand set of menus to register users and update information.

Seven asynchronous full-duplex lines connect the system to the telephone network; six more lines are connected to Fujitsu's FENICS service, which provides value-added functions such as data processing as well as a basic communications service. The system operates at 2400 bps 24 hours a day. The FENICS network has access points nationwide, transfers data economically and reliably by sharing a packet network, and enables anyone anywhere in the country to use services charged only to the closest access point.
The system currently serves 5,000 local people and is accessed by people around the nation.
The NMC also has its own user-developed programs and gateway access. It provides the following subscriber services:

— Services guide:

Messages from and mail to the NMC operator, plus commands

— Electronic mail:

Mail exchanged among subscribers

— Alcoholic beverages database:

Information on 7,500 nondomestic types of liquor, and 506 types of SAKE

— Library database:

Search and retrieval of information on the 210,000 books in the Nishinomiya Central Library

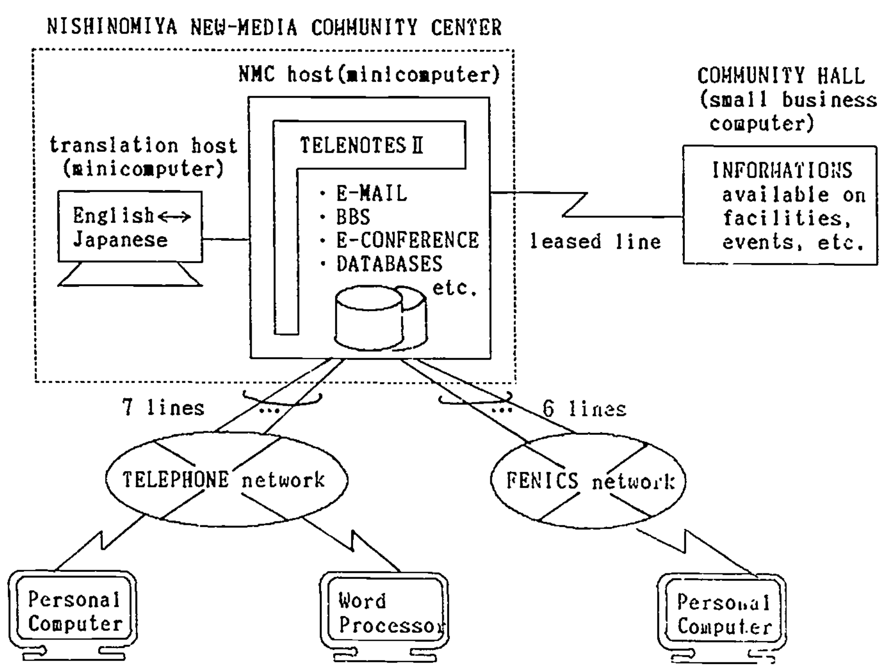

Figure 1 : NISHINOMIYA NEW-MEDIA COMMUNITY CENTER

— Administrative government document search and retrieval:

Search and retrieval of information on administrative documents maintained by the city

— Consultation on civil matters:

Consultation and information on the city administration in general, and requests and complaints in particular

— City guide:

Database of information on business and city offices and services

— Information on community events:

Guide to available facilities and upcoming events sponsored by the city

— Map and locale information:

Telephone numbers and addresses of 20,000 services and stores listed in NTT's "Town Page" classified advertising

— Educational and training services:

Information exchange on education, training, computer-aided instruction, etc.

— News updates:

Updates on community activities topics of current interest, society, culture, etc.

— Japanese-English/English-Japanese translation:

Electronic mail in Japanese translated into English, and vice versa, for NMC subscribers

— Consumer guide:

Services and prices monitored from home computers

— Miscellaneous information, upcoming events, horoscopes, and bulletin board services

The services outlined above have prompted many inquiries from other communities. Since the services Nishinomiya proposed to implement had no parallels in communities elsewhere, the city concentrated on a campaign based on the concepts of "only in Nishinomiya" and " Nishinomiya's unique databases."

4. NEW-MEDIA COMMUNITY CENTER OPERATIONS

4.1 ALCOHOLIC BEVERAGES DATABASE

4.1.1 OVERVIEW

To introduce NMC services, Nishinomiya introduced difference aspects step by step, working to make them "controversial," meaningful, and unique to Nishinomiya. Nishinomiya was already famous for its "Nada" brand of SAKE , so it seemed appropriate, in a nation where SAKE is used to celebrate every imaginable event--from sealing promises and offering libations to the gods to exchanging wedding vows and dedicating new buildings--to provide a database on alcoholic beverages. Nishinomiya's database contains information on 506 types of SAKE and 7,500 types of whiskey, brandy, wine, and other liquors, together, with detailed information on SAKE. A 12-query electronic "quiz" adds a light tough while enabling callers choose the best libation for that "special occasion."

4.1.2 SYSTEM

The SAKE database provides three types of search and retrieval: one on detailed information, one on choosing the right beverage and one for data registration.
Using the detailed information function, callers obtain explanations on brands and beverages by using menus and keywords. Callers can similarly search information on manufacturers and brands of Japanese sake.
Using the "choice" function, callers find out which SAKE will serve them best based on the occasion and mood.
Using the registration function, the database operator registers and updates data.

4.1.3 ENVIRONMENT

The software for this database was developed in C using a relational database under the UNIX host. Data was organized using TELENOTES II. Thus, the system offers a unified operating method to callers.

4.1.4 PROSPECTS

The database can be accessed at any hour from anywhere. Given SAKE's popularity and the database's detail, the city administration intends to expand it and eventually set up links with SAKE brewers, retailers, and restaurants carrying or featuring special brands--activities expected to stimulate both commercial and industrial growth.

4.2 LIBRARY DATABASE

4.2.1 OVERVIEW

In the next stage, the city administration decided to introduce a service that would be immediately useful to citizens of all ages--a library database on books in the city's Central Library.
In a nation famous for its 99%-plus literacy rate and love of learning, books are an important item. Nishinomiya City Central Library was no longer located near the city center, which made it difficult to reach--despite the attraction of its large number of books. Using the library database enabled people to check whether the library had the books they wanted, for example. The database already has 210,000 books and features information on new monthly arrivals. An electronic bulletin board features book reviews.

Callers can even leave messages requesting new look.

4.2.2 SYSTEM

Library database functions include search and retrieval title, author, code, field, and keyword. The database itself was developed and implemented the same way as the SAKE database. In specifications of the search section, data displaying was elaborated to enable gradual narrowing of data. In the way of possessing data, indexing and development method of temporary table were also elaborately designed to enable the system to fully respond to a large-scale database.

4.2.3 PROSPECTS

Like the SAKE database, library information is available 24 hours a day to anyone in the nation. Thus, it enabled them to visit the library to borrow a necessary book when necessary, and obtain information on opening hours and books of the library, staying at home.

The Central Library, as "living room library", has become a facility familiar to them. The center operator came to be able to offer information directly useful to the citizens of Nishinomiya, and, as an administrative body, realized a service a step closer to the citizens.

In addition to such broad access, the database will eventually be expanded to enable users to reserve and borrow books.

4.3 TRANSLATION SERVICE

4.3.1 OVERVIEW

Having developed the NMC to where its usefulness was well established, the city administration began to book into avenues that could also provide profitability. Having been made increasingly aware of their insularity through negative events such as trade friction, Japan's citizens have resorted to a number of ways--encouraged by industry and government--to "internationalize" their outlook. One of these has been learning and using foreign languages. The city administration reasoned that making an easy-to-use translation service available would encourage people to shed some of their insularity. Thus, they made available a Japanese-to-English and vice versa form of electronic mail by which subscribers could submit text in one language and have it sent back to them in the other.

4.3.2 SYSTEM

The system is, like other NMC functions, based on TELENOTES II and uses a machine translation system running on a host outside the NMC network host. (See Figure 2.) The machine translation host accesses the NMC network host every 30 minutes to download translation requests from a mailbox. After translating requested documents, the host returns them to the NMC network for distribution to subscribers.

4.3.3 PROSPECTS

The machine translation system uses a UNIX-based minicomputer. It is best applied to fields with a fairly fixed vocabulary, however, e.g., science and technology, and must be used recognizing these limitations. It is economical, even if the translation leaves something to be desired. It is, like other database functions provided by the NMC, available on a 24-hour basis to subscribers throughout the nation. This system is an effrective system with which profitability as business can be found. There are something to achieve about improvement of the quality of contents by amelioration of dictionary, differentiation of markets and applicable fields, and establishment of a charging and billing system. Given that machine translation technology has yet to mature, the service offered by systems such as the NMC have a potentially promising-and profitable--future.

4.4 COMMUNITY HALL GATEWAY

4.4.1 OVERVIEW

Nishinomiya City has a Community Hall, where city agencies, citizens, and businesses hold

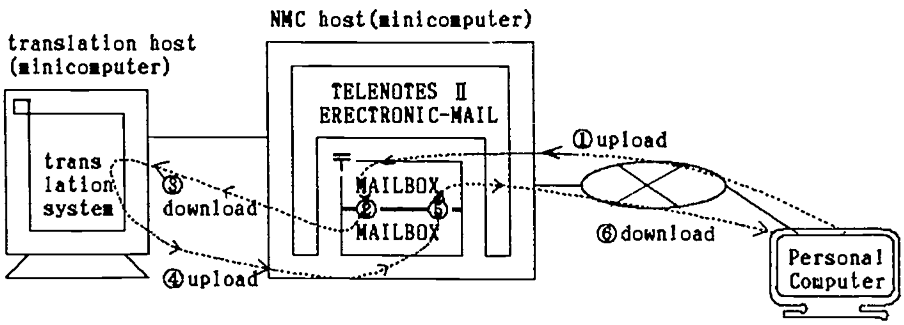

Figure 2 : TRANSLATION SERVICE

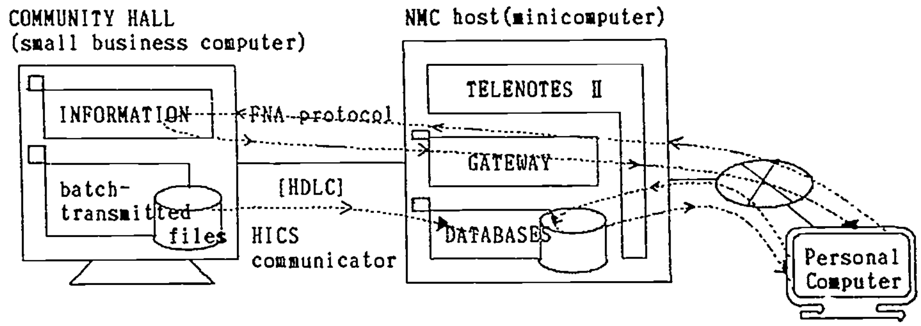

Figure 3 : COMMUNITY HALL GATEWAY

meetings and events. The Community Hall manages facilities, meeting rooms, and information on upcoming events using an office computer that also processes municipal business.
The NMC network and the Community Hall host have been linked to improve administrative services and make information available on facilities and events.

4.4.2 SYSTEM

Functionally speaking, the shared system provides a gateway and databases. (See Figure 3.) The Community Hall gateway uses the NMC host's gateway, i.e., a relay function emulating a user's terminal connected to the NMC host from a terminal connected directly to another host. Since the NMC host operated on a 24-hour basis, but the Community Hall host does not, information from the Hall's host is updated by file transfer daily after closing hours to make Hall host information available to citizens during off hours.

4.4.3 ENVIRONMENT

The NMC and Hall hosts are connected by leased line and a high-level data link procedures. Using the Hall's gateway, data is transferred using Fujitsu's FNA protocol. In the Hall database, files are batch-transmitted using the HICS system.

4.4.4 PROSPECTS

Increasing gateway destinations, broadening the types of information offered, and adding functions such as the reservation of space for events, the administration intends to provide an increasingly useful service repertoire to subscribers.

5. EVALUATION

In the three years since its inception, NMC has shown a gradual and steady increase in the number of subscribers and accesses. This progress is due to the NMC's easy-to-use menus, its 24-hour-a-day access, its economical line charges, and its open forum giving subscribers a chance to provide feedback about how they would like to see the system --and the city--run. Personal computer networking enables subscribers to contribute new programs and information on NMC use.
The NMC's most popular features appear to be the alcoholic beverages database and a "news corner" that keeps subscribers up to date with happenings around the city. It also provides advice on everyday subjects language.
In terms of municipal administration, the NMC provides information on city services, administrative decisions affecting data on the latest library book, and suggestions on how to use the "Community Hall". It provides a sounding board for Nishinomiya residents to fell administrators what they like--and do not like. The city administrators also use the NMC to monitor consumer prices, for example, by surveying local opinions. The system holds promise as a viable business venture in areas such as machine translaiton. The Nishinomiya City government works on adding new and useful application and tools to improve system services. To ease life for the handicapped, for example, meetings are conducted including sign language. The NMC provides training, materials for personal computer use and ongoing education. It also provides lectures on NMC services.

6. PROBLEMS

The NMC remains smaller than most commercial networks and thereby offers more give and take between users and system administrators. As the system matures, this may change. The system administrator will have to learn to manage NMC activities in a way that does not stifle subscriber creativity and initiative, however big the system gets.
The NMC's current operating expenses are mostly covered by the city budget, but it is hoped that the center will eventually become financially independent, charging for its services, reducing its operating costs, and lightening the load on system operators. Campaigns will be needed to attract new subscribers. User interfaces should also be improved by adding fax, voice services, imaging, and the introduction of public terminals.

7. CONCLUSION

In considering its original objectives of introducing an information system to revitalize industry and provide Nishinomiya's citizens with a sense of community, the NMC has achieved the following:

— Strengthening a sense of belonging and community among Nishinomiya's citizens

— Contributing to a stranger identity of Nishinomiya as a unique city

— Improving municipal services to the local population

— Providing a forum for feedback by citizens to the city's administrators

— Establishing an information center to keep people up to date on city activities

NTT's VI&P vision

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1. ABSTRACT

In order to achieve new telecommunications services early in the 21st century, NTT has proposed "VI&P" as its vision of the future communications environment. "VI&P" aims to attain future communications services that have Visual, Intelligent, and Personal attributes. This paper introduces the aim and outlines the VI&P vision and discusses network technologies through which the VI&P vision will be realized.

1. VI&P service concept

The progress achieved in technology over the past hundred years has enabled telecommunication networks to progress from telephones used solely for speech to multimedia for the exchange of text, data, and video. Telecommunication services will contribute to the society and economy of the 21st century. In 1990, NTT proposed a future telecommunication service concept for the 21st century called "Visual, Intelligent and Personal: VI&P." This concept is based on the development of visual and intelligent technologies, and on society's demands for a person-oriented and information-based way of life (**Fig.1**).

VI&P means communications services which strive for the qualities of being visual, intelligent, and personalized. These services will employ high-speed, broadband, intelligent ISDN networks. They will include new types of telecommunications services such as image-based "visualizing" services, "smart" services whereby an abundance of information is readily available and the called party can be sought out and contacted no matter where he may be, and "personalized" services which respond to the consumer in a user-friendly manner, according to customer taste.

2. VI&P services

Figure 2 shows the evolution of VI&P communications services.

"Visual" signifies the visualization of communications. It allows people to communicate not merely through the sense of hearing, but also the sense of sight to view images, facial expression, and text. The visual telephone will be the basic tool for visualizing communications, providing, for example, high definition images, three-dimensional video communications, and access to video databases from a keyboard.

"Intelligent" signifies the development of network that have intelligence. This permits people to fully utilize the network without the need for any special expertise or intricate procedures. The new network will: perform the role of a well-trained secretary; enable users to select service items tailored to their own

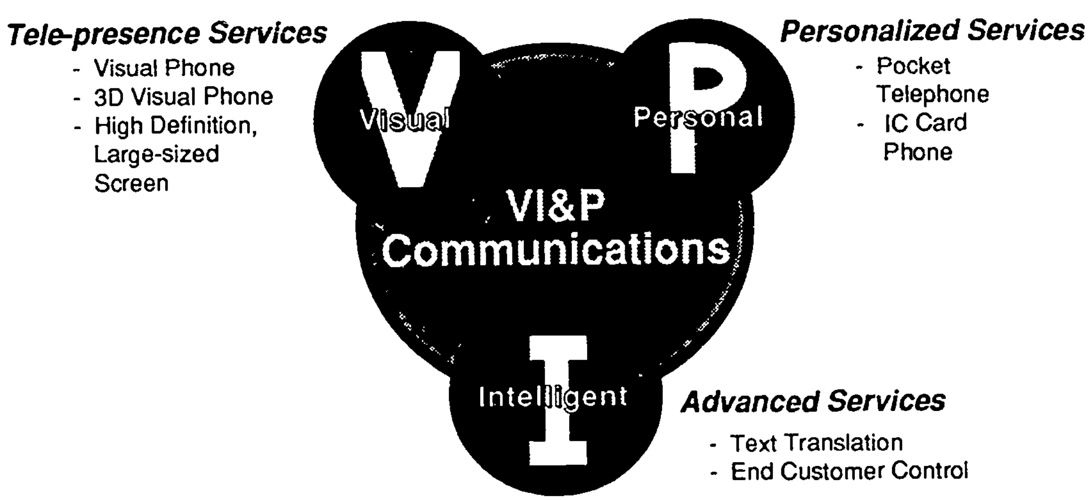

FIGURE 1. *VI&P COMMUNICATIONS.*

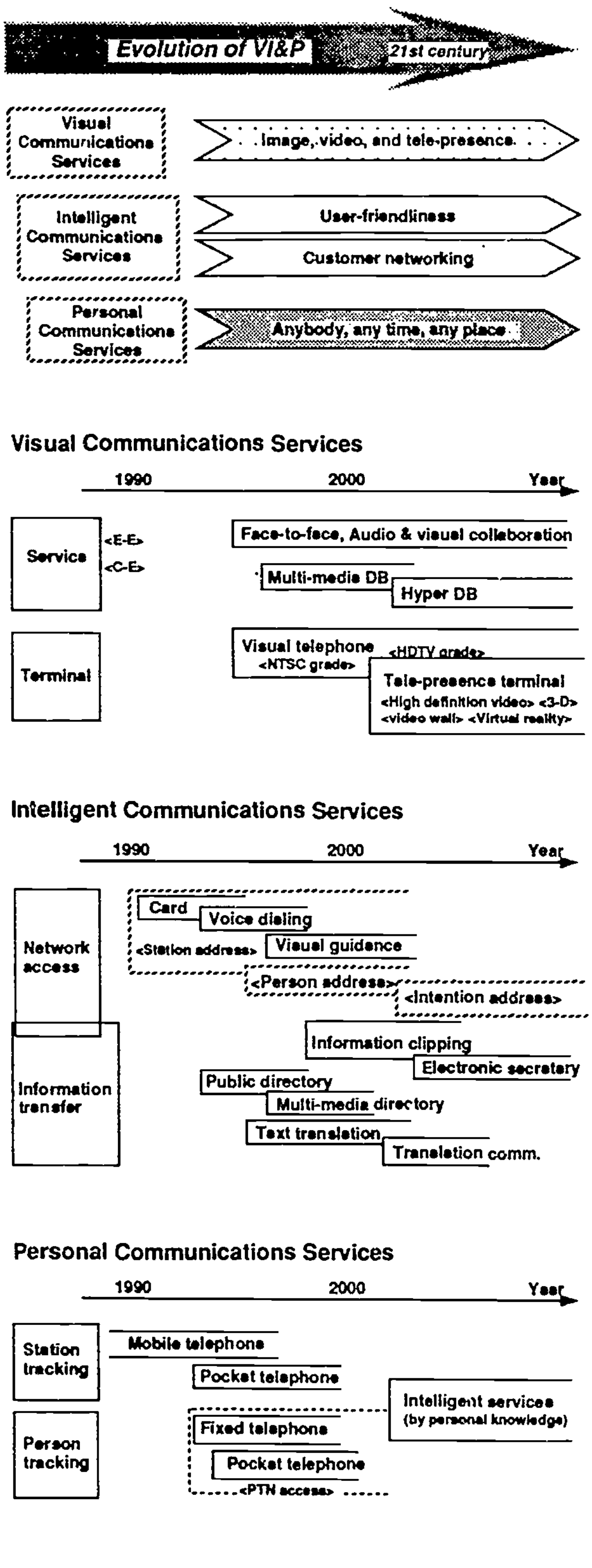

FIGURE 2. *EVOLUTION OF VI&P COMMUNICATIONS SERVICES.*

needs; and provide computer-aided automatic natural language translation.

"personal" signifies the idea that the new communications services should support personal activities in both business and private lives, utilizing the intelligent network and the new communications terminals. The possibilities opened by personal communications include the following: personal accessibility by means of ultra-small portable communications terminals; the offering of personal telephone numbers allowing the user to receive calls anywhere; registration of multiple personal telephone numbers; and the securing of user confidentiality.

The VI&P services are divided into two categories, basic and advanced.

(1) Basic Services

The three basic communication services within VI&P will be telephone, "text mail," and "visual telephone." All of these are person-to-person interactive communication services which NTT intends to provide nationwide.

The telephone remains the basic medium for voice communication. In addition to the standard telephone, compact pocket models are likely to become increasingly common.

Text mail comprises text and still-picture communications. By interconnecting a number of personal computer networks, a user will be able to communicate with any computer on any network. Text mail is likely to become one of the mainstay services.

The visual telephone will make its debut as an image-based medium for face-to-face communications. Positioned as a mainstay high-speed broadband ISDN service, the visual telephone will be offered with image quality rivaling that of today's television.

(2) Advanced Services

VI&P advanced communications services, which will be extensions of basic services, should become popular as wide-ranging competition among communications suppliers and manufactures produces easier-to-use, more convenient services. Some examples of advanced communications services features are:

Video Communication Services
- high-definition, Large-screen, and Multi-screen Video
- 3D Video

Intelligent Services
- Language Translation
- Highly confidential Communication
- Electronic Secretary

Personal Services
- Auto-person Calling
- Personal Number

'rivacy Protection
Flexible charges.

(3) Rate Structure

Achievement of affordable rate structures will be extremely important to the success of VI&P. First, it is ideal to have a rate structure which will enable people to user communication services freely without paying attention to the distance of communications. Telecommunication technologies should overcome the limitations of distance. Secondly, it is expected to offer a reasonable rate structure for visual communications which must transmit more information than the telephone. Future rate structures will make visual communications affordable freely, thanks to the construction of broadband ISDN.

3. Network technologies

VI&P communications services will be realized through the use of broadband ISDN. This will enable large amounts of information and video images to be transmitted at high speed[1][2]. The important network technologies include optical fibers, asynchronous transfer mode (ATM), intelligent network (IN) and universal personal telecommunication (UPT).

(1) Optical fibers

The networks which support VI&P will require high-speed and broadband ISDN installations. To carry high-speed and broadband signals, optical fibers will be installed to every home. This idea is called "Fiber To The Home (FTTH)." **Figure 3** shows examples of optical fiber subscriber network configurations including that of FTTH[3].

(2) Asynchronous Transfer Mode (ATM)

The networks should carry all types of information in terms of media and speed. Examples of media are voice, video, data and mixture of them (multi-media). Bitrate examples of broadband services are categorized as shown in **Fig. 4**. Asynchronous Transfer Mode (ATM), whose characteristics are summarized in **Fig. 5**, is the technology that achieves flexible and economical transport and switching of every kind of signal[4].

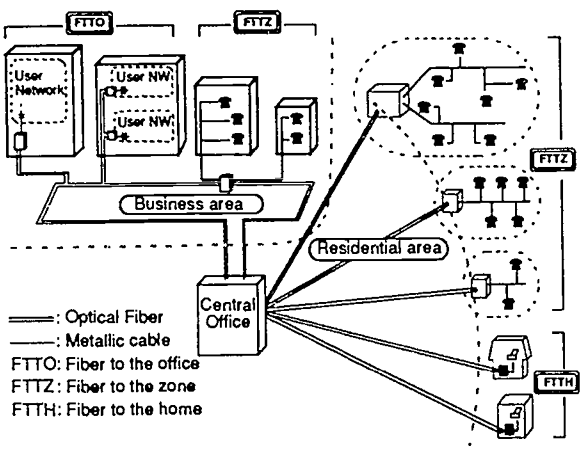

FIGURE 3. *CONFIGURATION EXAMPLES OF OPTICAL FIBER SUBSCRIBER NETWORK.*

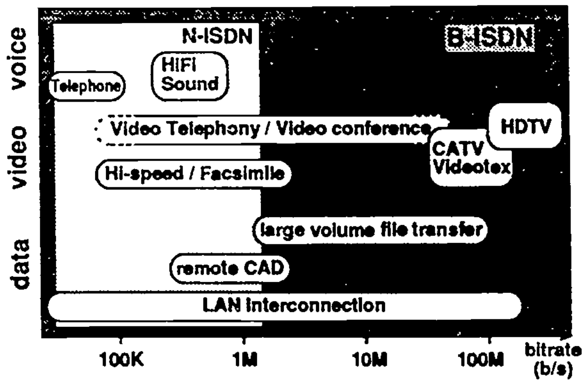

FIGURE 4. *BROADBAND SERVICE BITRATES.*

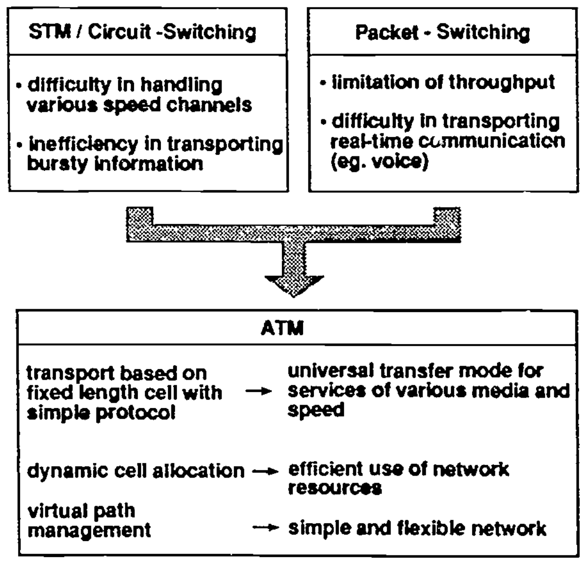

FIGURE 5. *CHARACTERISTICS OF ATM TECHNOLOGIES.*

(3) Intelligent Network (IN)

To Provide services with intellectual processing, it is necessary to install service management and control capabilities in the network. The network will be structured with a basic transport layer and a service management and control layer (**Fig. 6**). When introducing new services, the new service will be defined on the service management and control layer thus enabling the rapid introduction of services[5].

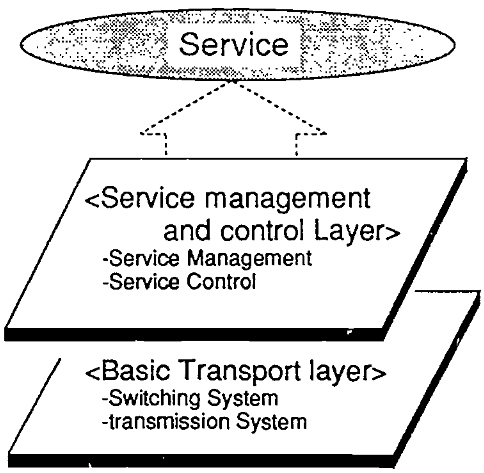

FIGURE 6. *INTELLIGENT NETWORK (IN).*

(4) Universal Personal Telecommunication (UPT)

Figure 7 shows the concept of UPT services. Using a UPT number which provides a unique personal identification, any user can make a call and/or can be reached at any time or place.

Figure 8 shows the network evolution toward B-ISDN by NTT [1].

In addition to these network technologies, a wide-range of communications technologies will have to be researched and developed in order to implement VI&P communication services. Figure 9 summarizes these technologies under the headings of human interface, information processing and data-base, and radio communication.

4. Conclusion

VI&P communications services represent NTT's basic service goal for the years leading into the 21st century.

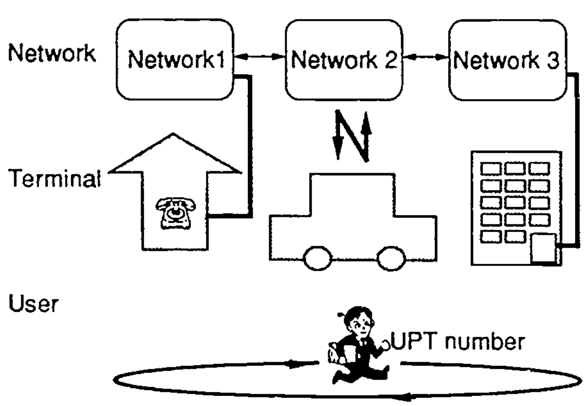

FIGURE 7. *UPT SERVICE CONCEPT.*

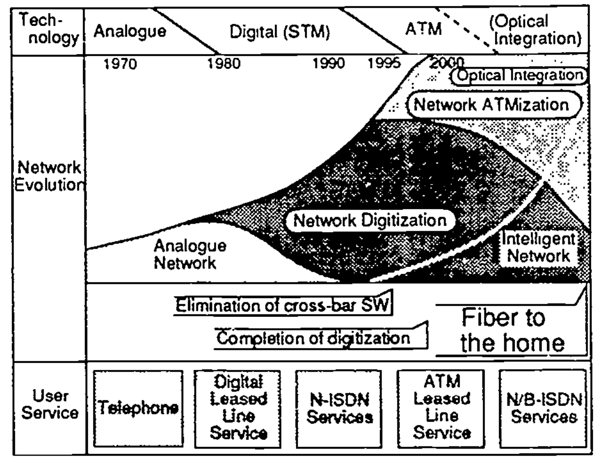

FIGURE 8. *NETWORK EVOLUTION TOWARD B-ISDN.*

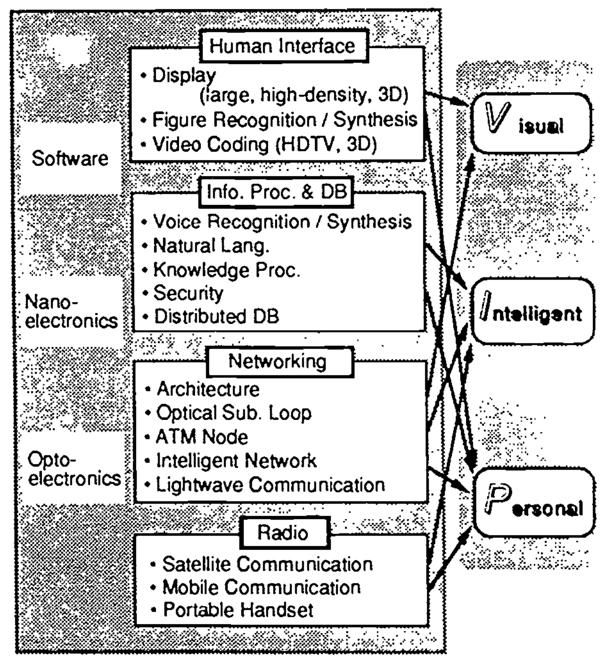

FIGURE 9. *TECHNOLOGIES FOR VI&P COMMUNICATIONS SERVICES.*

The VI&P vision aims to contribute to culture by streamlining and sophisticating the communications processes and quality through enhancement and diversification of the means of communications. The network and the communications services must be designed to put technology to work in order to open up the unlimited possibilities of communications and create new styles and values of human communications.

Amidst this increasingly progressive visual information culture, VI&P communications services are directed toward achieving an interactive media for user -selectable information communications in a fashion that prevents "information pollution" and "communication excess." By pursuing a network which supports Visual communications, Intelligent communications, and Personal communications, NTT intends to develop future communications services respecting users' essential communication needs.

In order to achieve this goal, we shall continue to say attention to the needs of the times and to the opinions of our customers, and to progress our Research and Development.

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An Implementation of Common Channel Signalling
Capabilities on TDX-1 Switching System

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Abstract

This paper describes design concepts, system architecture, design scheme, performance evaluation, and the test result of the common channel signalling function in TDX-1 switching system. At the same time, the deployment plan of CCS No.7 system in Korean ISDN network.

I. Introduction

ETRI has been studying ISDN technology for about 7 years. ISDN field trial service is now under its operation in 3 big cities, Seoul, Daejeon, and Cheju. These 3 cities are interconnected with CCS No.7 system for the ISDN services. This CCS No.7 system is the nation's first working system in the real network. The TDX-1A/B switching system is a digitalized and a fully distributed control system so that it could be easy to modify and to add new functions on the system. It means the system is very flexible so as to apply the system to any telephone network and also to data communication network, even to the oncoming ISDN network. In small cities, rural country side, and even in down-town areas, TDX-1 system is installed and operated. The installed lines reached up to 2 million. This figure says TDX-1 is a main system in the Korean telephony network. In order to implement ISDN capabilities on TDX-1A/B, the essential part is the CCS No.7 functionality. When we develop new technologies, such as the ISDN and the CCS No.7, we need to understand the standard specifications, test specifications, and requirements very carefully and prepare the national standard. Above all, the most important is a testing, test for individual function blocks, test for function interconnection, and test for protocols, validation, and compatibility. We know these test activities are necessary and important but there are many difficulties since the system that we are developing is the only one existing system, which ought to be a test bed, a standard, and a model system in the overall developing stage, which is the target system itself to be tested at same time.

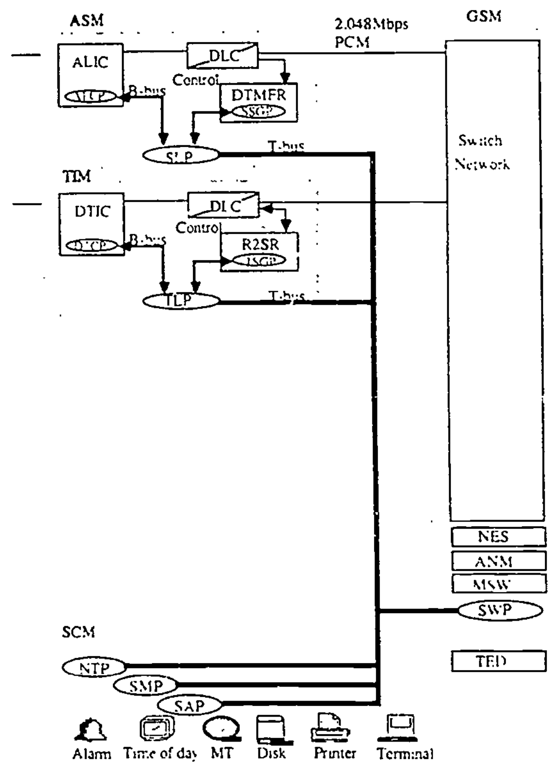


Figure 1. Hardware Structure of TDX- 1

II. A Brief Introduction of TDX-1 Switching System

1. A Brief System Structure

TDX-1A/B is a fully distributed control switching system which has a number of function blocks. Each one of the function blocks has a standardized control processor and the cluster. The control processor is divided into T-group processor and B-group processor. Each T-group processor is duplicated for the safety of the system. The B-group processor is controlled by the T-group processor. The cluster has the specific function of a function block. The processor of the cluster is called B-group processor. Inter processor communication is performed by the distributed reservation and selection technique via the global bus. There are two types of bus in TDX-1A/B. One is the T-bus which is a bus connecting all the T-processors and the other is the B-bus which is a bus between a T-group processor and a B-group processor. Figure 1. shows the hardware structure of TDX-1. According to the design concept, we added common channel signalling function. Figure 2. shows the hardware structure of TDX-ISDN.

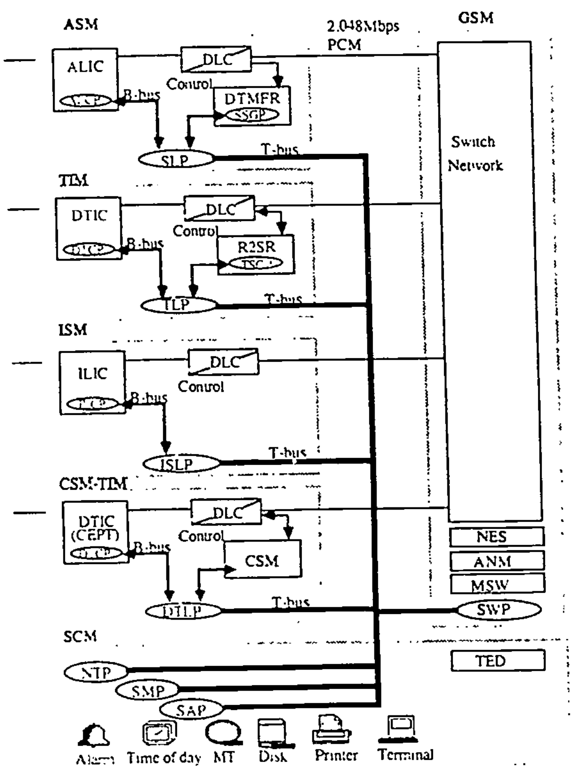


Figure 2. Hardware Structure of TDX- ISDN

2. System Capacity

TDX-1A is the first version. It has about 10,000 subscriber lines, 1,920 maximum trunks, 1,600 Erlang and 100,000 BHCA. TDX-1B is the updated version. It has about 22,000 subscriber lines, 4,800 maximum trunks, over 3,600 Erlang and 220,000 BHCA. It is enough to apply TDX-1 system for rural and country side application with local, transit, and remote subscriber handling functionality.

3. A Design Concept

TDX-1A/B is a fully distributed control system. It means that several control processors are involved in order to handle a function. Therefore, the implementation should performed under the concept of minimizing the impact on the existing whole system as much as possible. And another important point to be considered is the minimization of the influences caused by the newly added function and the simple message addition for the new services and the easy change of M&A function and the fast transition to the commercial exchange. For the purpose of above mentioned, the newly designed function module has been maintained the structure of the mother system and the compatibility of mother processor. A protocol is designed with functional modularity scheme so as to satisfy the layered structure for the flexible function addition and modification.

III. Common Channel Signalling System Development

1. Strategy

A new function design in an existing system needs a great amount of system engineering before starting design work. At the system engineering stage, a few experts, who have the knowledge for the whole system structure and the whole function, are working together on the system. We have to investigate system capacity, system structure and impact on the system by adding a new function. Especially, TDX switching system is a fully distributed control system in which a new function distribution into each function block must be well defined in order to reduce the impact and make an optimized design. After system engineering work, the function implementation is rather simple. The hardware structure of CCS No.7 is based on the TDX hardware design scheme. The signalling function is added into TDX system instead of designing a new separated whole function. For this reason, CCS No.7 operation and maintenance function is performed by the existing integrated system operation and maintenance function block using function addition and modification.

2. Development Events

A development project of the early version of CCS No.7 signalling system on TDX switching system had been launched in 1989. At that time the primary purpose of the development was to get a test bed system for CCS No.7 function. We would like to use the system for testing CCITT protocol specifications to fix a national standard specification. This system was installed and operated between two cities, Seoul and Daejeon. We got great experience through the operation and got operational data, such as quality of the trunk lines, signalling network configuration data. This achievement was followed by a new project for field trial and further commercial service system development. A core and basic technology, system engineering work of the project has been carried mainly by E.T.R.I.. We transferred the technology to 4 companies, Daewoo, Gold Star, Sam Sung, OTELCO to promote an effective system development, to shorten the development time, and to overcome shortage of research staff. This field trial and preliminary commercial service version is under field trial operation interconnected between cities, Daejeon, Seoul and Cheju Island.

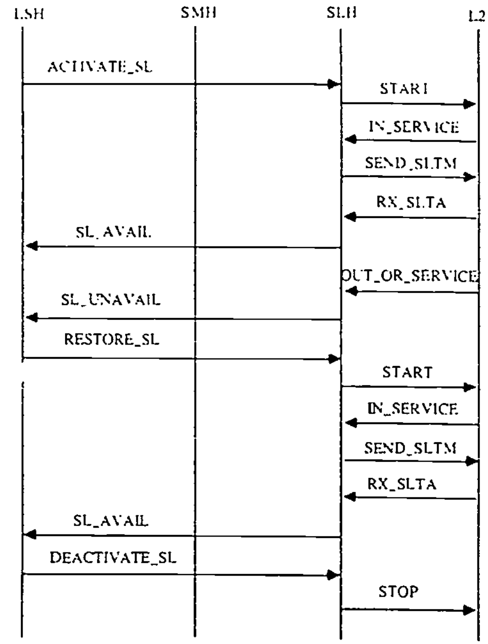


Figure 3. Software Signals

3. CCS No.7 System Structure

Commercial service system needs high reliability and maintainability. For these purposes, the main processor is duplicated, signalling message handling function is assigned to a dedicated processor, and operation and maintenance function is much enhanced. Function handling software has modular structure for easy modification, easy updating and reducing impacts from further changing. Each function module is programmed and tested individually and completely. After module integration, the one thing to be tested is the whole system function. Each module is inter communicated by well defined software signals. Figure 3. shows an example of the software signal between modules. This approach is very useful in design work of a big system by a few individuals. Figure 4. shows the CCS No.7 system structure and Figure 5. shows its subsystem structure.

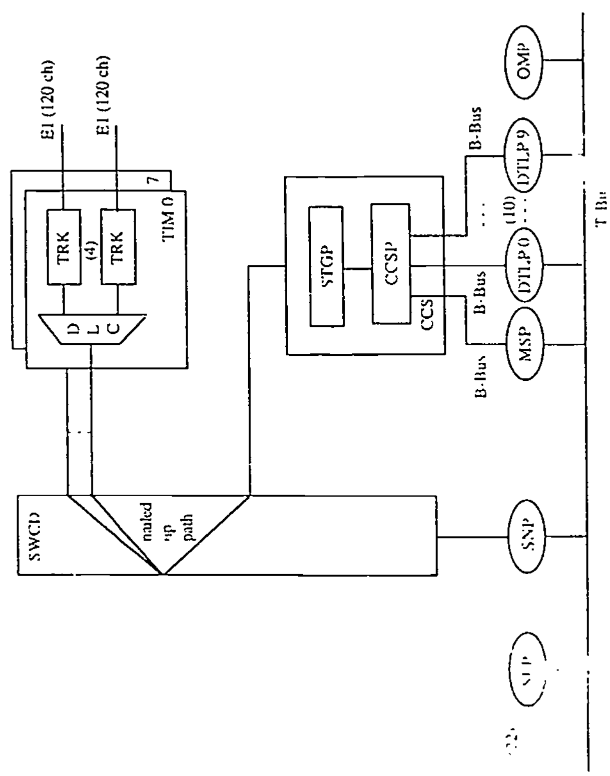


Figure 4. CCS N0.7 System Stucture

3.1. Hardware Structure

In the existing TDX-1A/B, TIM(Trunk Interface Module) is a T1 digital trunk interface module at which the interoffice signaling is performed by R2 signaling. CCS No.7 TIM is a CEPT TIM for CCS No.7 signaling system which is added on the TDX-1A/B system. CCS No.7 TIM consists of the CSS(Common channel Signalling Subsystem) functioning MTP(Message Transfer

Part), DTIC(Digital Trunk Interface Circuit), DTCP (Digital Trunk Control Processor), DLC and DTLP (Digital Trunk Line Processor) handling ISUP(ISDN User Part) and Call Control function. These ISUP and call control functions are distributed on the several DTLPs by necessity. CSS has 16 STBs(Signalling Terminal Board) handling MTP level 2 function and expandable, CCSP(Common Channel Signalling Processor) handling MTP level 3 function, and MSP(Maintenance and Service Processor) handling management functions. CCSP consists of SPB(System Processor Board), SMB(System Memory Board), MHB(Message Handling Board), BIOB(B-bus In/Out Board), DPB(Dual Processing Board). SPB handles main functions using an event driven operating system (EROS). These functions are level 3 protocol, timer, job scheduling, operation and maintenance function, and dual processing handling. SMB is a system memory with 1 Mbytes capacity. MHB interfaces with STBs by hardware arbitrated round robin scheme. Message handling function is located in this board. BIOB has 4 channel I/O port towards T-level processor. DPB is a supervising processor for dual SPB functions. It decides change over between the dual processors. We use hot stand-by dual processing scheme that means one processor is acting a active role and the other is acting a hot stand-by role. During the processing, two processors are working with the inputed data but difference is the stand-by processor is prohibited to send output data. Both processors retain the same operational data state by exchange the data through a special data bus named X-bus. Figure 6. shows dual processor structure. MSP is a T-level processor for signalling point data loading and updating, maintenance functions such as CCSP status supervision, DTLP status supervision, Bus status supervision and nailed-up path management data. This processor will be used for further function expansion such as ASE and TCAP. We designed a special bus called BAB(Bus Adapter Board) between BIOBs and T-level processor, DTLP with differential signal level. Figure 7. shows this scheme. Usually, one T-level processor handles several B-level processors but CCS No.7 function block is a B-level processor which belongs to more than one T-level processors, DTLP, depending on the signalling network configuration. So,

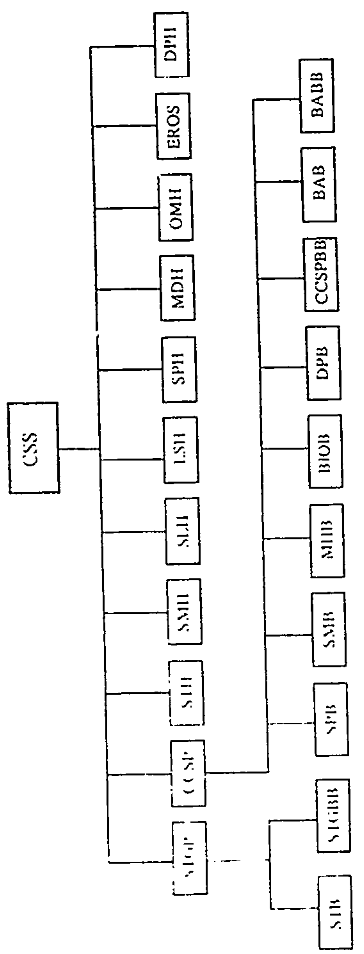


Figure 5. Subsystem Structure of the CCS No.7 Signalling System

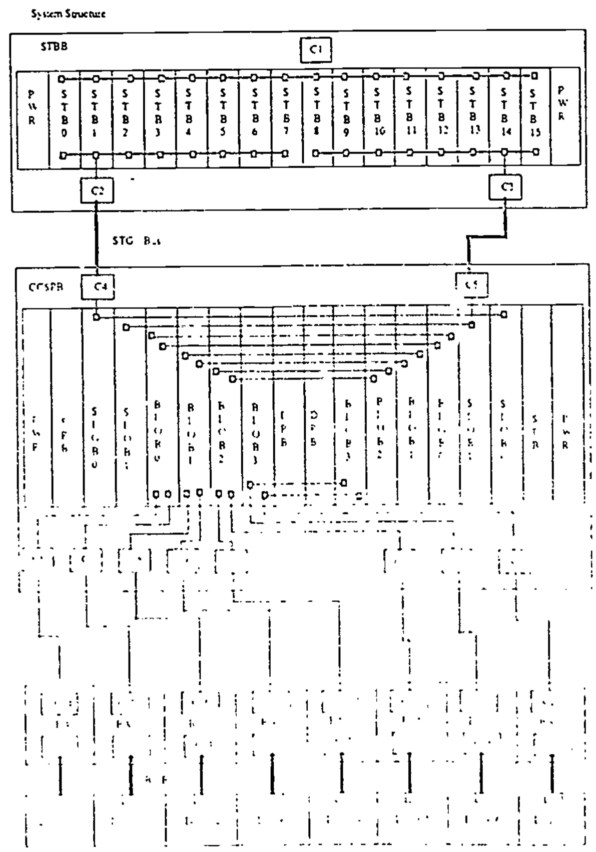


Figure 6. Dual Processor Structure

sometimes installation distance is apart far away. Figure 8. shows the hardware structure of the CCS No.7 signalling system.

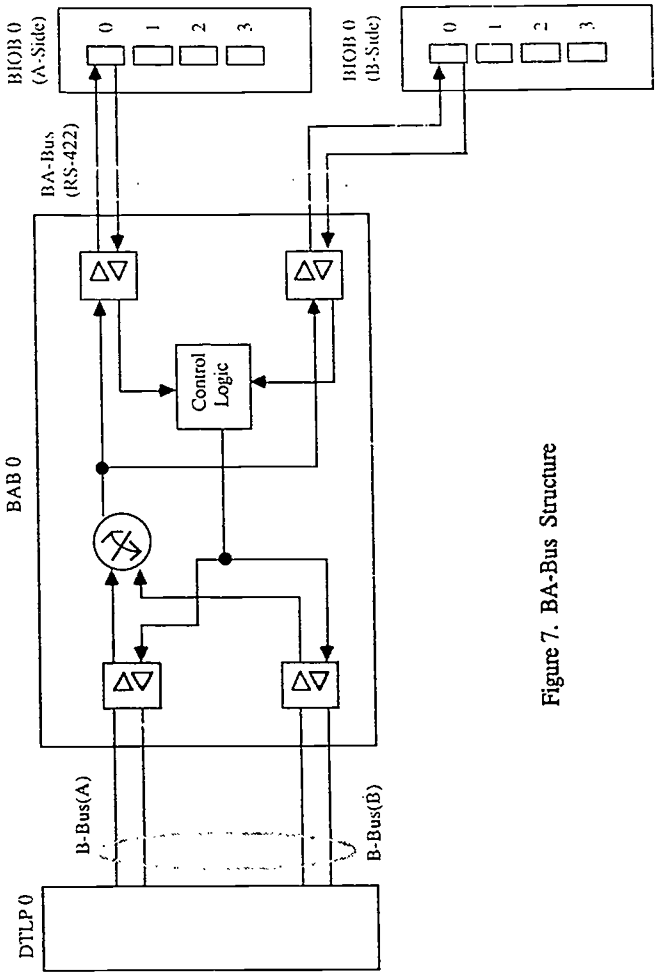


Figure 7. BA-Bus Structure

3.2. Software Structure

CCS No.7 function is implemented with a modular design scheme. One message handling involves many processors and software function blocks. Software modules consists of EROS(Event driven Operating System), STH(signalling Terminal Handling), SMH (Signalling Message Handling), SPH(Signalling Point Handling), LSH(Link Set Handling), SLH(Signalling Link Handling), MDH(Message Distribution Handling), OMH (Operation and Maintenance Handling), and DPH(Dual Processor Handling). EROS is a real time operating system for task, timer, interrupt and buffer management function. STH handles MTP level 2 function. SMH handles signalling messages and routing table management. SPH performs signalling point restarting, destination point, route status, network timer

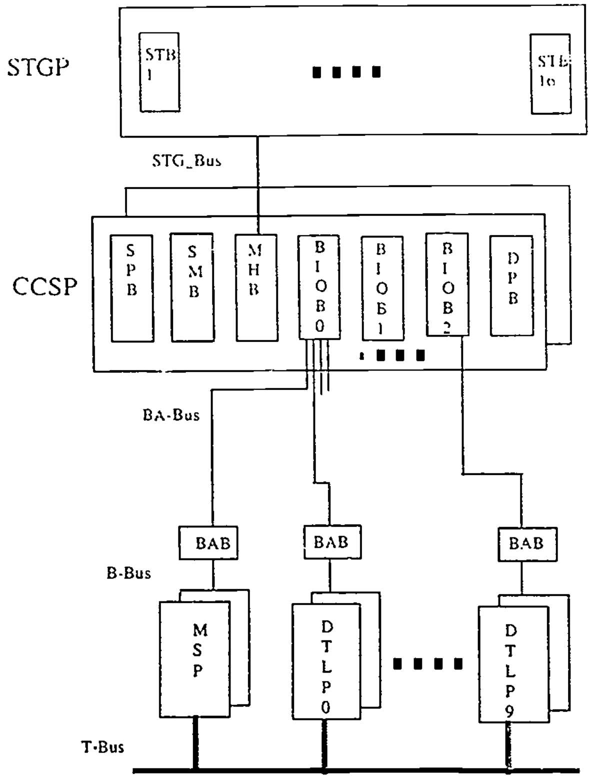


Figure 8. Hardware Structure of the CCS No.7 Signalling System

management, and change over, change back between link set function. LSH covers link set status management. and change over, change back between links function. SLH is assigned for link status management, link activation and deactivation and restoration function. MDH is a function block for message and signal input, output function. OMH deals operation and maintenance function as a whole including operating data management, management data measurement and alarm handling. The function block DPH is dedicated for dual processing. Figure 9. shows the software structure of the CCS No.7 signalling system.

4. Protocol Test and Performance Evaluation

Protocol testing is very important and never missed. It is an essential par in the project for proving compatibility and validity. In the development stage, we tested the protocol in the development system which is SUN computers. After full function integration, the protocol is tested by protocol testers using own protocol testing program. Figure 10. shows protocol test configuration and Figure 11. shows development and test

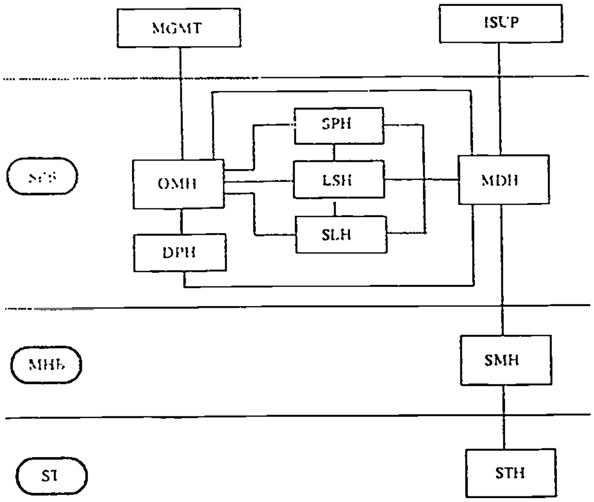


Figure 9. Software Structure of the CCS N0.7 Signalling System

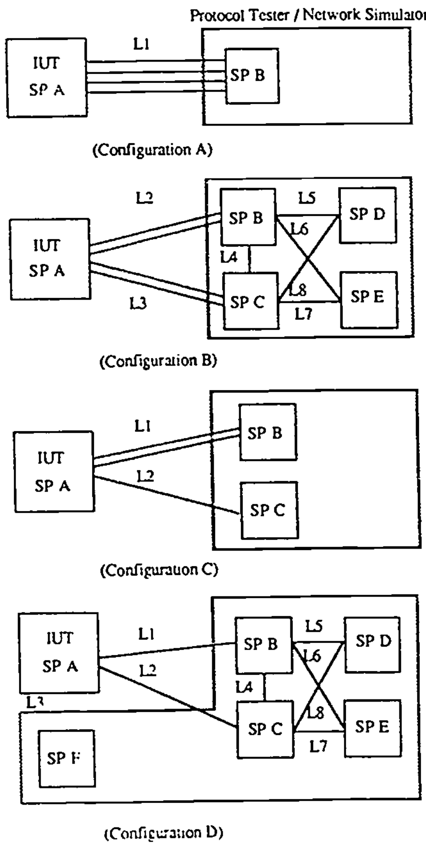


Figure 10. Protocol Test Configuration

configuration. Interworking and compatibility test was performed with other systems, TDX-10 and SMX(STP dedicated system). The performance evaluation has been done in different aspects, by simulation during system engineering stage before designing H/W, S/W, by

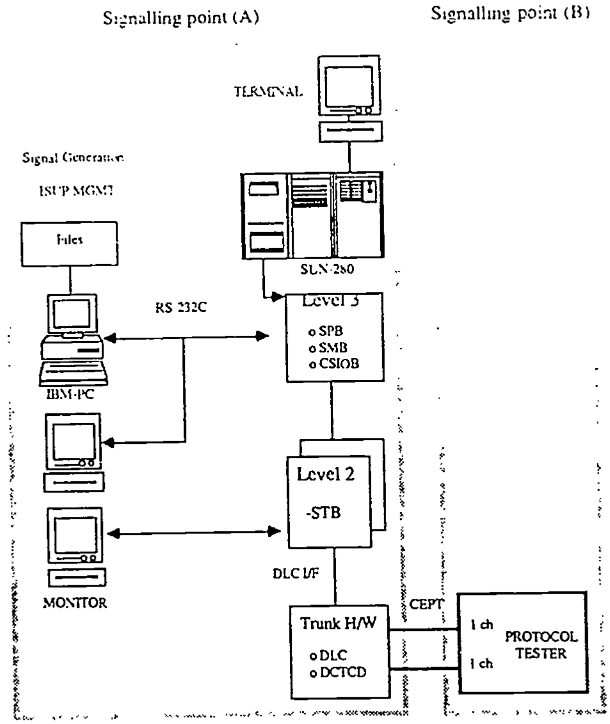


Figure 11. Development and Test Configuration

measurement after getting the real system. The got almost same results. Here show a calculation for performance evaluation.

(1) Maximum trunk call handling capacity in TDX-1B.

- 3600 Sec X Max trunks(CH) X Erlang / Holding time
- 3600(Sec) X 3,840(CH) X 0.8(Erlang) / 90(Sec) = 122,880 BHCA

(2) Processing messages per second

- 122,880(BHCA) X 7(msg/call) / 3,600(Sec) = 240(msg/Sec)

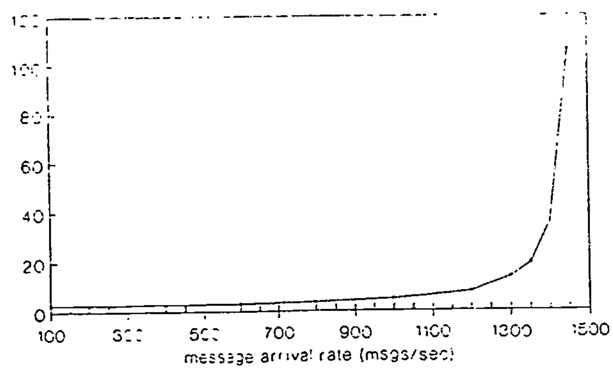
(3) Maximum evaluated processing capacity in CSS

- Average message length = 30(byte/msg)
- Per call ISUP message = 7(msg/call)
- SEP message processing capacity = 1,100(msg/sec)
- STP message processing capacity = 1,350(msg/sec)

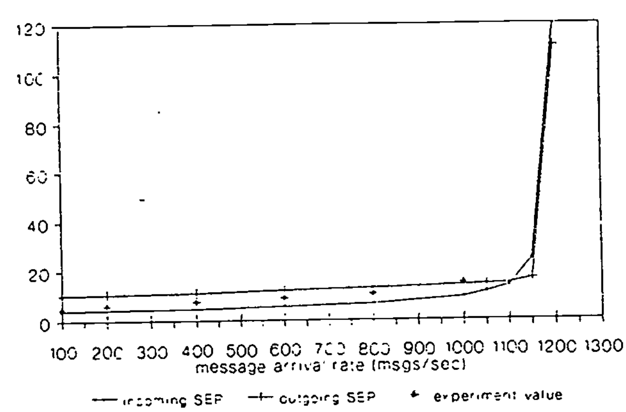
Figure 12. shows simulation results of the system capacity for SEP or STP application.

5. Future Deployment Plan

Considering the installed TDX-1 system in the network and the result of the pilot and field trial



(SEP Application)



(STP Application)

Figure 12. Simulation Result of the System Capacity

services, the possibility of commercial service application of the CCS No.7 on TDX-1 system becomes very clarified. The field trial CCS No.7 network will be expanded into seven big cities in the nation at the end of this year. This network will be a backbone signalling connection for the ISDN service among these cities. The commercial service is time tabled from July, 1993.

VI. Conclusions

The commercial model of CCS No.7 system will be fully tested and modified before its deployment using the model from 4 local companies. We get much experience from the pilot and field trial service operation. Field trial network becomes stable and very successful. The know-how will be feedbacked into the further development. This very first implementation of CCS No.7 signalling network in Korea could be used as a test-bed for other signalling system development activities. As a result of the operation, we know the commercialization of TDX-1 ISDN using common channel signalling network is very reasonable and feasible. We understand that the cooperative working method with local company is a very good try and strongly recommendable in the future development.

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Technology Enablers for Residential Broadband Services
in Today's Loop Environment

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1. ABSTRACT

A variety of video and multimedia services are in demand in the residential environment that will require bandwidth capabilities far in excess of the conventional 3 kHz bandwidth used in Telephone Company loop plant. This paper provides a review of a variety of loop and network technologies that can be used to expand that bandwidth and thus support those services. These technologies, including Fiber-in-the-Loop, Digital Subscriber Line and Asymmetrical Digital Subscriber Line technologies, will support and deliver bit-rates near and in excess of 1.5 Mb/s to residential Telephone Company subscribers. Supporting those delivery technologies are video compression, video storage and Asynchronous Transfer Mode switching. As the network evolves, care must be taken in the choice of technologies to ensure that the support for new residential services is not precluded.

2 INTRODUCTION

Market studies [1] over the past several years have shown that there is a significant demand and willingness to pay for a wide variety of residential broadband services that will require a significant increase in bandwidth over that used in the delivery of narrow-band services today. Those studies have identified the following services, now often referred to as Video-Dial-Tone (VDT) services, as those that have the highest consumer demand. Video-on-Demand leads the way with over a 60% level of interest in over 1500 households surveyed in the NYNEX region.

- Movies-on-Demand/Video-on-Demand
- Instructional Courses
- Videophone
- Games-on-Demand
- Expanded Entertainment
- News and Information

The demand for these services has led NYNEX and the industry as a whole to investigate the variety of loop, network and other technologies that can be made available to deliver broadband services to residential customers. Those technologies include:

- Fiber-in-the-Loop (FITL)
- Copper Pair and Asymmetrical Digital Subscriber Line (ADSL)
- Digital Subscriber Line (DSL)
- Video and Multimedia Server
- Video Compression
- Asynchronous Transfer Mode (ATM) Switching
- Network Control Systems

and a wide spectrum of Customer Premises Equipment (CPE) This paper will provide a review of such technologies, with an emphasis on loop technologies It will present a common sense path for deploying new loop technology in the future (See [2]).

3. RESIDENTIAL BROADBAND SERVICE REQUIREMENTS

Video-on-Demand, the residential broadband service with the highest likely demand, requires that we provide full motion and quality video in a configuration that permits customers make selections in real time. Interactive multimedia services have similar requirements in that customers will require real-time access to quality text, graphics and video information. The requirements for these and similar services can be equated to Bandwidth, Quality and Interactivity and can be supported from a generic network architecture standpoint as shown in Figure 1.

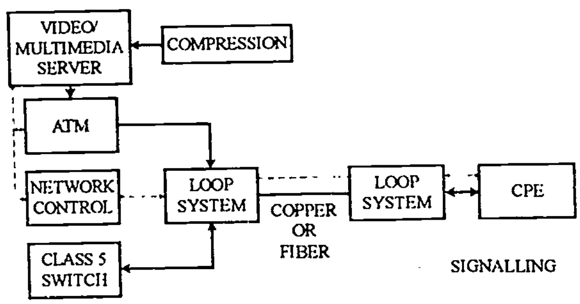

FIGURE 1
GENERIC RESIDENTIAL BROADBAND ARCHITECTURE

In this architecture, subscribers would be provided access to a video server via an ATM switch and one of a variety of loop systems A video server, based on either hard disk or robotic technology, could contain hundreds or thousands of digitally compressed videos that are accessible on a real-time basis. Market research indicates that, for a Video-on-Demand service, interactive capabilities such as fast-forward, rewind, pause and other VCR-like capabilities are required on a real-time basis Therefore, control of the access to broadband information, such as videos, must be provided to the subscriber via a full duplex signalling channel and a network controller. The network controller would interpret the customer requests and instruct the ATM switch and information server to provide the connections required to deliver the requested information to the customer. Of primary importance is the requirement that Plain Old Telephone Service (POTS) also be supported by the same loop system. POTS switching is supported by a conventional class 5 switch in the near-term, and perhaps will be supported by an ATM switch in the future.

Relating our bandwidth, quality and interactivity requirements to this architecture, bandwidth must be supported by the server, switch and loop transport system. Quality is related directly to the bandwidth of the switch and transport system as well as to the sophistication of compression techniques that are used. Interactivity must be supported by the signalling channel, the network controller and the functionality within the ATM switch and the server. The remainder of this paper will pay particular attention to loop transport and video compression technologies.

4. HYPOTHESIS FOR TRANSPORT EVOLUTION

The bandwidth required to transmit video or graphics at an acceptable level of quality has historically been thought to require the capabilities and flexibility of FITL systems. More recently, new and evolving technologies, such as ADSL, a new 1.544 Mb/s Digital Signal Processing (DSP) based technology, have made it clear that near-term alternatives can be made available well in advance of the ubiquitous availability of FITL. Combining Motion Picture Experts Group (MPEG) 1.5 Mb/s video compression and ADSL technologies will ensure that a quality video signal can be delivered to our subscribers. However, ADSL technology does have its limitations. ADSL, in any practical form, will be limited in the number of simultaneous video channels deliverable and/or the quality of video provided on those channels While the ADSL/MPEG alternative is attractive for the near-term, FITL is expected to be the long-term solution for offering VDT services in the Telephone Company environment.

5. MPEG COMPRESSION

Several years ago, the Motion Picture Experts Group of the International Standards Organization (ISO) began developing video compression standards for the purpose of supporting the access to video information at about 1.5 Mb/s, a rate that can be supported by CD-ROM technology. This technology, dubbed MPEG-I has been documented in a standards proposal at the decoder level and has been forwarded to ISO for consideration as an International Standard. Subjective tests performed at NYNEX indicate that MPEG-I compression techniques are capable of producing video at a quality level somewhat better than VCR quality. These results were promising in light of the plans for developing 1.544 Mb/s ADSL technology.

Subsequent to much of the MPEG-1 work, applications were identified that require quality significantly better than VCR-like quality. These applications included Direct Broadcast Satellite (DBS), cable TV, High Definition TV (HDTV), and other residential video applications. As a result, an MPEG-II development effort has been underway, under the auspices of the ISO-MPEG body, to support these needs; efforts are now directed at developing a video compression algorithm that will operate at various rates between about 3 Mb/s and 20 Mb/s. Early tests have shown that compressed video bit-rates on the order of 4-6 Mb/s can support broadcast quality video. Projections indicate that HDTV may be supported at an MPEG-II bit-rate on the order of 20 Mb/s. It is expected that an MPEG-II standards proposal will be available in 1993.

6. ASYMMETRICAL DIGITAL SUBSCRIBER LINE

At about the same time that MPEG-1 standards were being developed, the development of a new loop access technology, High bit-rate Digital Subscriber Line (HDSL), was under way HDSL was intended to permit full duplex, repeaterless access to our network at 1.544 Mb/s. Initially, it was thought that there could be a marriage of MPEG compression and HDSL in order to provide residential customer access to video via the existing copper loop plant. With the results of market research leading the way, there was enthusiasm about the possibilities here.

However, there were several constraining factors that rendered the use of HDSL in the residential environment unrealistic. First, HDSL in its classical form, requires the use of two copper pairs. In NYNEX, as in much of the United States, the average number of copper pairs available to residential customers is about 1.2 to 1.5. Therefore, a significant percentage of our residential population could not access the network via HDSL technology. Furthermore, the baseband modulation techniques used in the generally accepted HDSL implementation, and specifically the 2B1Q line code, does not permit simultaneous support of conventional telephone service. Additionally, the 12,000 foot loop-length limitation of HDSL restricts its use to distances near only the average loop length in the NYNEX Region. This, along with the requirement for two pairs, is not an acceptable constraint Add to this the projected cost of HDSL (presently $5000-$8000 per loop and possibly about $2000 per loop in quantities [3]) and it becomes clear that HDSL is not an acceptable option for supporting residential broadband services.

An alternative was sought and in circa 1990, scientists at Bellcore proposed a new digital signal based technology that could:

- operate on a single wire pair,
- over 18,000 feet,
- with up to 3000 feet of bridge taps,
- in a single direction,
- deliver an asymmetrical 1 544 Mb/s signal,
- simultaneously support conventional telephony or basic rate ISDN with the high rate signal, and
- simultaneously support an interactive 16 kb/s signalling channel.

This concept, Asymmetrical Digital Subscriber Line (ADSL), was subsequently pursued by a number of common carriers and vendors across the world and now is being addressed by the T1E1.4 working group in the United States where various proposals are under consideration. The architecture proposed for ADSL is shown in Figure 2. In this architecture, the ADSL Terminal Unit in the Central Office (ATU-C) unit provides the modulation and signal combining functions while the ADSL Remote Terminal Unit (ATU-R), in communication with the ATU-C, performs the more difficult adaptive signal processing and signal recovery process

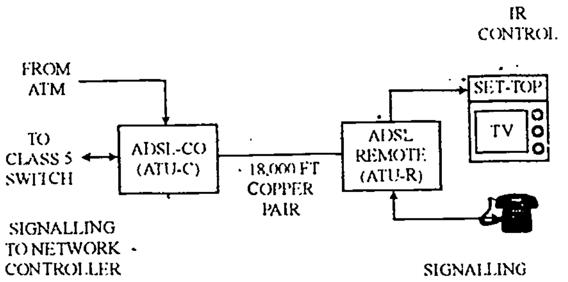

FIGURE 2
ADSL ARCHITECTURE

For loops approaching the distance limit, the high bit-rate signal arriving at the ATU-R is expected to be in the single millivolt range, have a pulse shape significantly different from the one transmitted at the ATU-C and be corrupted by crosstalk, thermal and impulse noise. Therefore a sophisticated level of digital signal processing is required that is under development in a number of research and development laboratories globally.

Various modulation techniques are under consideration by T1E1.4 that may meet the above requirements:

- Discrete Multi-Tone (DMT)
- Quadrature Amplitude Modulation (16 QAM)
- Carrierless Amplitude Modulation/Phase Modulation (CAP)

Computer simulations for each of these technologies have been relatively inconclusive as to which will perform the best in the real loop environment. Therefore, laboratory comparison tests of each of these techniques are scheduled for the first quarter of 1993 at Bellcore and NYNEX. It is anticipated that the results of those tests, performed on behalf of T1E1.4 will provide a basis for continuing standards work in that standards working group

In order to meet the aforementioned multiple and simultaneous signal transmission requirements, the POTS, signalling and high bit-rate signals are placed in the spectrum in a fashion as provided (for illustrative purposes only) in Figure 3. This will ensure that POTS, signalling and broadband capabilities can be simultaneously supported.

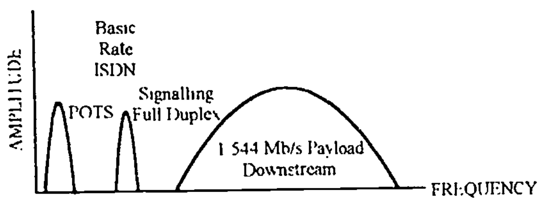

FIGURE 3
ADSL SPECTRUM - SINGLE COPPER PAIR

In light of the applications and development plans for a higher quality/higher bit-rate MPEG-II video compression capability, higher bit-rate ADSL (ADSL-II) solutions are now being considered. In addition, there has been identified a need for multiple channel video capability, a capability that would provide for multiples of 1.5 Mb/s each supporting MPEG-I video. However, as shown in Table 1, the capacity of the copper loop plant is limited. Thus the use of an MPEG-II compression technique or the use of multiple channels of MPEG-I and an ADSL-II in that plant is also limited.

Length:	300'	600'	1.5K'	3K'	6K'	9K'	12K'	18K'
Mb/s:	249	128	46.4	19.7	7.7	4.3	2.7	1.2

TABLE 1 [4]
Theoretical Transmission Capacity of 2-Wire 24 AWG Twisted Pair Copper
NEXT Dominated Environment - 49 Disturbers,
57 dB NEXT Loss at 80 kHz, BER=10^{-7}

As noted, the theoretical capacity at 18,000 feet of 24 AWG wire is 1.2 Mb/s, a capacity that indicates the challenge that will be experienced in trying to support even MPEG-I video at that distance. Studies in NYNEX show that the average copper loop length in the New York and Boston metropolitan areas is about 8000 feet. At those distances, we may be able to support up to three MPEG-I video signals, or one MPEG-II low bit-rate video signal, but only on about half of our loops. The remainder of those metropolitan loops as well as the majority of loops in suburban and rural areas will not be able to do so.

Therefore, if we are to universally transport signals at rates in significant excess of 1.544 Mb/s, alternative access architectures to ADSL, such as Digital Subscriber Line or Fiber-in-the-Loop, must be exploited.

7. DIGITAL SUBSCRIBER LINE

Since there exists a market need for video quality that approaches broadcast quality, e.g., MPEG-II quality, and also a need for multiple channels in the MPEG-I market environment, and since the copper plant is Shannon capacity limited, alternative delivery methods must be investigated. One such alternative is the use of Digital Subscriber Line (DSL). DSL, in brief, is a technology that utilizes a high capacity fiber backbone to feed broadband and telephony signals to Remote Digital Terminals (RDT) which in-turn feed individual pairs of copper wires that deliver services to the end-users.

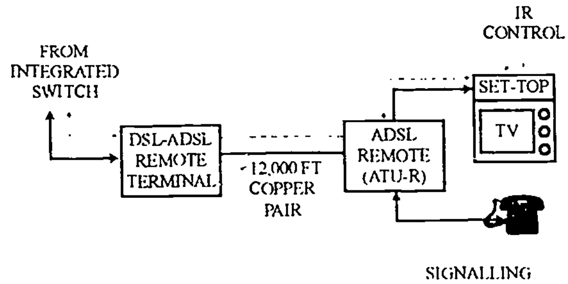

FIGURE 4
DSL ARCHITECTURE

In the past, telephone companies have deployed DSL technologies in Carrier Serving Areas, areas for which there was a goal of limiting the length of subtending loop to about 12,000 feet. In our goal to support one or more MPEG-II or more than one MPEG-I video signal, this would appear to be an attractive alternative and it is being investigated for those areas where DSL exists or is planned.

Several modifications will be required for existing DSL products in order to make this a viable solution (Figure 4). Central office equipment must be developed that will deliver the combined POTS, broadband and signalling channels to the remote terminal. Additionally, an ADSL capability must be integrated into the remote terminal. While such integration would significantly increase the penetration of a Video-on-Demand capability to end users served by DSL, such integration has not yet begun. Perhaps as important, DSL is used in the NYNEX region to serve well under 10% of residential subscribers. It is not clear whether there will be a significant increase in this penetration prior to the deployment of FITL systems, systems that can provide the long-term solution for our subscribers' residential broadband services needs. Investment in integrating ADSL into DSL remote terminals should thus be carefully scrutinized.

8. FIBER IN THE LOOP

Fiber-in-the-Loop systems have been under development for a number of years. However, it is noteworthy that many FITL systems were developed initially with the purpose of supporting Plain Old Telephone Service (POTS), with a secondary purpose of supporting conventional cable TV broadcast. Development of an interactive broadband capability by FITL vendors has only recently begun to be addressed, and it is anticipated that interactive broadband service requirements discussed above will only begin to appear in FITL product in late 1993 or early 1994. Therefore, it is prudent that the Telephone Companies carefully review the architectures and broadband features of FITL systems before decisions are made to deploy a particular system.

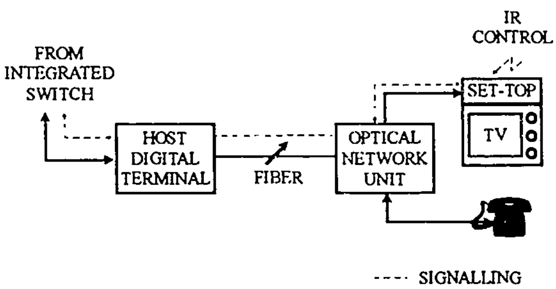

FIGURE 5
FIBER IN THE LOOP ARCHITECTURE

Fiber-in-the-Loop systems that will support a Video-on-Demand service, and as shown generically in Figure 5, must be capable of delivering from 64 to 120 conventional cable TV channels, supporting a full-duplex 16 kb/s to 64 kb/s full duplex signalling channel, as well as a full cadre of dedicated data channels that in turn can support multimedia data transmission or full quality digital video channels. This is in addition to the need to support conventional narrow-band POTS and Basic Rate ISDN services. At this time, there are FITL system vendors that are developing systems that will support all of these requirements. When taking advantage of video compression, such systems could, for example, support from 64-45 Mb/s broadcast channels to 1792-1.544 Mb/s broadcast channels depending on the type of video compression utilized. MPEG-II compression at about 4.5 Mb/s, which would support broadcast video, could be supported by this system in a configuration that could deliver about 600 broadcast video signals to our subscribers.

All FITL systems should be viewed with these or similar capabilities in mind. Otherwise, a FITL solution might be chosen that can do nothing more than support existing and conventional telephony and video services without the ability to gracefully expand in support of interactive residential broadband services

9. CONCLUDING REMARKS

There exists a market need for the delivery of more sophisticated video and information services to residential consumers than ever before imagined. The need to develop transport capabilities to support those services is thus of significant importance. The telecommunications industry has responded by developing and/or proposing a number of delivery technologies and systems including video jukeboxes, multimedia servers, network control systems, and loop transport systems. This paper has focused on the latter where several solutions are available or becoming available.

In telephone company environments where there is significant copper plant, limited DSL deployment and little FITL deployment, an evolution plan must be developed that will support near and long term support of residential broadband services. Such a plan might include:

1. Deployment of ADSL technology for loops that are under 18,000 feet in length and where there is no plan to deploy integrated DSL/ADSL or FITL to meet near-term needs.

2. Deployment of an integrated DSL/ADSL technology only if warranted by possible service take rate, rehabilitation plans and economic factors. FITL deployment should be considered before this option is selected.

3. Deployment of FITL technology capable of supporting conventional and narrow-band services, cable television broadcast *and* residential broadband or Video-Dial-Tone services. Deployment of FITL should be considered first in areas where alternative one and two do not or can not apply or where the economics, even projected economics, justify FITL over either of those options. Additional deployment scenarios should be based on rehabilitation, new build and other economic based needs.

Broadband loop technologies are crucial to the need to support residential broadband market needs. The technologies to support them are available or are becoming available now. Therefore, planning must not wait Only commitment will ensure that we can meet the residential broadband service needs of our subscribers in the near and long-term.

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Frame Relay and Evolution to ATM

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Abstract

Frame Relay is available today and being actively deployed by public and corporate data networks in order to support LAN to LAN interworking over Wide Area Networks (WANs). Frame Relay services are based on international standards, and primarily suited for data communication.

In parallel, there has been extensive standardization as well as design and development activity underway for the new Asynchronous Transfer Mode (ATM) technology and services. ATM technology will not only offer far higher bandwidths, but also offer higher speed access and brand new services, primarily for multi-media devices.

The topic of this paper is to explore the evolution alternatives for the Frame Relay and ATM technologies and services. The two technologies are briefly reviewed. The implications of the evolution from the service providers' viewpoint are studied. In addition, the service commonalities and evolution paths are examined from the end-users' perspective.

1.0 Introduction

The development and deployment of personal computers and workstations have driven the need for these devices to communicate for generating, obtaining, and sharing information. These devices have the power and sophisticated programming to make peer-to-peer and client-server communications natural and sometimes even transparent to their users. This same power enables them to make use of higher speed transmission services, and services that enable both multiplexed and simultaneous communication with multiple devices in diverse locations.

Much of that communication takes place over Local Area Networks (LANs). LANs have high transmission rates (typically 4 Mbit/s to 100 Mbit/s), few transmission errors, and multiple devices attached to them. LANs are being interconnected by bridges and routers to make networks that sometimes span the globe.

Wide area transmission techniques have also become faster and less susceptible to errors. This decreases the advantages of hop-by-hop error correction, allowing better performance by optimizing end to end communication protocols But the same increase in available transmission capacity also increases the attractiveness of sharing that capacity for communication to multiple sites.

This led to the development of Frame Relay technology and services. Frame Relay offers the end system or bridge/router a statistically multiplexed path to multiple locations as X.25 does, but with lower overhead due to the elimination of hop-by-hop error correction. Frame Relay has received rapid acceptance. There are many private and public networks, and many manufacturers of both end-user and network equipment. But it is still very much a new market, with ongoing technology, standards, service definition, and application development.

Even as Frame Relay is enjoying its first rush of deployment and use, another generation of technology has captured the attention of technology advocates in the standards, carrier, and user community. Asynchronous Transfer Mode (ATM), a technology under development in the CCITT standards committees for several years, is receiving increasing attention by makers of workstations, the LAN community, and end users as well as the carriers. Interest groups, alliances, and product announcements all receive many column inches of space in the trade press.

What are these technologies, and how will they impact users' and carriers' investment decisions? Whether you should skip Frame Relay and just wait for ATM? Or if Frame Relay is already being used, will it be necessary to migrate to ATM? Will migration be difficult? How do these new technologies relate to the private line or X.25 services in use today? This paper aims to provide some answers to these questions.

2.0 Frame Relay

Frame Relay is a data communication technique similar in many ways to X.25. It was first defined by CCITT in the context of ISDN, so has historically been standardized by CCITT Study Group XVIII. However, most of the deployment of Frame Relay technology in both private and public networks has been outside of ISDN by using V-series interfaces. For example, Northern Telecom's family of packet data network products has added Frame Relay service to the many other packet services it provides on worldwide public and private data networks.

2.1 Frame Relay and Other Network Techniques

A typical user of Frame Relay may be creating a network where there are multiple locations with LAN routers or bridges that need to communicate. Prior to the availability of Frame Relay, these routers could have been connected with dial-up modem or digital facilities, X.25 virtual circuits, or private lines. All these techniques still have their place. Frame Relay offers another service that combines some of the advantages of X.25 with some of the advantages of private lines.

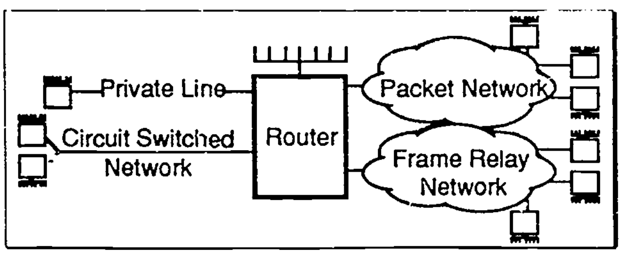

Figure 1: Wide Area Network Access Options

A private line usually provides the highest bandwidth[1] to a user. However, this is also the most restrictive interconnect

[1] The maximum available bandwidth already reaches at least 2.4 Gbit/s using SDH facilities.

option, in that only one other fixed location is available for each interface on the router.

A circuit switched line can reach many different locations, one at a time. Available bandwidth, while growing quickly, is usually limited to 14.4 kbit/s using V.32 bis modems, or 64/56 kbit/s using digital facilities. There is now increasing deployment of T1 and ISDN PRA switched networks, offering up to 1.920 Mbit/s, and even more limited deployment of switched T3 facilities with almost 45 Mbit/s capacity.

X.25 network interfaces brought the first widely available statistically multiplexed service. A router uses a single X.25 interface to reach many other locations over Switched or Permanent Virtual Circuits (SVC or PVC). This offers the opportunity for lower router costs due to the lower number of interfaces, plus lower network access costs for the same reason. Public networks usually tariff the service on a usage-sensitive basis. Although early networks were limited to 9.6 kbit/s, access speeds rapidly reached 64 kbit/s, with rates of 2 Mbit/s now available on Northern Telecom products.

Frame Relay, like X.25, offers statistically multiplexed virtual circuits with similar opportunities for savings in network interface and access costs. In currently offered services, these connections are Permanent Virtual Circuits (PVC). These PVCs are used mostly as replacements for private line services. Public network tariffs may be flat-rate based upon the committed throughput, or they may be based upon actual usage. Access rates range from 56 kbit/s to 1,920 kbit/s, but are expected to soon reach the T3 rate of 45 Mbit/s.

Each Frame Relay virtual circuit on an interface is identified by a Data Link Connection Identifier (DLCI). This serves the same purpose as an X.25 Virtual Circuit Identifier. It appears as the first two[2] octets of the frame header. The final two octets are the HDLC CRC-32, used for error detection. All of the remaining octets in a frame are available to carry higher layer protocols and user information.

There are several reasons that Frame Relay has gained rapid acceptance with a promising future. The ones we'll look at in the following sections are:

- Industry-wide Implementation Agreements,
- A single standard encapsulation for LAN traffic, and
- Frame forwarding techniques for bursty traffic.

Then we'll see how this evolves smoothly to ATM service.

2.2 The Frame Relay Forum Implementation Agreements

The Frame Relay Forum was established in 1991 to promote the interoperable implementation of Frame Relay equipment and services. The Frame Relay Forum now has over 100 corporate members with worldwide scope. These members include providers of network equipment, network access equipment, router and bridge vendors, workstation vendors, chip vendors, Frame Relay service providers, and users of Frame Relay services. As a founding member, Northern Telecom has played a major role in its activities.

The Forum adapted the ISDN-based definitions of Frame Relay from CCITT Study Group XVIII. For earlier availability, the Frame Relay Forum Implementation Agreement[1] for the User-Network Interface (UNI) expanded the physical layer specifications to non-ISDN interfaces.

The implementation agreement includes layer management procedures that allow the end system and network to ensure that each is still operational. Layer management procedures also indicate the status of the end-to-end communication path. The symmetry of the layer management procedures allows their use between subscribers and networks, between networks, or even where a private network is a subscriber to a public network.

An Implementation Agreement[2] for the Network to Network Interface (NNI) for PVC Frame Relay service has also been adopted by the Frame Relay Forum. Northern Telecom will be deploying NNI capabilities this year. This will allow end-to-end data transfer and the associated layer management signaling and procedures to insure that the end-to-end status of the virtual circuit is available at all NNI's and the two UNIs. The Inter-Carrier Committee of the Frame Relay Forum is already working on the second issue of this agreement. This might include, for instance, in-line procedures to enable a carrier to easily obtain the billing information for a call that traverses multiple carriers.

Although current Frame Relay equipment supports only Permanent Virtual Circuits, work is progressing on the standards for Switched Virtual Circuit (SVC) service. In CCITT, Q.933 is a completed specification for the User-Network Interface(UNI) signaling for SVC services. The Frame Relay Forum is producing implementation agreements for a subset of Q.933 for early deployment.

2.3 Frame Relay Standard for Inter-LAN Communication

Standards defining how end-systems communicate across a Frame Relay network are also important. Such standards allow users to combine equipment from different manufacturers to communicate either within a single user's environment, or via a public network to other users. A prime example of such a successful standard is the standard for interconnecting LANs across a Frame Relay network using routers or bridges as Frame Relay end systems.

To define how the LAN protocols would be carried within Frame Relay frames, the Internet Protocol over Large Public Data Networks (IPLPDN) working group of the Internet Engineering Task Force (IETF[3]) defined an encapsulation scheme: RFC1294: "MultiProtocol Interconnect (MPI) over Frame Relay."[3]

RFC1294 is a proposed standard, which is the first step in the IETF standardization process. Several independent interoperable implementations of this standard are already widely deployed. IPLPDN sought to maximize the value of this standard by including the operation over Frame Relay of not only the Internet Protocol (IP) protocol suite, but also consistent methods for dealing with other LAN protocols such as OSI ConnectionLess Network Protocol (CLNP). It even specifies a method of carrying LAN traffic across a Frame Relay network utilizing bridging techniques compatible with IEEE 802.1.

Figure 2 shows a simple internet consisting of two LANs communicating over a Frame Relay network. The boxes underneath show the relevant protocol stacks. RFC 1294

2 Frame Relay standards allow for two, three, or four octets for a DLCI. Services and equipment currently deployed implement only two octets.

3 The Internet Engineering Task Force is a voluntary organization chartered by the Internet Society.

deals with the MPI layer in this diagram. It defines how an IP packet is encapsulated across the Frame Relay network. This allows IP and other network layer protocols to be passed transparently between the routing software in the routers. When bridging of LAN protocols is desired, the whole IEEE 802.2 frame is similarly encapsulated for transparent carriage across the Frame Relay network.

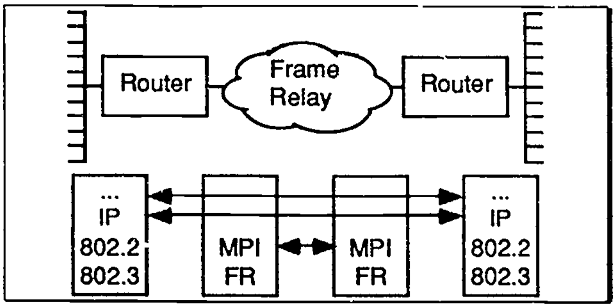

Figure 2: MultiProtocol Interconnection Over Frame Relay

This landmark work has seen rapid industry and standards acceptance. It has been implemented in many router and bridge products, and deployed in several private and public Frame Relay networks. The American National Standards Institute (ANSI) is currently enhancing the MPI over Frame Relay work to add support for carriage of even more protocols than IPLPDN specified.

Because of these co-coordinated activities in the Frame Relay Forum and the IETF, the new technology of Frame Relay is being deployed simultaneously in wide area network switches and in LAN router access devices to enable real benefits for end users. These benefits include the savings in access device interface costs obtained by statistical multiplexing of the network interface, and the savings in WAN facility costs arising again from statistical multiplexing. When using a public network, the access charges are likely to be lower for the single high speed network access facility, rather than multiple access facilities of lower speed.

2.4 Frame Relay Forwarding Techniques

The benefit of a single high speed network interface also allows other user benefits. Consider, for example, a network of six routers interconnected by a full mesh of 384 kbit/s leased facilities. The five 384 kbit/s lines at each site could be replaced by a single 1920[4] kbit/s line to a Frame Relay network. Although this offers the same **total** transmission capacity at each site, the statistical multiplexing nature of Frame Relay may allow more effective use of this capacity.

The "may" in the previous sentence is because there is a difference in the way Frame Relay network vendors implement frame forwarding within the network. In one case, although frames enter the network at line rate, they are transmitted across the network at the rate established for the particular virtual circuit. This allows precise engineering of backbone and access bandwidth. But it also means that the capacity reserved for traffic to other sites cannot be dynamically allocated when those VCs are not using their capacity.

This model is called **ingress buffering** because the frames received at line rate are buffered at the source node, then transmitted across the network and out the network egress link.

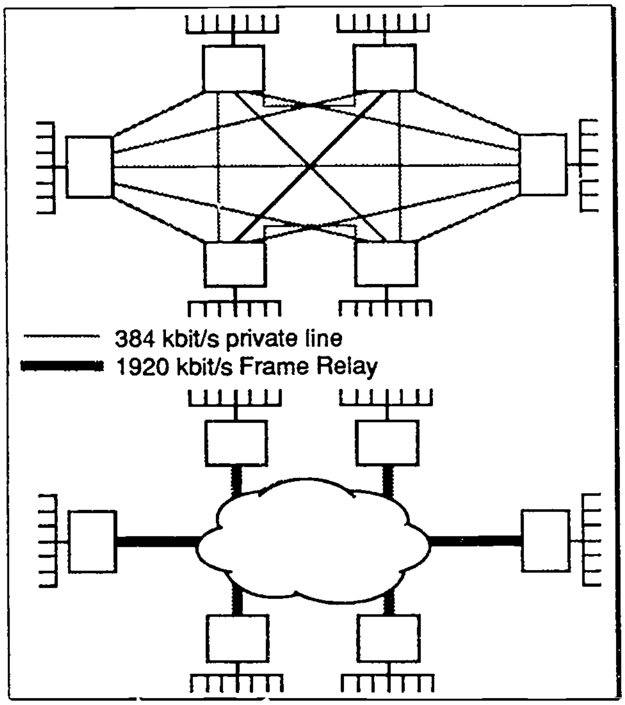

Figure 3 Private Line vs. Frame Relay Network

In contrast to this are networks such as those provided by Northern Telecom that immediately forward received traffic across the network at network trunk rate, and then out the destination link at its line rate. Data is only buffered at the destination node if the destination access line is busy transmitting a frame. The frame could be from the same source, particularly if the source access line rate is faster than the destination access line rate. Or the line may be busy transmitting data from other sources. This model for immediate network traversal is called **egress buffering**. It requires statistical rather than deterministic engineering of network facilities, but brings large benefits to those users whose traffic patterns are not deterministic or predictable.

These benefits arise because LAN traffic is very bursty not only between individual stations, but also when several streams of traffic are aggregated. An even distribution of traffic between the sites is unusual, and that distribution changes over time. Users initiate file transfers, including perhaps printing on remote printers, when they want.

An ingress-buffered network interface must have individual virtual circuits defined for each destination at the **maximum** throughput capacity needed at any particular time. An egress-buffered network interface, in contrast, allows the access line to be shared according to the instantaneous needs and capacities of the currently active sources and destinations.

In our example, it may be that the 'normal' level of background traffic between sites occupies 10% of the capacity to each other site. Then the amount of capacity available for an additional single file transfer in a source-buffered network is limited to 90% of 384 kbit/s, or 345 kbit/s. In contrast, in the

4 1920 rather than the more commonly quoted 2048 kbit/s line rate is used here, because this is the effective data rate most commonly available after allowing for the signaling and framing overhead of the transmission system.

destination buffered case, the data can move at 50% of 1920 kbit/s, which is 960 kbit/s, a 278% increase in throughput!

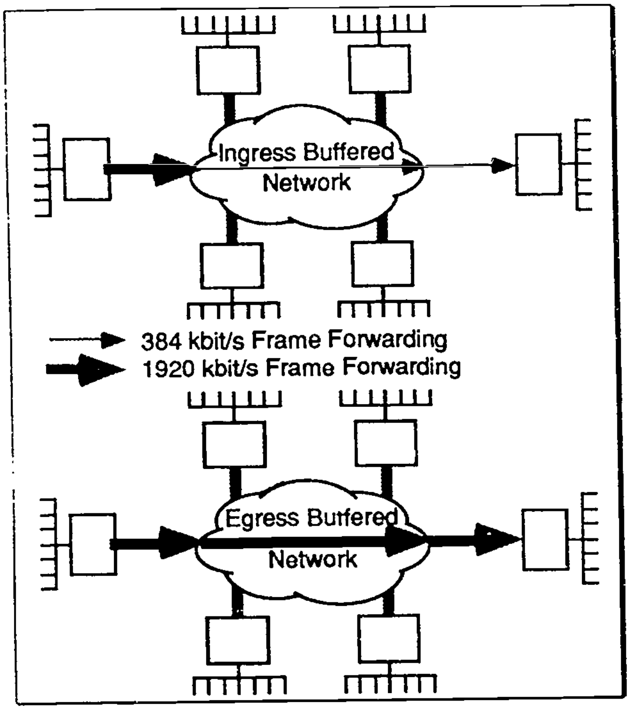

Figure 4 Ingress vs. Egress Buffering

Frame Relay standards are in place for both network and access equipment. Products have been developed, and networks are being deployed. For example, Northern Telecom has both private and public Frame Relay networks deployed in many countries. These networks also continue to offer their other selections from the wide range of other packet services available on Northern Telecom's DPN-100 family of data communications products. These include the synchronous X.25, X.75 and asynchronous terminal support using the X.3/28/29 standards, SNA support for terminals, hosts, and LANs, as well as specialized protocols for the banking, Point of Service, and airline industries. These are all carried across a common homogenous trunk backbone.

The benefits of Frame Relay for multiplexed data transfer across high speed, high quality wide area facilities are already being enjoyed by private and public network users. These benefits carry over into the emerging technology of ATM.

3.0 Asynchronous Transfer Mode

Asynchronous Transfer Mode is an emerging cell-based technology and set of standards. The standards are being developed by the CCITT working towards a new transmission system for Broadband Integrated Services Digital Network (B-ISDN). For this reason, it is envisaged as being able to carry all types of traffic.

3.1 ATM Traffic Categories

Circuit based services include ordinary voice telephone calls to high-speed video transfers. This Constant Bit Rate (CBR) traffic will be carried as an evenly spaced stream of cells.

Variable Bit Rate (VBR) traffic is generated by variably compressed or silence-suppressed circuit services. The more familiar packet and frame based data services also generate VBR traffic. These VBR services only generate cells at the rate necessary to carry the current traffic load.

These are ways the ATM network can carry traffic from existing and planned user services, in which subscribers don't necessarily have a cell interface. But subscribers also can get direct access to the basic cell layer of ATM networks. They then are able to send multiplexed cells to distinct destinations. This is similar to the Frame Relay capability to send multiplexed frames to distinct destinations.

3.2 ATM Deployment

As a public network technology, ATM is planned to be the switching fabric that will bring greater transmission throughput, better transmission utilization, and faster switching speeds.

ATM is now also being enthusiastically pursued as a potential private network technology for both LAN and WAN use. LANs began as a shared media, and thus shared bandwidth, technology. Token Ring/8802.5, 10BaseT Ethernet/8802.3, and FDDI are all now based upon non-shared media between workstations and hubs. If the hubs in LANs are replaced by switching technology, then the bandwidth to the individual stations does not need to be shared either.

LANs are also tied to particular Media Access Control protocols at particular fixed media speeds. ATM, like Frame Relay and X.25, is scalable to the needs of the individual workstation. If a new server or workstation must have higher transmission capacity, this does not require retrofitting the same capacity to the other systems already on the network.

The workstations that sit upon LANs continue to increase in power, and will be requiring the data rates offered by ATM. They are also running applications for which a multi-media transmission technology is desirable. It would seem prudent to adapt the millions of dollars of public network driven standards and technology development generated by ATM to the private network WAN and LAN environments.

So there is now a large body of people who are eager to deploy ATM technology in private networks, even within a single site. Public network leased line facilities may interconnect these local ATM environments initially, until there is enough critical mass to make the deployment of public ATM services viable. This allows the end-users to acquire and become familiar with the capabilities of ATM in their own environments. Thus the public networks do not have to deploy expensive infrastructure before the users get to develop the applications and interfaces they need to make effective use of the technology.

Both users and providers for public and private network interests are represented in the ATM Forum which was established in 1991. As a founding member, Northern Telecom participates actively in ATM Forum to replicate for ATM the benefits achieved by the Frame Relay Forum in getting early implementation of standards and compatible user and network equipment. Like the Frame Relay Forum, the ATM Forum already has a large membership of companies involved in a broad cross-section of the industry.

3.3 ATM Technology

Like Frame Relay, ATM is a connection-oriented technology that can be used to offer connection-oriented or connectionless services. All cells in a connection follow the same path through the network. Thus cells arrive in the same order as which they were sent.

ATM defines two major types of virtual connections, Virtual Path Connections (VPC) and Virtual Channel Connections (VCC). There are fields to identify both of these in the ATM header, called Virtual Path Identifier (VPI) and Virtual Channel Indentifier (VCI).

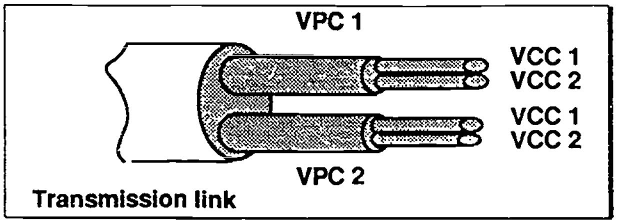

Figure 5 Virtual Path Connections & Virtual Channel Connections

As shown in Figure 5, Virtual Channel Connections are subsets of Virtual Path Connections. This allows the ATM network to use VPCs as virtual trunks between ATM switches. These Virtual Path Connection virtual trunks may then be routed amongst facilities by using ATM Virtual Path Connection cross-connects.

What are ATM cells? Cells are a fixed-length unit of transmission, rather than the variable length that can be carried by frames. The decision to base ATM technology on cells was based on the need to carry multiple types of traffic. This includes traffic types such as high-speed Constant Bit rate (CBR) traffic that requires very little variation in network delay.

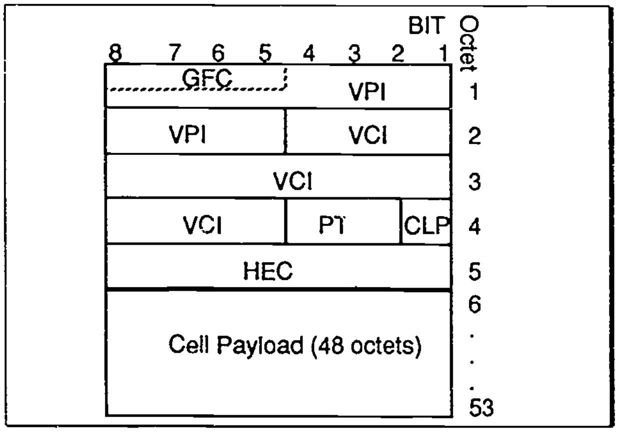

Figure 6: ATM Cell Structure

ATM standards specify a 53 octet cell, as illustrated in Figure 6. The first five octets are a cell header used for ATM functions such as virtual connection identification. The remaining 48 octets are cell payload available for information transfer and other higher layer functions.

The cell header format is slightly different at the ATM UNI and NNI interfaces. At the UNI, there is provision for some flow control functionality. This might allow several devices to equitably share a single ATM access line to the network. For example, an ATM access line to a residence may need an efficient simple way to handle several phones, televisions, and computer workstations without the need for switching. The Generic Flow Control (GFC) field of the ATM header in the UNI is available to support this type of functionality.

The Network to Network Interface by contrast is assumed to be point-to-point. For this reason, the GFC field in the UNI header has been eliminated from the NNI header. This allows for a larger number of Virtual Paths to be used as virtual trunks between switches.

The remaining fields in the header include a Payload Type (PT) of 3 bits, one bit of Cell Loss Priority (CLP), and an 8-bit Header Error Check (HEC).

ATM is currently defined to run on T3 facilities, as well as any of the Synchronous Digital Hierarchy (SDH) or Sonet rates. At these high rates, cell switching allows the low delay variation sought for circuit emulation, while still allowing the statistical multiplexing gains of packet-oriented traffic. At lower rates, cell switching has no technical advantages over frame switching. On the contrary, the cell overhead becomes more burdensome, and the cell accumulation delay does not allow effective mixing of multiple types of traffic.

3.4 ATM Adaptation

To carry traffic across an ATM network, the traffic has to be divided into a sequence of cells. Conceptually, this is no different from the existing practices of dividing traffic into packets (in X.25) or frames (in Frame Relay) or even datagrams (in Internet Protocol (IP) or ConnectionLess Network Protocol (CLNP)). For circuit mode traffic, the analogy is a little looser. In those existing time division multiplexed systems, the time slots into which the traffic is divided are not self-identified as belonging to a particular conversation, which is necessary in ATM to bring the benefits of statistical rather than time division multiplexing.

To allow interworking of different sources of traffic of the same type, this mapping function of information into ATM cells must be standardized. Different mappings are being defined to take account of the diverse requirements of different types of traffic. Then all of these types of traffic can be carried as multiplexed cells across a homogenous ATM backbone network fabric.

These mappings are defined in the ATM Adaptation Layers (AAL). The unit, or flow, of information that higher layer protocols wish to send may have service specific information added by a service specific Convergence Sublayer (CS) of the AAL layer. This information is then segmented into cells at the source and reassembled at the destination by the Segmentation And Reassembly (SAR) sublayer.

For the types of traffic that originates as packets or frames, three AALs have been defined. AAL-3 is for connection-oriented traffic, and allows cells from multiple frames from various points of a multipoint VC to be intermixed. AAL-4 is for connectionless traffic, and uses the same techniques to allow for multiplexed cells from various frame sources.

But for the simple case where cells from various frames are not intermixed within a single virtual connection, a very simple ATM Adaptation Layer called AAL-5 has been defined. AAL-5 segments frames into cells, but only adds control information to the last cell. This minimizes the amount of control information required per segmented frame, thus maximizing the bandwidth that remains to carry user data.

The last cell of a frame is marked in the ATM Payload Type field of the ATM header. The AAL-5 trailer is always the last eight octets of this cell. The length field in the trailer contains the length in octets of the original frame, 'n' in Figure 7.

Combined with a 32-bit checksum over the data that is also contained in the trailer, this provides a very powerful mechanism for detecting lost or corrupted cells.

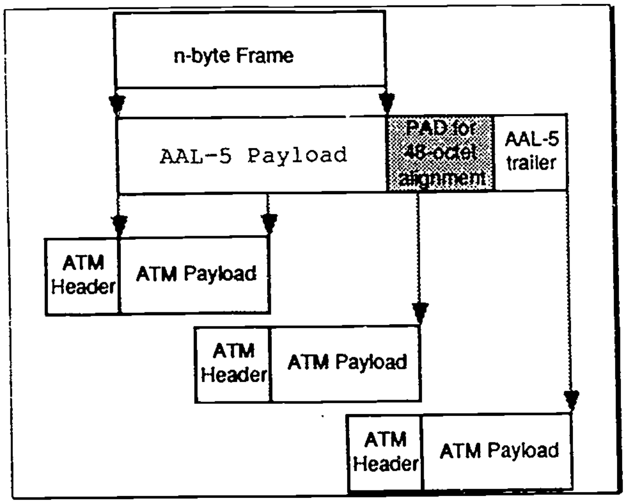

Figure 7: AAL-5 Adaptation

3.5 ATM Standard for Inter-LAN Communication

The Internet Engineering Task Force (IETF) is considering the application of ATM to interLAN communication in its ATM working group. Currently, it is envisaged that there may be at least three ways to carry today's interLAN traffic over ATM.

When there is an ATM network from source to destination workstation, there may be no need to carry the overhead of the LAN link and network layer protocols. In the OSI sense, this would mean using null (or very skinny) data link and network layers, with the transport layer riding directly on a suitable ATM AAL layer. In the TCP/IP protocol suite, this might mean running TCP and UDP directly on AAL-5. Or, there may be entirely new transport layer protocols that take even better advantage of the high bandwidth available with ATM. This environment does not provide interworking with current LAN-based workstations or protocols.

Alternately, it may be desirable to make the ATM network look as much like a LAN as possible. In this environment, the 8802.2 Logical Link Control layer is carried by ATM AAL-5. This maximizes the commonalty with LAN-based protocols, especially in a local ATM environment within which the use of bridges or routers is not necessary. Bridges and routers would still be used to connect the local ATM "LAN" to other LAN and WAN technologies.

It may also be desirable for the bridges and routers attached to the ATM network to interwork with the bridges and routers attached to the Frame Relay network. This is the subject of the next section.

4.0 Frame Relay to ATM

If Frame Relay is available today, and ATM will soon become available, which should be used when? The simple answer is: you can use both!

There are at least two ways in which this statement is true. The first is that Frame Relay traffic can be carried across ATM trunks between switches. This is part of the ATM promise to use a single switching fabric for multiple services. But it is also a way of providing much higher trunk speeds between Frame Relay services. This is called Frame Relay Service carriage over ATM. Northern Telecom's packet switches will use this technique not only for Frame Relay Service, but also their rich suite of additional packet data services.

The second is that traffic originating at a Frame Relay subscriber may be delivered to an ATM subscriber. This might be the case where traffic from a multitude of Frame Relay access lines terminates on a single or few ATM access lines. Or perhaps the ATM site has subscribed to an ATM access facility because it uses other ATM services not needed at the Frame Relay sites. This is called **interworking with ATM**.

Both user and network standards are necessary to allow successful interworking. The network standard is CCITT I.555. This standard defines a method of encapsulating entire Frame Relay frames from multiple Frame Relay virtual circuits into a single ATM virtual connection. This has the benefit of minimizing the resources required of the ATM network, both in virtual connection management and in traffic monitoring. At the same time, it also smoothes the statistical nature of the Frame Relay traffic, by combining many different sources of statistical traffic into a single larger statistical stream.

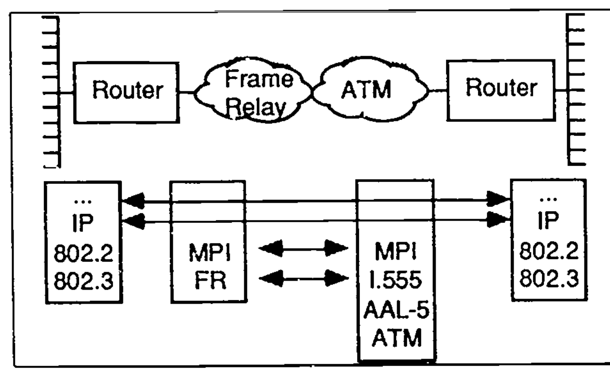

Figure 8: Frame Relay Interworking With ATM

The user protocol to allow bridges and routers to interwork between use of Frame Relay and ATM networks is also being developed. In the deliberations of the ATM working group of the IETF to decide how to carry LAN traffic across ATM, there is strong support for using the techniques of I.555 to allow interworking with Frame Relay. The technique is to use AAL-5 to encapsulate the data and control information that would have gone to a Frame Relay interface. Figure 8 illustrates the resulting protocol stacks.

This technique is useful in several environments. Perhaps the easiest one to understand is the need to easily add network capacity. It is unlikely that any public or private network large enough to consider adding ATM technology to an existing Frame Relay environment is able to shut down its network. Users whose site has been upgraded to ATM will want to continue to work with users whose site is connected by Frame Relay. And since it is likely that the first sites to be upgraded to ATM speeds are those that need the capacity most, it is even more likely that users at Frame Relay sites will still want to reach the resources at the ATM sites.

But network growth and expansion is not the only reason. Another is that the move to ATM may be driven by a desire at one, or a few, sites to have access to multimedia services that are not widely deployed. This might be the situation in an industry that has a few manufacturing and repair sites requiring rich connectivity for exchange of Computer-Aided Design (CAD) drawings or images of failed parts. However, it may well be that those CAD or image workstations remain unnecessary in sales or accounting offices.

Similarly, it is likely to remain true for many companies that certain locations remain small enough, or are in isolated enough environments, that access to ATM technology is either not justified or is simply not available. Here as well, use of Frame Relay services may continue to be the best answer. Interworking allows the major sites to use ATM to handle the consolidated bandwidth needs of the other major ATM sites and the many Frame Relay sites. Since Frame Relay is suitable at narrowband and wideband rates to T3, and ATM becomes suitable at T3 rates and above, interworking allows the end user to tailor the technology at each site to the needs of each site.

5.0 Conclusion

Frame Relay is a data network technology that is available today. Users have access to standardized access technology to enable them to use Frame Relay for real benefits in LAN Internetworking applications. Carriers can deploy the LAN bridges and routers for the users to provide a LAN to LAN public or virtual private network solution.

ATM is a networking technology that promises benefits to many applications besides data networking. When used to carry Frame Relay traffic, it offers a higher speed backbone trunking capacity. And it can be deployed in an inter-LAN environment for new capabilities or capacities while still allowing interworking with LAN traffic carried by Frame Relay.

Northern Telecom's family of packet data networks has integrated Frame Relay into the rich suite of data protocols it supports. All these protocols are carried together over a single trunk fabric. As ATM capabilities are added to this suite, additional capacity and services will become available while retaining the investment in user protocols, equipment, and practices.

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Biography

Mehmet Unsoy holds B.S.E.E, M. Math, and Ph. D degrees in computer science. From 1978 to 1983, he was a manager with Bell Canada, responsible for various design and planning aspects of Telecom Canada's Datapac packet network. Dr. Unsoy joined BNR in 1984 as manager, data standards evolution, and has held vaious management positions. Recently he was the director of DPN Development including the evolution of the DPN technology. He is currently with Northern Telecom as Director of Data Product Line Management posted in Tokyo, Japan.

Kenneth Hayward holds a B.Sc. degree in Mathematics. Following three years as a Lecturer and Systems Analyst at Mount Allison University, he joined BNR in 1972 as a Systems Programmer. In 1976, he became a member of the SL-10 development team, the basis for the Datapac Network. In the course of several management positions, he developed the initial architecture for the DPN-100 product line. He is now a Senior Advisor in the Advanced Product Planning Group.

Enterprise Networking using Frame Relay

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Abstract

Networking in corporations has evolved into a new area called *enterprise networking*, which encompasses a much broader range of standards-based technologies and networking products. Tomorrow's worldwide enterprise networks (ENs) of multinational corporations are expected to move not kilobits but megabits per second, and in some cases, even gigabits per second. It is not just file transfer and interactive graphics, but imaging applications like document-image processing and multimedia applications that will determine the bandwidth of the required link or circuit. While current technologies like T-1 and frame relay efficiently and effectively support high-speed file transfer and interactive graphics, future broadband technologies like ATM and B-ISDN will support bandwidth guzzling applications like imaging and multimedia, thus providing new capabilities for end-users and new market opportunities for network services providers. Today, broadband primarily means T-1 and T-3 point-to-point terminations, which are growing at a rate of 20% annually. The driving force behind this sensational growth is enterprise networking, which primarily supports six *traditional* applications, viz., voice, bulk data transfer, electronic mail, fax, two-way video conferencing (using compressed video technology), and internetworking mixed LAN-types. The most rapid growth is seen in the area of internetworking mixed LAN-types, which is tremendously influencing enterprise networking strategies. Multinational corporations are looking not only for an effective, ubiquitous, high-speed internetworking option to interconnect their islands of disparate LANs via their EN, but also for a switched, non-dedicated, transparent delivery service offered by network services providers, which can facilitate the transport of bursty data over the wide-area network in a cost-effective way. And, one such option, which meets both these requirements, is *frame relay*.

The paper presents a detailed insight of the frame relay technology and its application as an internetworking option for enterprise networking from a *business* standpoint. The paper begins with a comparison of X.25 and frame relay as internetworking options. It elucidates the suite of standards supporting the frame relay protocol and describes frame relay's frame structure and format. The paper explains how a public frame relay network service can be implemented as an internetworking option in a hybrid networking environment and discusses the challenges facing frame relay, including how this technology addresses the critical issue of interoperability of networking products. The paper concludes with a discussion on the issues to be considered while designing the EN using frame relay.

Key Words : Enterprise, Network, Hybrid, Design, Internetworking, Interoperability.

The need for a high-speed internetworking option

Hybrid networking, through its ability to leverage public network facilities, offers a more robust and economical enterprise networking strategy. The high-speed public network, which becomes the *backbone* of the EN, is used to interconnect the islands of disparate LANs (or mixed-LAN types). Internetworking LANs requires LAN-like speed across the EN. A key attribute of LAN traffic is that it is *bursty* . There are long idle periods punctuated by rapid transmissions of short duration.[1] LAN-based applications - such as, large file transfers between PCs and host (like a mainframe) and graphics-based applications like interactive CAD - are becoming speed-sensitive and delay-sensitive. Thus, the need to transport bursty, *protocol-oriented* data traffic across the EN in a cost-effective way requires a high-speed internetworking technology, which not only facilitates the tunneling of protocols in their *native* mode, but also provides bandwidth-on-demand.

X.25 and frame relay as internetworking options

X.25, which symbolizes traditional packet switching, and frame relay are two of the current internetworking options for enterprise networking. The frame relay protocol is based on ANSI standards, which have been ratified by the CCITT. Both frame relay and the CCITT-defined X.25 protocol are statistical multiplexing protocols. While high data rates and larger bandwidth are important to ensure short, internodal transmission times, the main source of delay in most X.25 networks is the cumulative effect of nodal transit delay times. Also, bandwidth utilization in X.25 networks is generally low due to processing delays and the innate perversity of the X.25 protocol. Frame relay changes this scenario drastically. Just as X.25 is defined as an *access* protocol to a packet network, frame relay is defined as an access protocol to a broadband packet network. While higher speeds are technically feasible, most X.25 networks support access speeds no higher than 64 Kbps in the United States; and internationally, this is closer to 19.2 Kbps. Frame relay can accommodate access speeds up to T-1/E-1 rates worldwide. Compared to X.25, frame relay is a more streamlined protocol that trades heavy error protection for simplicity of operation with the aims of minimizing processing overhead and maximizing the data transfer rate.[2]

The distinctive nature of the two protocols - X.25 and frame relay - is best understood by their placement in the familiar OSI Reference Model (OSI-RM). The X.25 protocol mandates each intermediate system (network node) to operate a complete Data Link layer protocol on each connection segment with multiplexing and routing (or relaying) performed at the Network layer (Layer 3). This has a number of advantages; however, the considerable amount of processing - at each step from origination to destination - required by the X.25 protocol make high-speed implementations difficult. Frame relay operates completely within the Data Link layer of the OSI-RM. In the frame relay protocol, the Data Link layer is divided into two sub-layers.

Frame relay performs multiplexing and routing (or relaying) functions at the lowest of the two sub-layers, which is called the Data Link *Core* sub-layer. Other Data Link layer functions (e.g., sequence control and error recovery) are provided by the end systems. The frame relay technique strips out all the functions defined in the Network layer (Layer 3) and part of those in the Data Link layer (Layer 2), thus facilitating higher performance. As a result, frame relay not only supports network access at high data rates, but also supports high-speed data transport across the EN.[3] Figure 1 presents a comparison of the X.25 and frame relay protocol stacks.

In terms of functionality, frame relay is more efficient than X.25. The frame relay protocol enables each node to make a fast determination of the route of each incoming frame. If the receiving node is the destination, the incoming frame is processed; if not, it is quickly passed on (or relayed) to the next node in the EN. The need for processing is reduced to looking at the header and very little buffering is required. Hence, transit delays are negligible and independent of the number of hops.

Frame relay provides maximum utilization of the available bandwidth - on the backbone links - at speeds above 256 Kbps. Most modern - X.25 - packet switches are able to compete directly with frame relay switches at trunk speeds up to 256 Kbps. At line speeds up to 256 Kbps, there is no significant performance advantage in using frame relay, vis-a-vis, X.25, as an internetworking option. However, when bandwidth requirements increase, and when packet sizes get bigger than 256 bytes, which is typical in the case of bursty traffic, frame relay is the obvious choice. It clearly outperforms X.25 in such situations. Frame relay thus offers a superior option in terms of price/throughput performance.[4]

There are significant technical differences between the two protocols:

• *Dynamic Bandwidth Allocation*: In an X.25 network implementation (based on T-1 multiplexer-based backbone network), the bandwidth in the physical connections within the backbone network is channelized and dedicated to a particular destination, and is thus available only to traffic bound for that location. Frame relay supports the establishment of multiple, end-to-end logical connections or permanent virtual circuits (PVCs) within a single physical circuit (including the access circuit). In a frame relay network, bandwidth on the physical link is allocated to a PVC only when it is needed; at other times, the bandwidth is available to other end-to-end PVCs. The various logical connections or PVCs share the total bandwidth available on the physical link. This concept of releasing bandwidth available on the physical link to PVCs - when needed - is often referred to as dynamic bandwidth allocation.[5]

The mechanism to establish a switched virtual circuit (SVC) on demand and tear it down when not needed has now been defined and standardized by ANSI. With the implementation of SVCs, true dynamic bandwidth allocation or bandwidth-on-demand capability is now available, and T-1/E-1 speeds on the backbone can be economically achieved, which is technically not feasible using the X.25 protocol.

• *Congestion Management* : This is one area where frame relay is very different from X.25. In the event of an overload, the X.25 protocol enables a node to regulate throughput, and ensures that no retransmissions due to network losses occur. Due to the absence of an explicit flow control mechanism in frame relay, emphasis is placed on "load-balance" of the network during its design to avoid overloading of trunks and nodes - resulting in packets being discarded - during operation. Flow control is explicit in the X.25 protocol definition, while it is implied through congestion management in the case of frame relay. Frame relay switches utilize congestion notifiers to warn transmitting and receiving DTEs, which are access devices, of a congestion situation in the network.

• *Error Detection and Recovery* : This is another area where frame relay is different from X.25. Error detection and recovery (or correction) - which results in heavy processing overheads and is the primary speed-limiting factor in X.25 networks - is explicit in the X.25 protocol. The frame relay protocol does not provide for recovery of frames corrupted while the data traffic moves through the WAN "cloud". The protocol, however, includes a Frame Check Sequence, which is a cyclic redundancy check for *detecting* corrupted bits, so that corrupted data can be discarded by the end node. But it does not include any mechanism for *recovering* (or correcting) corrupted data (for example, by requesting retransmission). The X.25 protocol, on the contrary, requires every node (or packet switch) in the network to perform error detection and recovery as packets are passed from a transmitting device to a receiving device. The X.25 protocol requires error-free receipt of a complete packet by every node - before any onward transmission of the data can begin. This error correction mechanism was needed because the X.25 protocol was developed for networks to cope with modem-driven transmissions across noise-prone analog circuits. This constraint has been intentionally eliminated in the frame relay specification because frame relay was developed for networks based on virtually error-free digital circuits.

The frame relay specification eliminates the need to check frames for errors as they are passed from one switch to another in the network. Instead, only the switch that receives frames from the transmitting DTE or customer premise equipment (CPE) router and the one passing frames to the receiving DTE (or CPE router) check frames for errors. If a frame has an error, the switch simply discards it. Because frames with errors are discarded, a frame relay network relies on the higher-layer protocols in the end systems. It requires the end system on the LAN - connected to the CPE router at the receiving end - to use a Transport layer protocol (like TCP) that informs the transmitting end system to resend missing frames. The primary function of a frame relay network is end-to-end data transport. Recovering data discarded due to errors is not the concern of the frame relay network. Also, a frame relay network does not guarantee the delivery of data. Higher-layer protocols in the end systems are responsible for monitoring end-to-end data transfer and requesting retransmission of frames that may be discarded by the network due to errors or congestion.

Frame relay can also be used for internetworking PCs and workstations connected to X.25 equipment (like PADs and packet switches). The advantages of tunneling X.25 packets via a frame relay backbone network are many. Preservation of existing X.25 network definitions like Closed User Group (CUG) and other network security features are the key benefits. Also, for users of X.25 network services, encapsulation of X.25 packets within frame relay frames provides end-to-end error protection while taking full advantage of the speed and efficiency of the frame relay protocol.[6] X.25 can also be used to extend the access of an EN - based on frame relay - internationally. End-users in multinational corporations can access servers on remote LANs by dialing into X.25 PDNs, which support intermediate devices like protocol translators, that act as a *gateway* to their EN (via the X.25 network). In this context, frame relay technology can be considered as an extrapolation of X.25 into today's reliable, end-to-end digital networks.

Why frame relay?

Packet switching based on the X.25 protocol is a proven technology, which isn't the best internetworking solution, but gets the job done. However, when nine different locations in four different countries in three different continents - with each site having a different host and a LAN configuration running different protocols - have to be internetworked, and if virtually error-free transmission has to be ensured for transporting bursty traffic, X.25 is definitely not the way to go. This requires a high-speed access-cum-internetworking technology like frame relay. Conceptually, frame relay technology provides the EN exactly what it needs. It's a protocol developed for high-speed data communications and is designed for networks that use virtually *error-free* digital circuits, which is attributable to the availability of newer, fiber optics-based digital transmission facilities.[7]

Frame relay transforms the EN into a high-speed networking infrastructure by:

- reducing *process time* since it does not require higher layer processing at each node and increases the speed of *intra* nodal data transport; and
- reducing *move time* (of data through the EN) due to variable length packets and higher bandwidth utilization, thus increasing the speed of *inter* nodal data transport.

Frame relay networks provide full logical connectivity and transparent delivery services. This scenario is well-suited for the main purpose of frame relay, which is internetworking mixed-LAN types.[8] Frame relay's variable-length frames - which make the most efficient use of available bandwidth - also mesh well with the variable-length packets used by protocols like TCP/IP and DECNet.[9] Frame relay also offers a more flexible routing mechanism than most internetworking protocols, like TCP/IP.

What is frame relay?

Frame relay, technically, is a high-speed network interface-cum-switching technology. Frame relay is also the underlying technology for fast-packet networks or broadband packet networks.

The term *relay* implies that the frame is not processed at the end point of each network link, but is relayed to the final destination.[10] Frame relay simplifies the transfer of data units by transforming it into OSI-RM's Layer 2 function. This enables the Data Link layer to designate logical connections and perform routing, which are functions of the Network layer or Layer 3.[11]

The key characteristics of a frame relay network can be summarized as follows:

- Transparent end-to-end transport of frames; only the header information and the Frame Check Sequence are modified by the intermediate network nodes.
- Detection of transmission format, and detection of (but not recovery from) operational and transmission errors (e.g., frames with unknown Data Link Connection Identifiers).

Standards

Frame relay networking and interface standards have been, and continue to be, defined by the American National Standards Institute's (ANSI's) T1S1 Committee. The standards defined are forwarded to the CCITT for ratification as Recommendations.[12]

The three important ANSI-defined frame relay standards are: T1.606, T1.617, and T1.618.

T1.606 standards cover frame relay network services description; the T1.617 standards cover signaling and network management specifications; and the T1.618 standards cover the description of frame relay protocol's core.

T1.606 standards specify frame relay network services in terms of user-network interface requirements and internetworking requirements. It was approved by ANSI in 1990. The equivalent CCITT Recommendation, I.233, is now in the final stages of approval. I.233 also standardizes the use of switched virtual circuits (SVCs). T1.606 Addendum describes congestion management and was also approved recently by ANSI. The equivalent CCITT Recommendation, I.370, is also in the final stages of approval.

T1.617 Annex *B* and Annex *D* standards were approved in 1991. The equivalent CCITT Recommendation is Q.933, which is going through the formal approval process. T1.617 Annex B describes the management of PVCs on a channel supporting a mix of PVC and SVC connections. The T1.617 Annex D standard specifies critical network management functions, particularly useful in the public frame relay network context. Access signaling and PVC management functions are a part of T1.617 Annex D. The Local Management Interface (LMI) specifications forwarded to ANSI by the Frame Relay Forum has been approved by ANSI and incorporated into the T1.617 Annex D standards.

The frame structure and frame format of the frame relay protocol is primarily based on the T1.602/ Q.921 (LAP-D) standard, but extended with congestion management fields. The new standard designated, Q.922/LAP-F, defines a full Data Link layer protocol in its own merit. Frame relay uses only a subset of the protocol called *LAP-F Core*. This protocol supports data transfer in a frame relay network, and is defined in ANSI's *T1.618* standards.

The equivalent CCITT Recommendation is Q.922 Annex A. The recommendation includes key aspects of the frame relay protocol that describes the structure of the frame, the Frame Check Sequence, and delimiting flag bit pattern. The frame relay data transfer protocol defined in the Core is intended to support multiple end-user protocols - simultaneously - within a single physical channel. The LAP-F Core provides procedures for transparent, end-to-end transfer of user data. Traditional functions, such as windowing and error correction, are not included in the Core.[13 14]

Consolidated Link Layer Management (CLLM) is a signaling protocol for frame relay networks that predates LMI. The specification for CLLM appears in the T1.618 standards and in the equivalent CCITT Recommendation, Q.922 Annex A. The main function of CLLM messages is to augment the Backward Explicit Congestion Notification (BECN) mechanism for reporting network congestion. CLLM messages report congestion in more detail than LMI, noting both the congestion's cause and its expected duration along with a list of Data Link Connection Identifiers (DLCIs) that should reduce traffic. The optional Status Update feature of LMI, however, performs a similar function, and its implementation in the richer set of LMI functions makes LMI seem more attractive.[15]

The standard for permanent multicast virtual circuit (PMVC) developed by two vendors has been forwarded to ANSI by the Frame Relay Forum. PMVCs give transmitting DTEs the ability to have a frame delivered by the network to multiple locations.[16]

A description of the frame relay structure and format

One of the characteristics of frame relay is its variable framing structure.[17] The end system's protocol-specific frames are encapsulated and placed in the variable length information field of the frame relay frame and tunneled through the frame relay network.[18] Frame relay utilizes a frame structure consisting of an opening Flag, a two-byte Header, a variable-length Information Field, Frame Check Sequence (FCS), and a closing Flag. The structure of the frame relay frame is shown in Figure 2.[19] Figure 3 shows how information is arranged in the header of a frame.[20 21]

How frame relay works

Figure 4 shows a simple configuration of a frame relay network consisting of switches acting as backbone network nodes (indicated as FRN). The end systems (ES) on Ethernet LANs - at remote locations - use frame relay access to communicate with each other. The three LANs are connected to the frame relay backbone network using customer premise equipment (CPE) routers equipped with the frame relay interface and software. Within the wide-area network "cloud", the five network nodes handle the network's side of the frame relay protocol. In the network configuration described, the transmitting and receiving DTEs - i.e., CPE routers A, B, and C - at each end are connected to the network's local access node by a physical - local access - link. The physical connection to the remote location is further established by the frame relay network's backbone links, which connect the remote node to the local node.

The end-to-end logical path taken by the frame along the originating local access link, through the frame relay network "cloud", and along the terminating - local access - link to its ultimate destination is called a *logical connection* or a *virtual circuit*. In a frame relay network, a virtual circuit uniquely defines the path between two end points (defined by the location of the DTEs). The virtual circuit configured as a dedicated path between two end points is defined as a permanent virtual circuit (or *PVC*). The CPE routers at the three locations are connected to each other via end-to-end PVCs rather than with dedicated physical circuits.

Data Link Connection Identifier (DLCI) is frame relay's logical connection identification mechanism. The DLCI is *not* a destination address. It's just an identifier of virtual circuits, which facilitates the multiplexing of several end-to-end PVCs over a single physical circuit. Since the DLCI is a 10-bit number, the frame relay protocol defines *1024* possible DLCIs. Of these, *2* DLCIs (0 and 1023) have been reserved for signaling and *30* DLCIs (1 to 15 and 1008 to 1022) have been reserved for future use. For instance, networks that have the optional multicasting feature implemented, reserve DLCIs 1019 to 1022 for that purpose. The remaining *992* DLCIs, 16 to 1007, are available to subscribers.[22]

The DLCI has *local* significance only. DLCIs are not unique throughout the network. They are unique, however, on a specific end-to-end PVC. A PVC has to be identified by different DLCIs at local and remote access interfaces. But, DLCIs can be repeated at different points within the network "cloud", and they can also be used for identifying local and remote access interfaces (connected by other end-to-end PVCs).

Let us suppose that CPE routers A, B, and C are interconnected via PVCs. The DLCI at the CPE A end of the PVC, which connects CPE C, is 25 and the DLCI at the CPE C end of the PVC is 55. Notice that the DLCIs at each end of the virtual route are *different*. The CPE B end of the PVC - connecting CPE A - is also 55, because the PVC that interconnects CPE routers A and C is different from the one interconnecting routers A and B. When CPE router A sends a frame to CPE router C, it places DLCI 55 in the header of the frame. Before the network delivers the frame to CPE C, the end node changes the DLCI from 55 to 25, which also allows the receiving DTE to identify the frame as being from a particular DTE. While changing the DLCI, the network also recalculates the frame's FCS.

A frame relay network operates based on certain key service parameters. They are:

- Committed Burst Size (Bc)
- Excess Burst Size (Be)
- Committed Information Rate (CIR)

Committed Burst Size (*Bc*) is the maximum amount of subscriber data (in bits) or the largest number of consecutive bits that the network is configured to transfer - without discarding - under normal conditions, during a time interval defined as the Committed Rate Measurement Interval, *Tc*. Tc = Bc/CIR.

Tc is the time interval during which the end system is allowed primarily to send Bc amount of data, or a maximum of committed amount, Bc, plus the excess amount of data, Be. Tc is not a periodic measurement interval, but a sliding window that is triggered by the receipt of data from the end system.

Excess Burst Size (*Be*) is the maximum amount of uncommitted data (in bits) in excess of Bc that the network will attempt to deliver during Tc. Data, Be, is treated as discard eligible by the network and there is a greater likelihood that some data will be discarded.

Committed Information Rate (*CIR*) is the data rate (in bits per second) guaranteed by the the frame relay network services provider for transferring information under normal conditions during a time interval, Tc. It is a mechanism that is used to allocate network resources while provisioning network services. CIR is primarily associated with the logical links connecting frame relay nodes within the network "cloud". A PVC's CIR may be less than or equal to the physical capacity of the whole circuit. It is primarily the subscriber data throughput that the network commits to support under normal conditions within a specified period without discarding data.

Data from a transmitting DTE instantaneously arrives at the frame relay access node at the Access Rate (*AR*) of the physical circuit (or the access link), which connects the frame relay interface of the DTE and the frame relay interface of the network node. Traffic from end systems on the LAN - connected to the CPE router - rarely sustains the throughput provided by the AR. Hence the access node is generally able to transfer Bc through the network at the CIR as the minimum data transfer rate. However, when many end systems transmit bursty data at once, the network can become congested and discard frames. A frame relay network can discard data for any of the following two reasons, which are also the reasons for network congestion. The first is that data from an end system has exceeded the amount the network has been configured to transport. The second is a failed CRC, which indicates physical transmission errors.[23 24]

The different network interface points mentioned above admit bandwidth according to pre-decided network service parameters based on the following rules:

- Incoming bits - received by the frame relay network for a particular logical link (or PVC) - totaling less than or equal to Bc bits during time interval, Tc, are transmitted transparently to the destination (without being discarded).
- Incoming bits - received by the frame relay network for a particular logical link (or PVC) - totaling in excess of Bc bits, but less than Bc+Be bits during time interval, Tc, are accommodated by the network and transmitted to the destination as discard eligible.
- Incoming bits - received by the frame relay network for a particular logical link (or PVC) - totaling in excess of Bc+Be bits are treated as immediate discard by the network nodes.

It is possible that some bits within an incoming frame may be dealt with according to one of the above rules. All bits in an incoming frame are processed according to the above rules.[25]

Implementing frame relay as an internetworking option

Figure 5 describes the architecture of an EN based on frame relay. The *hybrid* EN architecture uses a public frame relay network as the internetworking option.

In an EN with a traditional T-1 backbone - that uses full/fractional T-1 links for internetworking remote LANs - multiple links between each CPE router and the EN node (T-1 multiplexer) are needed to create mesh connectivity, and bandwidth on the backbone is pre-allocated for each connection, which may not be adequate for handling bursty traffic. In an EN that uses a frame relay backbone, as mentioned earlier, bursty traffic generated by each application can receive the entire - T-1 - bandwidth, on demand. Also, in this approach, instead of many point-to-point, dedicated physical links between the CPE router and the EN node, only one router port per location is needed to establish a physical - access - link between the CPE router and the public network services provider's point-of-presence (PoP), which acts as the EN node.[26] This reduces recurring transmission costs and non-recurring equipment costs by curtailing not only the number of leased lines and CSUs required, but also additional CPE routers that may be required.[27]

In EN architectures that use a public frame relay network as the internetworking option, end-to-end connection between various CPE routers is established by the network services provider using PVCs or SVCs.

In a PVC-based implementation, the PVCs are configured by the network services provider at service subscription. In this setup, whenever an end system needs to send data, the CPE router or the DTE uses a pre-assigned logical connection identifier (or DLCI) to identify the pre-established path (or PVC) through the network to the desired destination. The DLCI not only allows the receiving DTE to identify a frame as being from a particular DTE, but also helps the network nodes to identify the frame as being from a particular logical connection, and also facilitates the multiplexing of several logical connections (or PVCs) over point-to-point physical connections. The end-to-end PVCs also share the bandwidth on the access link. There are no call setup procedures in a PVC-based implementation. The transmitting DTE simply needs to know the local DLCI associated with the local - logical - connection between the remote - receiving - DTE and the end node. In this implementation, network connectivity can also be rapidly changed - by adding or removing PVCs - via software control. Thus, it's easy to modify not only the network configuration, but also plan growth in an orderly manner.

In an SVC-based implementation, a user (of an end system) can dial the address of the destination end system. This establishes a dialog with the network and signals to the network, in real time, the destination for all frames. The end-to-end virtual circuit is then set up by the network's node and is assigned DLCIs (including the DLCI, which is associated with the local connection between the remote DTE and the end node). Connection between a transmitting DTE and the receiving DTE is accomplished as needed by establishing a realtime SVC that exists only for the session's duration.

There are many advantages in designing a hybrid EN architecture (using a public frame relay network as the internetworking option). In this setup, network equipment and facilities, backbone network planning and design, network operation (including end-to-end network management and technical support), and network equipment maintenance are the responsibilities of the network services provider. The end-user organization is only responsible for the network equipment connected to LANs in the corporate campus and in the remote locations, which are internetworked by the EN.

The key advantages can be summarized as follows:

- Cost-effective wide-area connectivity
- Fewer points of hardware failure
- Lower administrative and maintenance costs

Frame relay is thus well suited for designing multiprotocol ENs that need to support the client/server architecture, which is a LAN-based distributed computing environment that requires LAN-to-LAN connectivity without reliance on a central site.[28] Frame relay is not only an appropriate network interface, but also an appropriate internetworking option to interconnect remote LANs - supporting client/server applications that generate bursty traffic - across the EN.

Challenges facing frame relay

Frame relay is not the simple technology it might first appear to be. There are some technical issues that have not yet been fully resolved. Frame relay standards, which emerged rapidly, are undergoing constant changes, and are still evolving. Network congestion can be a problem if the end systems do not co-operate. With nothing to throttle the frames flowing into the network from the end systems, an intermediate node may run out of buffers to hold the frames in transit. The only response to this condition is for the intermediate node to drop frames. The situation can quickly escalate if the end system retransmits frames in large numbers in order to recover missing frames, thus adding to the congestion problem. Better congestion management techniques like CIR metering by frame relay nodes, and Xon/Xoff-like flow control mechanisms are thus vital.

There is currently no consensus on the management protocols to be used for managing frame relay networks. Management of frame relay networks is not based on any standard management protocols like SNMP or CMIP. The scope of LMI procedures will have to be enhanced to provide SNMP-like network management capabilities.

Even in the internetworking arena, there are some critical issues that have to be resolved. From the perspective of a CPE router, frame relay is a transparent Data Link layer protocol for internetworking remote LANs. Frame relay, today, does not support many of the protocol functions specifically needed by routers over a serial link, such as exchanging routing information between remote routers, and guaranteeing the delivery of frames, etc. Standards committees within ANSI are working on several proposals to adapt frame relay into a complete Data Link layer protocol for supporting these critical functions.

These proposals include layering the point-to point protocol (PPP), an existing standard serial line protocol for multiprotocol routers, on top of frame relay to provide complete Data Link layer protocol functions.[29]

A key concept that dictates the development of enterprise networking strategies is *interoperability* . A question that frequently comes up for discussion is: Does frame relay address interoperability? The answer is *yes* and *no*. In a typical frame relay network environment, two CPE routers from vendor A can exchange frames over a backbone network supported by vendor B's frame relay switch. The routers at each end of the logical connection process the frames. In this case, the frame relay network provides communication between two devices at Layer 2 and does not enhance the scope of interoperability. True interoperability, on the other hand, is the ability of vendor A's router to send frames across a frame relay backbone network - supported by vendor B's frame relay switch - to vendor C's router. In this case, interoperability enables the interconnection of networking products from different vendors. This multivendor interoperability is currently not feasible. Today, Interoperability - as defined by ANSI and the CCITT - depends on the definition of two key points of interconnection:

- The User-to-Network Interface (UNI)
- The Network-to-Network Interface (NNI)

The UNI describes how the CPE router interconnects with the frame relay network node and the NNI describes how two different frame relay networks interconnect to provide communications among their respective end systems. The UNI standard has been approved by ANSI and CCITT. The NNI standard ratified by the Frame Relay Forum has been forwarded to ANSI for approval.[30]

Critical business issues like billing and tariffs require more analysis. Today, charges for services are based on the number of PVCs subscribed per access circuit. These charges are not usage sensitive. The service charge is a flat rate based on parameters like CIR, burst rate, etc. The access - physical - circuit and access bandwidth are charged separately. Also, there are no standardized billing procedures. These are just some of the many business issues that have to be resolved.

Summary and Conclusions

The *issues* to be considered while designing ENs using frame relay are:

- The type of applications supported by LANs at different locations;
- The number of remote LANs to be internetworked and the logical connectivity required, i.e., which two end systems need to communicate using what protocol, for establishing end-to-end communications; and
- The type of traffic to be supported and its characteristics, i.e., maximum packet size, frequency of the message or the amount of data transmitted (in number of packets), and the end-to-end response time required.

Frame relay, however, is not the ultimate panacea for all the vicissitudes in enterprise networking . Managers responsible for planning data networks in corporations and end-users of enterprise network services should realistically assess their needs before planning enterprise networking strategies. Before selecting a particular frame relay service offered by a network services provider as the internetworking option for their EN, they should analyze critical issues like:

- how much bandwidth on the backbone network is required to support their LAN-based, client/server computing applications; and
- can frame relay optimize their backbone bandwidth and provide a cost-effective option for internetworking remote LANs.

Frame relay is an emerging technology and has its own "suite" of issues concerning network congestion management and flow control mechanisms, that have to be resolved before it can be implemented globally by network services providers. Frame relay, however, has shown the promise of combining the best qualities of different protocols - particularly X.25 - and leased lines. It's a technology that has been accepted worldwide, and will not only co-exist with new broadband technologies - like Asynchronous Transfer Mode (*ATM*) - that are being developed, but will also play the role of a harbinger in the development of future broadband network technologies.

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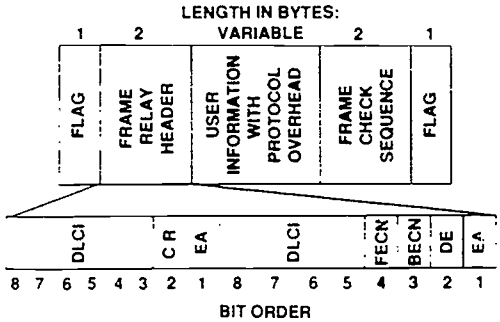
X.25		
LAP-B		CORE (LAP-F)
LAYER 1		LAYER 1

X.25 Frame Relay

Figure 1 Comparison of X.25/Frame Relay Protocol Stacks



DLCI = DATA LINK CONNECTION IDENTIFIER
EA = ADDRESS EXTENSION
FECN = FORWARD EXPLICIT CONGESTION NOTIFICATION
C R = COMMAND RESPONSE
DE = DISCARD ELIGIBILITY
BECN = BACKWARD EXPLICIT CONGESTION NOTIFICATION

Figure 2 Frame Relay Frame Structure

FLAG SEQUENCE				
DLCI (msb)			C/R	EA (0)
DLCI (lsb)	FECN	BECN	DE	EA (1)
FRAME RELAY INFORMATION FIELD (VARIABLE LENGTH)				
FRAME CHECK SEQUENCE (msb)				
FRAME CHECK SEQUENCE (lsb)				
FLAG SEQUENCE				

Figure 3 Frame Relay Frame Format

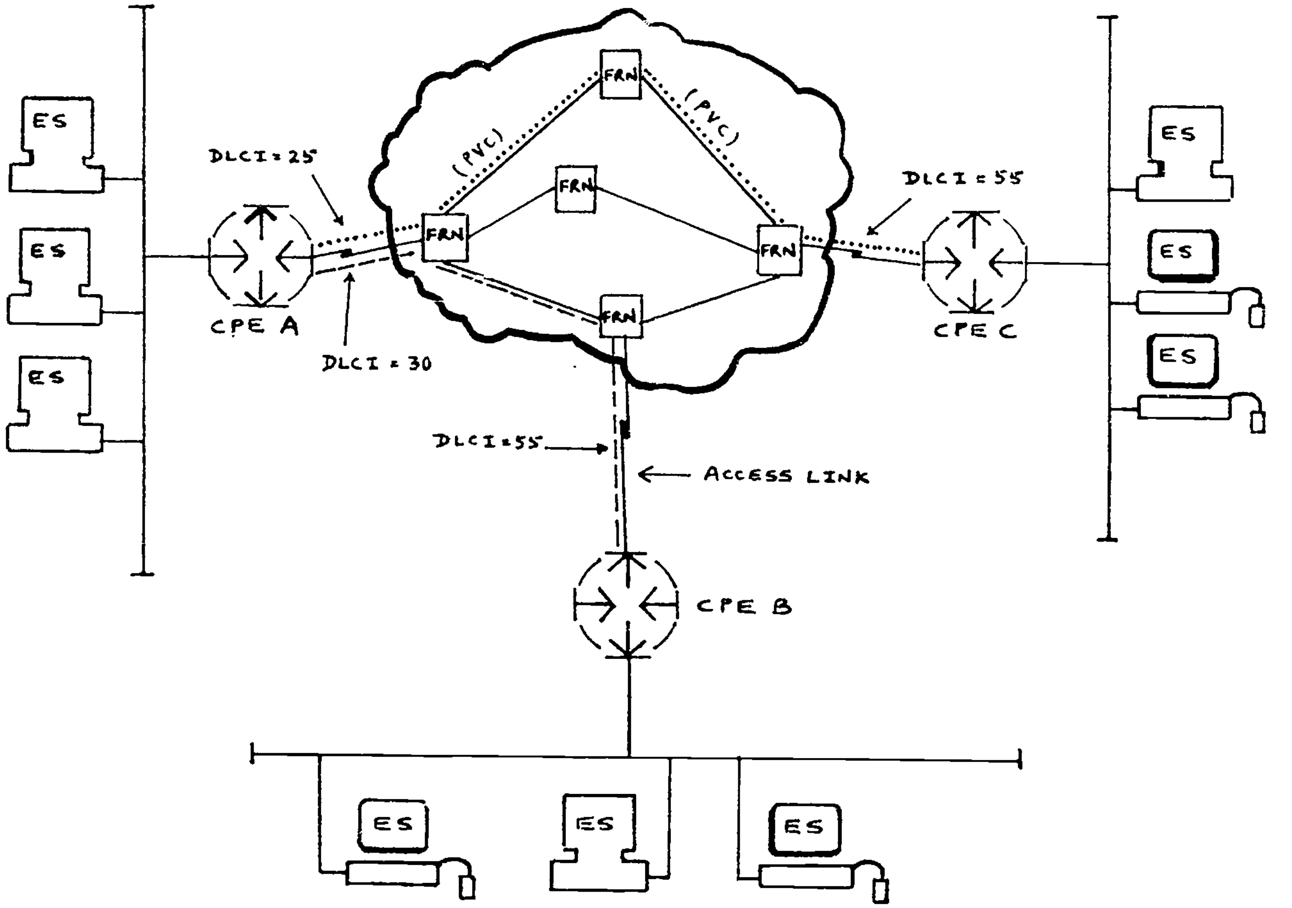


Figure 4 A Simple Configuration of a Frame Relay Network

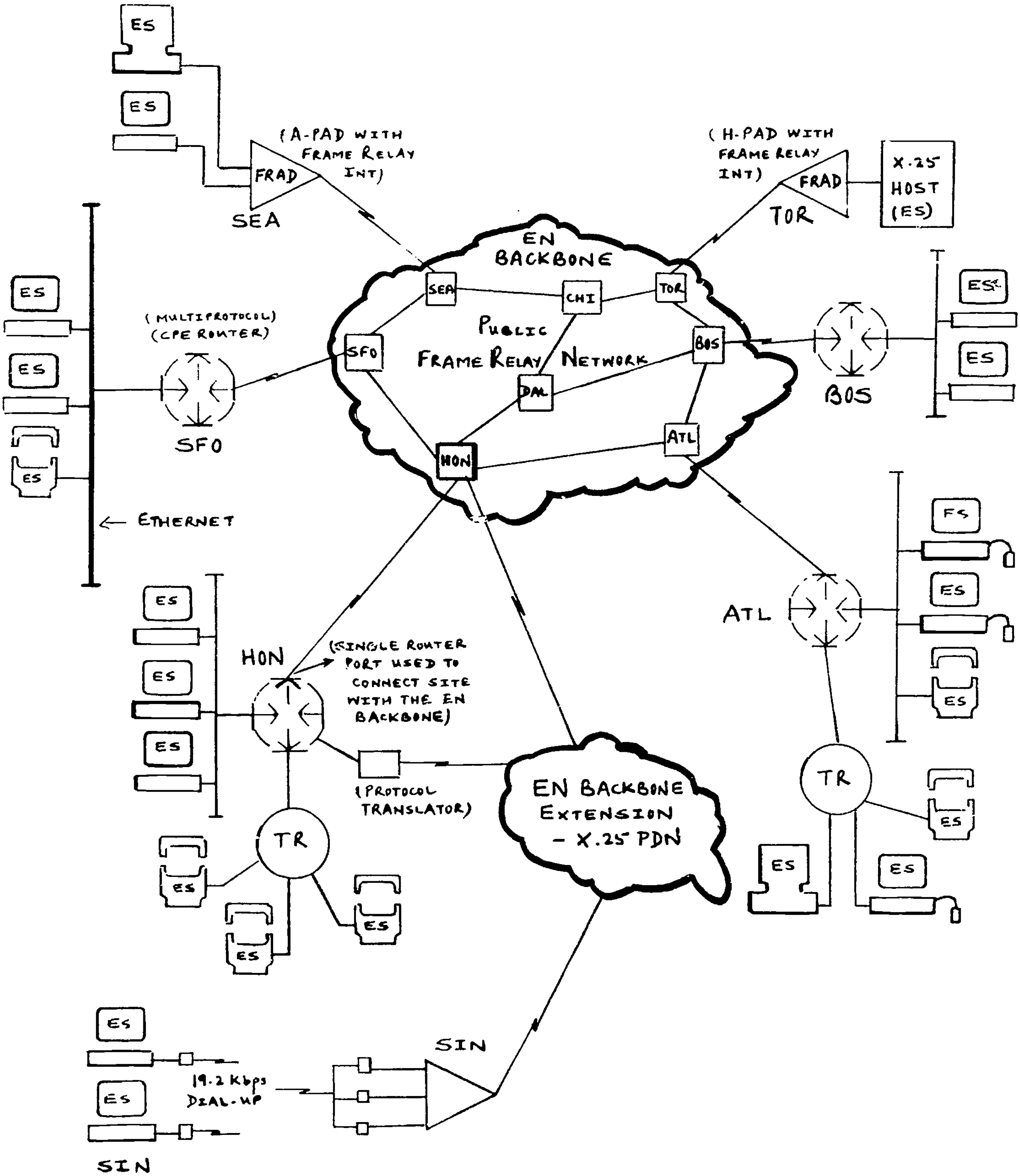


Figure 5 Hybrid Architecture of an EN

ATM Service Node:
A Step Toward Broadband Telecommunication Networks

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Abstract

An ATM Service Node, a high-speed switching system based on ATM technology, which realizes Broadband services is introduced. ATM networking topology, system implementation methodologies and mechanisms to accommodate Frame Relay and SMDS services into the ATM backbone network are presented.

1. Introduction

Broadband Integrated Service Digital Network (B-ISDN) [1,2] is opening a new era for multimedia telecommunications. This network is perceived as an all-purpose digital network that provides high-speed interfaces for integrated access to support a wide variety of applications. With the standardization of the Asynchronous Transfer Mode (ATM) as the transport vehicle well progressing, it greatly facilitates the implementation and acceptance of the B-ISDN.

However, B-ISDN is still seen by some as a service for a distant future. Indeed, it will take some time before B-ISDN can become a commonpart in our society. As the standardization work and technology in telecommunication are clearly headed toward B-ISDN, it is a matter of time that cost-effective broadband switching systems will be introduced to meet the requirements for today as well as for tomorrow.

The ATM Service Node is a system developed to meet such requirements. The switch, which is implemented based on ATM technology, features an output buffer type architecture. The switch allows Frame Relay (FR), Switched Multimegabit Data Service (SMDS) and ATM access interfaces onto an ATM backbone network. The three types of access interfaces provide the flexibility of accommodating various services to meet the changing needs of network users.

In this paper, ATM networking for B-ISDN is first introduced. Interworking between Frame Relay and ATM and between SMDS and ATM are then presented. Finally implementation methodologies on the ATM Service Node and mechanisms realized to accommodate FR and SMDS services into the ATM backbone network are discussed.

2. ATM Networking for B-ISDN

ATM has been selected by the CCITT standard body as the transfer mode for broadband services [3]. ATM is a high-speed cell-based switching technology. An ATM cell is composed of a 5-byte header and a 48-byte information payload. It employs a connection-oriented protocol to support both connection-oriented and connectionless services. The low delay nature of cell switching allows it to carry data as well as real-time voice or video traffic which may have constant bit rate (CBR) or variable bit rate (VBR) characteristics. So ATM is a prominent candidate to be used in high-speed networking infrastructure for B-ISDN.

Our view of B-ISDN is an ATM network with switches or service nodes interconnected by a unified ATM interface. The network, as depicted in Figure 1, serves as a unified all-purpose transporting mechanism to support existing voice, data, and video services in today as well as services that will be emerging in the future. The network accepts the user traffic at the user's preferred interfaces on one end of the network and transporting to the other end. The user interfaces which can be ATM, FR, or SMDS at DS1 or DS3 rates are converted into ATM format at the service nodes. Local Area Network (LAN) are also connected to the ATM backbone through access systems such as routers or ATM multiplexers.

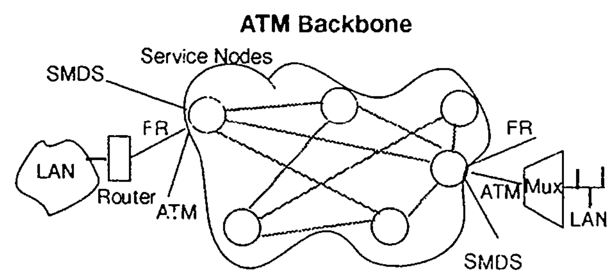

Figure 1 ATM Network Architecture

The ATM backbone can be readily implemented today with DS3/OC-3 (Optical Carrier level 3) rate. As the technology becomes available and the demand for higher bandwidth justifies its need, the ATM backbone can migrate to OC-12 rate or even Gigabit [4] to support user application at higher access rates. The migration will be gradual and smooth with no interruption to existing services.

In order to support the Frame Relay and SMDS services, protocol interworking between Frame Relay and ATM and between SMDS and ATM becomes the crucial links to be provided to guarantee the success of the ATM backbone networking.

3. Frame Relay and ATM Interworking

The FR to ATM interworking is designated to provided service interconnections between two or more FR users or between FR users and ATM users across the ATM backbone network. In either case, a layered protocol conversion process is required to convert the data from one to the other.

Figure 2 shows the protocol stacks for Frame Relay and ATM. The Frame Relay service is a connection-oriented service with the FR layer (LAPF) serving as the link layer function and residing on top of the Physical layer. ATM is also a connection-oriented service. ATM consists of the Physical layer, the Physical Media Dependent (PMD) sublayer, and the ATM layer, all serves as layer 1 function to provide the connection-oriented service.

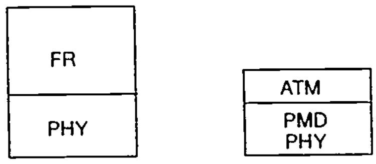

Figure 2 Frame Relay and ATM Protocol Stacks

The interworking unit between Frame Relay and ATM provides a bi-directional bridging function between the two protocol stacks. As depicted in Figure 3, the FR-ATM interworking unit processes the protocol information layer by layer and terminates the Frame Relay frames originated from a Frame Relay router or CPE. The frame termination includes FR physical layer termination and FR link layer termination. The FR physical layer generally supports unchannelized DS1 and channelized DS1. The FR link layer functions include Higher-Level Data Link Control (HDLC) frame termination, FR header termination, frame error checking, and link management signaling. The signaling and link management for switched Frame Relay services still need to be finalized, but a number of signaling schemes have been adopted to provide permanent virtual connections. Such signaling standards include Local Management Interface [5], T1.617 Annex D [6], and CCITT Q.933 [7].

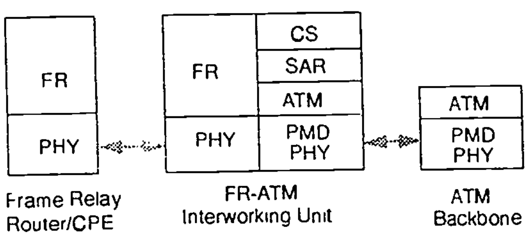

Figure 3 FR-ATM Interworking Unit Protocol Stacks

The FR-ATM interworking unit then converts the FR frame into ATM format according to the ATM protocol stack which consists of not only the layer 1 protocols for the ATM layer, but the Adaptation layer functions such as Segmentation And Reassembly (SAR) and possibly Convergence Sublayer (CS).

Two interworking methods can be used for FR transport: FR-ATM Encapsulation and FR-ATM Conversion. The FR-ATM Encapsulation Method applies only to FR to FR communications. In this method, a received FR frame is first terminated and verified for Frame Check Sequence (FCS) error. An errored frames is discarded without being processed at this point. Only an error-free frame including FR header (H) (without Flag) is encapsulated into ATM cells, as shown in Figure 4, after the ATM Adaptation Layer (AAL) header and trailer are added. In this process, Convergence Sublayer (CS) overhead (CS-H and CS-T) may or may not be added before the frame is segmented into SAR-PDU (Segmentation and Reassembly Protocol Data Unit) payload and assembled into ATM cells.

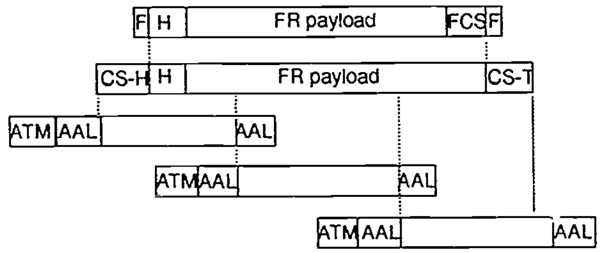

Figure 4 FR Frame Segmentation with CS Added for Encapsulation Method

In FR-ATM encapsulation, ATM Virtual Path Identifier/Virtual Channel Identifier (VPI/VCI) value is mapped from Data Link Connection Identifier (DLCI) value in the FR header. Other fields in the FR header are also checked or mapped to the ATM header fields if necessary. The ATM cells are then routed through the network using a pre-established virtual channel. At the destination, another FR-ATM interworking unit provides a reverse process where the FR frame is reconstructed by reassembling the received ATM cells and adding the FCS. This FR-ATM Encapsulation Method provides a simple means for FR frame transparency.

The FR-ATM Conversion Method applies to either FR to FR communications or FR to ATM CPE communications. In this method, a FR frame is terminated and error-checked. The error-free frame excluding Flag, FCS, and FR header is encapsulated and segmented into ATM cells. The encapsulation takes the user data part of the frame only as shown in Figure 5. Again, the CS overhead may or may not be added before the frame is segmented into SAR-PDU payload and constructed into ATM cells.

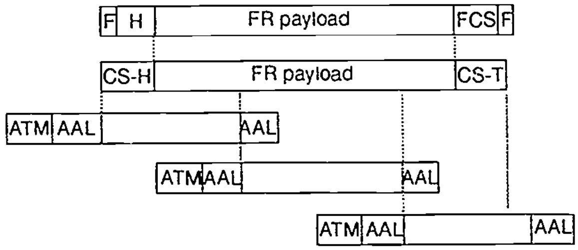

Figure 5 FR Frame Segmentation with CS Added for Conversion Method

The ATM VPI/VCI value is converted from the DLCI value in the FR header. The other fields in the FR header are either mapped to ATM header field or just dropped.

Comparing the above two methods, each has its own advantages and limitations. The Encapsulation Method provides end-to-end Frame Relay protocol transparency through the ATM network. However, it restricts the communications only between FR CPEs unless ATM CPEs recognize the Frame Relay protocol. The Conversion Method provides the flexibility to allow FR CPEs communicate with either FR or ATM CPEs. The limitation is that ATM/FR protocol can not be fully converted. Functions supported by the Frame Relay protocol such as Forward/Backward Explicit Congestion Notification (FECN/BECN) have to be dropped.

The ATM Service Node adopts the Encapsulation Method to provide early Frame Relay service through the ATM backbone network. The Conversion Method will be provided when the issues mentioned above are examined by the standard bodies.

4. SMDS and ATM Interworking

SMDS is Bellcore's proposal for high speed connectionless service over a metropolitan area. The SMDS protocol is based on the IEEE 802.6 Metropolitan Area Network (MAN) to provide user access via dedicated Subscriber-Network Interfaces (SNI). The SMDS Interface Protocol (SIP), as shown in Figure 6, defines a three-layer protocol stack for user gaining access to the SMDS network across the SNI. The SIP functions include addressing, framing, and physical transport.

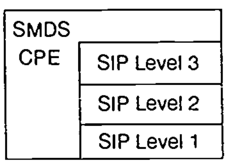

Figure 6 SMDS Protocol Stack

SIP Level 1 is the physical layer. It defines bit-level transmission of SIP Level 2 message across the physical facility. SIP Level 2 performs control functions for serial transmission of the SMDS higher layer data unit. An error protection mechanism is also handled at this layer. SIP Level 3 provides addressing for user data as well as protection against lost and mis-routed L2-PDU (Level 2 Protocol Data Unit) over the network.

In a connectionless service, such as SMDS, each PDU contains the addressing information and the user data. Each PDU is independently routed to its destination, without regard to establishing or maintaining connections. The responsibility for message integrity is checked only once by the L3-PDU, rather than checking at a lower layer for each data unit.

ATM is based on connection-oriented cell-based switching. SMDS uses the same cell relay switching technology. The structure of SMDS L2-PDU is similar to the ATM cell format with the exception of the Access Control field and the Network Control Information field [8]. The interworking between SMDS and ATM is to take advantage of the connection-oriented ATM backbone network to provided a connectionless service between two or more SMDS users. However, SMDS routing should be made according to L3 addresses because of its connectionless nature. The following discussions focus on SMDS routing mechanisms through the ATM backbone network.

Two address conversion and routing methods apply to the SMDS-ATM interworking: centralized and distributed. In the Centralized Method, shown in Figure 7, all SMDS cells received by the access switches are handed over to a central switch (SMDS Server) where full address matching, screening, and conversion are performed. The SMDS messages are routed to their destinations through the SMDS Server. This method eliminates the need of L3 address translation for each access switch, but the central switch requires a large translation table and high processing power to cover all addresses conversions.

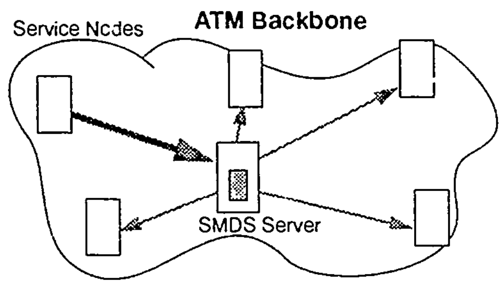

Figure 7 Centralized Address Conversion and Routing

In the Distributed Method, shown in Figure 8, the address translation and ATM cell conversion are performed at each access switch and the ATM cells are routed directly to their destination. In this method, the access switches can handle a larger traffic more effectively with a smaller translation table in each switch. However, the translation table needs to be duplicated for each switch and a virtual circuit needs to be established for each SMDS address pairs.

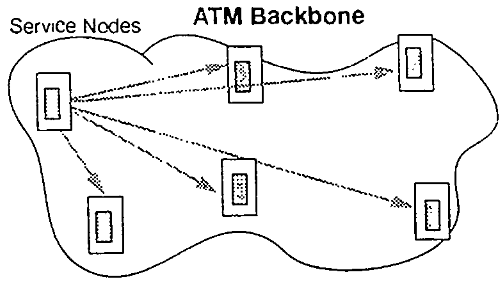

Figure 8 Distributed Address Conversion and Routing

The ATM Service Node adopts a Hybrid Method, as illustrated in Figure 9, which is a combination of the two methods mentioned above. The idea of using the Hybrid Method is that a typical end-user tends to send information to selected destinations. For these selected destinations, the ingress Service Node can use pre-assigned ATM virtual circuits to convey SMDS traffic (i.e. L3 address full translation function). For the rest of the destinations, the Service Node will only perform partial address checking from the ingress L3-PDU and transmit information to one of the SMDS Servers which then routes the L3-PDU to the specified destination.

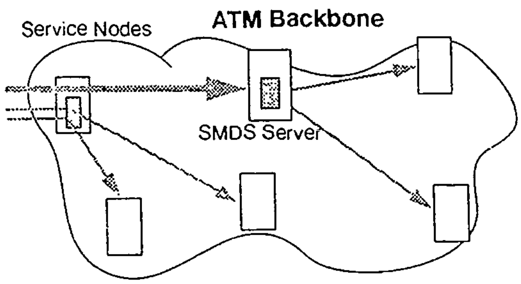

Figure 9 Hybrid Method for SMDS-ATM Interworking

5. ATM Service Node System Architecture

The NEC's NEAX 61E ATM Service Node Model 10 was designed with the ATM networking in mind. The Service Node currently supports ATM DS3 and OC-3 interfaces for the backbone network. User interfaces currently supported by the Service Node include ATM and SMDS services at DS3 and DS1 rates and FR at DS1 rate for either channelized or unchannelized services.

The ATM Service Node, as depicted in Figure 10, consists of three major functional subsystems: the ATM Output Buffer Modular (ATOM) switch subsystem, the interface community subsystem, and the processor subsystem.

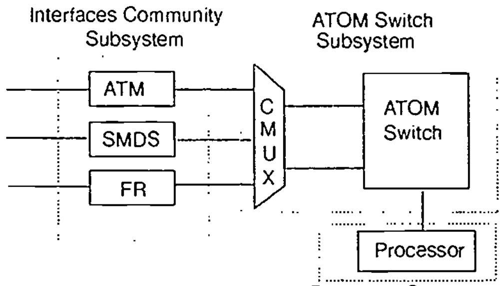

Figure 10 NEAX 61E ATM Service Node Model 10 System Configuration

As shown in Figure 11, the ATM Service Node is composed of a Basic Frame and one or more Line Interface Frames. The Basic Frame accommodates a duplicated processor unit, a duplicated switch unit, and two interface units. The Line Interface Frame accommodates up to four additional interface units for ATM, SMDS, and FR.

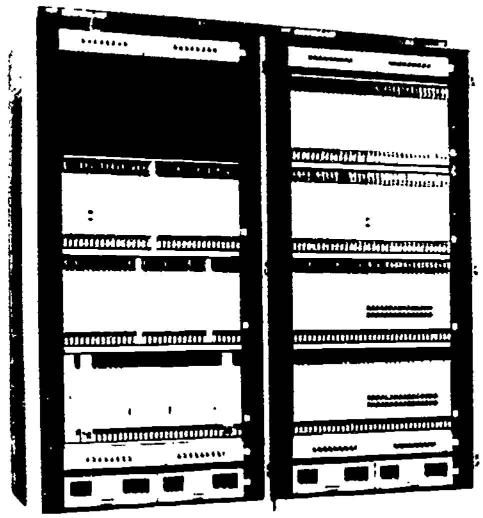

Figure 11 NEAX 61E ATM Service Node Model 10 Basic Frame and Line Interface Frame Layout

5.1 ATOM Switch Subsystem

As depicted in Figure 10, the ATOM Switch Subsystem consists of a core switching fabric (ATOM Switch) [9] and the Cell Multiplexer (CMUX). The core switching fabric, shown in Figure 12, implements an 8 x 8 single stage ATM-based switching function and provides a total throughput of 2.5 Gbps. The switching fabric uses dedicated output buffers for each output port to provide low cell loss high performance switching. Routing information which is conveyed via Switch Specific Overhead (SSO) are generated in the interface units and are appended to each ATM cells.

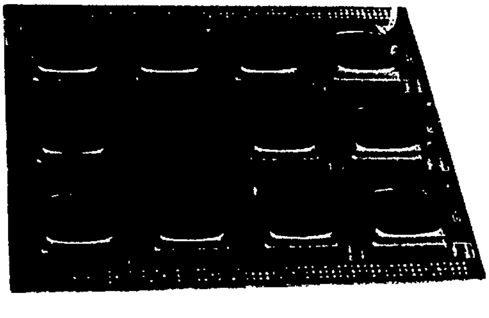

Figure 12 ATM Service Node Core Switching Fabric

The CMUX is located between the line interface card groups and the ATOM switch core. It is responsible for multiplexing and demultiplexing ATM cells transmitted between the interface units and the ATOM switch ports. The CMUX is implemented with cell synchronization and bus arbitration control functions to allow cells coming from multiple line interfaces being accommodated to the ATOM switch port.

5.2 Interface Subsystem

The basic functions of the Interface Community Subsystem are line termination and protocol conversion. A number of other functions are also provided such as speed conversion, multiplexing/demultiplexing of cells or frames, and traffic/alarm/performance data collection and reporting. The Interface Community Subsystem is composed of three groups of interfaces; ATM, Frame Relay, and SMDS. All cards in this subsystem are duplicated for more reliable operation, except for DS1 line interfaces.

The ATM layer protocol for the ATM interfaces is terminated in the ATM Interface Unit (ATMIU). The ATMIU converts the VPI/VCI values in the ATM cell into the switch internal logical channel to facilitate cell switching conducted by the ATOM switch. The ATMIU also performs the cell flow monitoring and bandwidth policing functions that are the essential parts of the Usage Parameter Control (UPC) function for ATM services.

The Frame Relay Interface Unit (FRU) provides both unchannelized DS1 and channelized DS1 interfaces. To support the ATM switching/trunking, multiple frames are accommodated and segmented into ATM cells for switch processing. The ATM Service Node provides not only frame segmentation function for the ATM network but the FR to ATM interworking capability to allow information to be exchanged between the user equipments that are connected by the two interfaces. The FR and ATM interworking mechanism is explained in Section 3.

The SMDS Interface Unit (SMDSU) provides line termination and Physical Layer Conversion Protocol (PLCP) termination at either DS3 or DS1 rate. The interface also includes L2-PDU termination and L3-PDU Destination Address (DA) conversion functions in order to convert SMDS cells into ATM cells. Section 4 describes SMDS/ATM conversion and networking.

5.3 Processor Subsystem

The Processor Subsystem, which has redundant configuration, is the central intelligent part of the ATM Service Node. It consists of a central processor, a hard disk unit, and a cartridge tape unit. The central processor (CPU) communicates with various I/O devices of the Service Node to perform the functions such as operation, administration, and maintenance (OAM).

The CPU is loaded with software which is partitioned into three layers, as shown in Figure 13. The Basic Operating System (OS), which consists of a real-time kernel, handles real-time task processing. The Extended Operating System (EOS) provides low level functionality and interfaces to several applications such as switch restart processing, fault processing, configuration management, equipment diagnosis, alarm handling, human machine interface, and protocol management.

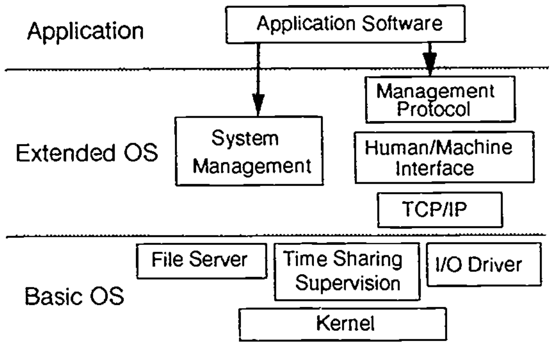

Figure 13 Software Structure

The Application software handles routing configuration, traffic counters and performance counters operation, accounting operation, and fault management. These functions are the major part of the ATM Service Node OAM functions.

6. Conclusions

With the national and international standard bodies aggressively refining standards for Broadband services and equipment manufacturers introducing ATM related products, ATM is gaining momentum. The clearer picture of Broadband services and ATM networking is also developing. In this paper, we have described technical issues with respect to accommodating SMDS and Frame Relay services into an ATM backbone networks. We have also presented our solution to provide a migration from pre-BISDN services to the B-ISDN. The NEAX 61E ATM Service Node Model 10, which is one of the first ATM switch with this picture in mind, is a powerful element in making B-ISDN service a reality.

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Japanese Digital Cellular Telecommunication System

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Abstract

Recently, the number of mobile cellular subscribers is increasing more abruptly, specially at large cities in all over the world. For the attainment of highgrowth, two technological improvement been occured. One is the research of new utilization of frequency band, other is digitalization. This paper will mainly discuss about current status of Japanese digital cellular telecommunication system.

(1) Introduction

As is shown in Fig.1, the research and development of digital cellular telecommunication system in Japan started in 1989 by MPT's study group and in 1991, voluntary technical standard of the digital cellular telecommunication system in Japan (JDC) was establishied as STD-27 by RCR (Research and development Center for Radio systems). Major features of JDC are 1)High subscriber's capacity 2)Increased density and reduction of infrastructure's cost 3)Downsizing and low cost of handheld portable terminals 4)Inter-connectivity with future ISDN by simplifiing air interface specification etc. Under the condition of limited frequency resources, efficiency of spectrum use is very important. JDC's system capacity is very high because of adopting QPSK modulation method which has better spectrum efficiency.

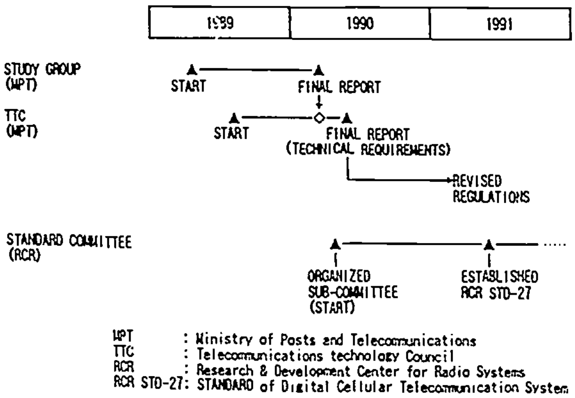

Fig.1 Research and study on digital cellular system in Japan

(2) JDC Technical Overview

When new digital system will be developed, the technical specification should be considered and established in accordance with market needs, especially for user's merits. Reduction of expences, many and better services, and security enhancement are the most important items.
Fig.2 shows the specification targets of the digital cellular systems. As for operator's side, to have high subscriber capacity within limited frequency resourses, to have a more economical infrastructure and to have flexible system for future services expandability are basic conditions. JDC has all such advantages in comparison with ADC and GSM. Operator's advantages means that operator can give the better services to end user. Technical comparison among JDC, ADC, and GSM are shown in Fig.3. The outstanding features of JDC are highly efficient spectrum use and speech codec method.

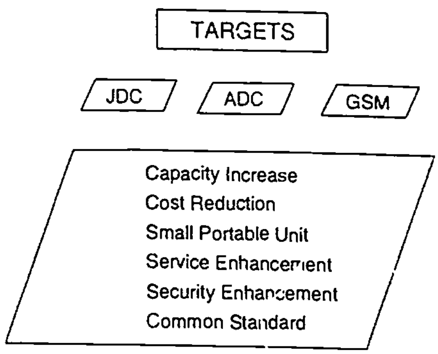

Fig.2 Target for digital Cellular system

	JDC	ADC	GSM
Frequency Band	800MHz/1500MHz	800MHz	900MHz
Access Method	TDMA	TDMA	TDMA
Channel Spacing	25kHz	30kHz	200kHz
Traffic ch/RF Carrier	3(6)	3(6)	8(16)
Transmission Bit Rate	42kbit/s	48.6kbit/S	270.83kbit/s
Modulation	π/4DQPSK	π/4DQPSK	GMSK
Voice Coding	VSELP	VSELP	RPE-LTP

Fig.3 Technical Characteristic of digital Cellular system

Fig.4 shows the spectrum characteristics of QPSK used in JDC and ADC system, GMSK used in GSM system. By Fig.4, it is clear that spectrum bandwidth of QPSK modulation is more narrower than GMSK.
But QPSK is weaker for non-linear distortion than GMSK. Nowadays, non-linear distortion of amplifier can be easily compensated by linearizer or feedforward techniques.
Depending on this high spectrum efficiency, JDC system can accomodate more subscribers than other systems. Fig.5 shows the subscriber's capacity within 10MHz bandwidth between JDC and GSM calculated under some conditions. The subscriber capacity of JDC is approx. double compared with GSM. Other important factor is total economy of the system infrastructure. Total economy means that the equipment cost is cheap, floor space for equipment is small, low power consumption, low installation and maintenance cost.
Fig.6 shows density of JDC equipments compared with analog equipments. The floor space for JDC is smaller than analogue system, approximately, one fourth.

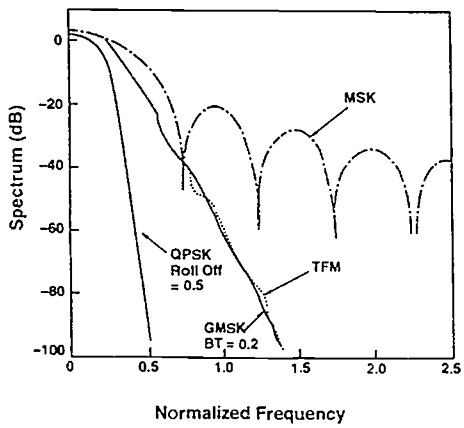

Fig.4 Spectrum Characteristics

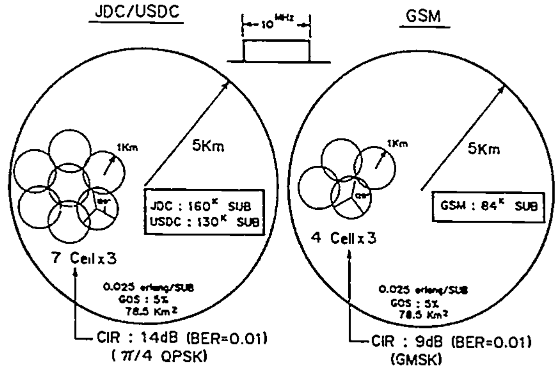

Fig.5 Example for subscriber capacity

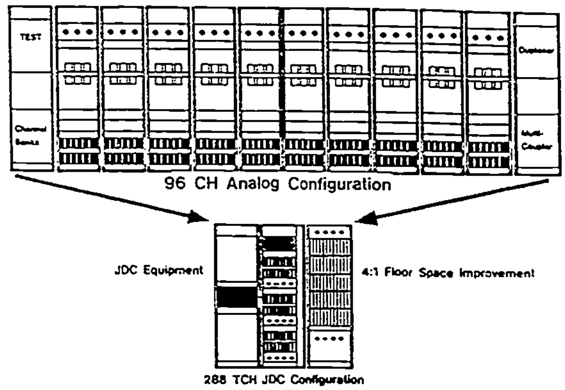

Fig.6 Equipment configuration of analogue cellular and JDC system

(3) JDC system overview

Fig.7 shows the system block diagram of JDC. Basically, this block diagram is almost same as other system's. In JDC, the air-interface between mobile subscriber and basestation is only specified and not specified A and A-bis interface such as GSM system. JDC's A and A-bis are specified freely by operators depending on their operational conditions.
Common amplifier(CAMP) is one of major features of JDC. By using CAMP, TM(Transmitter Multiplexer) is not necessary and dynamic channel assignment can be adopted. CAMP technique can also be applied to future micro-cell applications.
Photo.1 shows JDC TRX(Transmitter, Receiver) equipment which have been suplied to NIPPON IDOU TSUUSHIN CORPORATION.

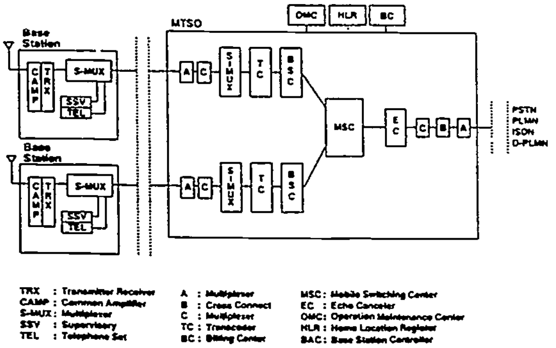

Fig.7 System block diagram of JDC

Item	Parameters	
	Hand Held Portable	Car Mount
Power Output	0.3/0.8W	2W
Weight	~230g	
Volume	~150cc	~700cc
Radio Frequency	TX : 900MHz band RX : 800MHz band	
TX/RX Frequency Separation	130MHz	
Access Method	3ch TDMA/42kb/s	
Carrier Frequency Separation	25kHz(interleaved)	
Modulation Accuracy	less than 12.5%	
Receiver Sensitivity	less than 4dBμ/10^{-2} (static) less than 7dBμ/10^{-2} (diversity)	
Adjacent Channel Leakage Power	less than -45dB	

Fig.8 Technical parameters of JDC terminal

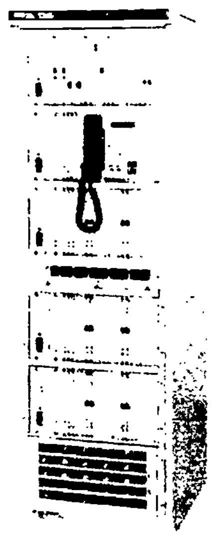

Photo.1 External view of JDC equipment

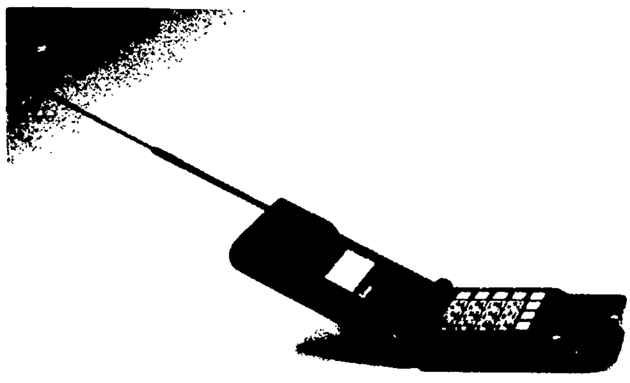

Photo.2 External view of Hand-Held Portable Telephone

(4) JDC Terminal Overview

Fig.8 shows the specification and design targets of JDC terminal. JDC has the feature of small and light weight terminals.
In 1993 to 1994, Japanese operators will launch the digital cellular system with the small hand-held portable and car mounts phones. Photo.2 shows the analogue terminal (MOVA N ; supplied to NTT DoCoMo) of which external form is almost same as digital cellular terminal. Fig.9 shows the downsizing example of JDC terminal in future.

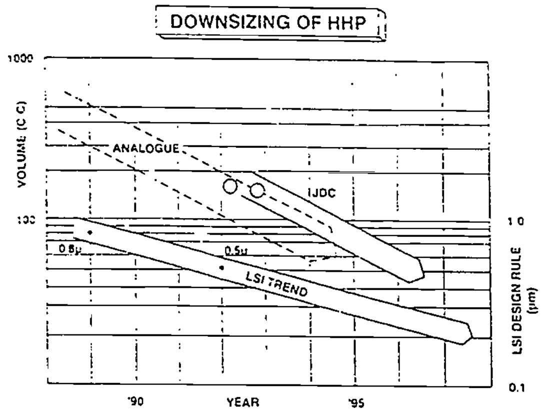

Fig.9 Volume trends of JDC Hand-Held Portable Telephone

(5) Conclusion

In conclusion, JDC is the user oriented system with the most advanced technologies. And also, JDC is the most enhanced and efficient digital cellular system, merging to ISDN era.

(6) Acknoledgment

Authors express their gratitude to NTT mobile communication network Inc.(NTT DoCoMo).

The Evolution of Wireless: Meeting the Mobile User's Needs

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1. Abstract

The popularity of wireless communications services and the growing mobility of modern society are fueling an evolution toward more personal communications services. Though many trials are being conducted with new wireless technologies such as digital cellular and microcells, studies that assess the user's need for advanced wireless services and the customers' definition of these services are driving this evolution. This paper explores both technical and user trials involving the evolution of wireless.

1. Market Environment

In the last 8-10 years the phenomenal growth of cellular and paging customers around the world has amply demonstrated the popularity of these services and the growing need for wireless communications in a mobile society.

Since 1983, U.S. cellular customers have gone from zero to more than 10 million. There are more than 4.7 million cellular customers in Europe and nearly 2.5 million in the far east including 1.5 million Japanese cellular customers. Paging customers number in the tens of millions around the world. In fact, BellSouth's paging companies serve more than 1.4 million pagers worldwide.

These figures prove the popularity and rapid growth of wireless communications services, at least among business consumers and those in higher income brackets. Projected figures for personal communications services are even higher. Many studies predict at least 40 million wireless users in the U.S. alone by the year 2000, and some say as many as 115 million. This market could produce an annual $50 billion in service revenue.

Since 1989, regulators, manufacturers and carriers around the world have been exploring ways to bring wireless services to more customers, with more variety and at a lower price.

2. Technical Trials

Much of the emphasis in these explorations has been on new technologies and networks such as digital cellular systems, microcell systems, and wireless PBX.

2.1 Digital Cellular

The conversion to digital cellular offers more than just capacity, it means additional capabilities and capital cost reductions. To the customer it can mean increased transmission quality, fraud protection and privacy. For these reasons digital conversion will occur in cellular markets of all sizes.

There are several digital cellular standards now being implemented around the world.

In North America -- Toronto, Chicago, New York, Los Angeles and South Florida are operating or preparing to offer TDMA digital cellular service. A TDMA systems is also in operation in Hong Kong.

GSM systems are being planned or operated in the U.K., Italy, Germany, Sweden, France, Australia, Finland, Norway, Switzerland, Denmark, New Zealand and other countries around the world.

Research is also underway on E-TDMA and CDMA. These two advanced digital access technologies are expected to offer capacity increases of up to twenty times that of today's analog cellular.

2.2 Microcells

Experiments with microcell integration into existing cellular networks have demonstrated that this is an excell nt technology for increasing both capacity and coverage in previously hard to reach areas such as in-building and in usage dense areas.

Microcells also have the added benefit of providing capacity increases without having to change subscriber units.

Cell site size is so small in Argentina and Hong Kong that these systems already closely resemble microcell personal communications networks. And DCS 1800 systems being designed for Germany and other European markets will use mini basestations and microcell size coverage areas.

2.3 Wireless PBX

Manufacturers around the world are exploring hardware solutions for wireless PBX needs. The Digital European Cordless Telephone (DECT) standard is a popular solution in Europe. Local exchange carriers such as BellSouth in the southeastern United States are also developing wireless central office solutions to meet these sames needs.

BellSouth is trialing various wireless Essx™ solutions in its Atlanta and Birmingham headquarters. The company has also tentatively planned a customer trial of wireless Essex™ for early in 1993. The target architecture is a wireless controller located within the network and basestations and handsets sold as CPE.

3. Market and User Trials

Though these technological advances are important to the evolution of wireless service, market research and common sense tells us that the user is blind to these questions of technology. They are interested in services. Recently more carriers and manufacturers have begun examining the variety of services to be provided by certain technologies and their appeal to the public.

BellSouth's Personal Communications Services trial in Orlando, Florida was designed to measure and understand the demand for different new wireless services and to analyze the impact of new services on existing services. The trial was conducted in two phases.

3.1 Demand Assessment

The first phase assessed consumer and business demand for wireless services including cellular, PCS, paging and cordless telephone. This pure marketing research was conducted in Orlando and Indianapolis. The 1174 participants experienced a simulated customer purchase process. They were exposed to ads, newspaper articles and word-of-mouth video tapes, shopped in a "retail store" or experienced a business to business sales call, and then were asked to assess the probability that they would purchase any wireless service including four test services: DriveAround PCS™, WalkAround PCS™, OutBound PCS™, and Cordless Phone Plus™ & EnZone Service™. Cellular awareness and use by the research participants were also tracked.

Results of this phase show that the introduction of PCS will mean a faster take up on all wireless services. This means that rather than creating an entirely new market, PCS will accelerate the rate at which customers who might normally purchase current cellular services will purchase wireless services of all types.

BellSouth does not believe that this implies a cannibalization of cellular business. In all likelihood, cellular carriers will be selling many of these Personal Communications Services using existing or digitally evolved cellular systems.

3.2 Usage Satisfaction

The second phase of the trial was simulated on the BellSouth Mobility cellular system in Orlando, Florida using modified Motorola MicroTACs™. Seven hundred and fifty users were provided with free phones for nine months and billed monthly for one of three levels of Personal Communication Services. Sales were promoted through a publicity campaign and handled by a direct sales force. Service was priced according to level of PCS service and all were less expensive than cellular. Two price plans were offered for each service; a standard rate and a package service which included a base rate and 120 minutes of use.

DriveAround PCS offered fully mobile cellular-type service without roaming and was priced 15% below cellular. WalkAround PCS, two-way calling with no hand-off, was 30% less than cellular and OutBound PCS, one-way calling with no hand-off, was 50% less than cellular. The DriveAround PCS sold out first, but all services were sold out ahead of schedule.

One result realized from this phase of the trial is that wireless customers may be willing to buy a service with less features than regular cellular -- but only at a significant discount to cellular. At prices close to cellular, customers want fully featured cellular service with hand-off and roaming. Other issues of concern to customers are transmission quality, ubiquitous coverage areas and longer phone battery life.

Another significant result of the trial and the preceeding market research was an indication that PCS equipment must be in the $200-$300 range for the service to be appealing to a large market.

This trial ended on September 16, 1992 and, interestingly, most of the trial participants opted to keep their phone and convert to cellular services.

4. Intelligence and Interconnection

In the future, our ability to interconnect the various new technologies and services being discussed and use of the intelligent network to enrich these services will be key to providing the user with the call management features necessary to true 24-hour follow-you-anywhere communications.

As wireless communications continue to grow and small portable devices become true consumer items, users will have more and more need to manage their calls. Business people will want to limit personal calls during the day and office calls on weekends. And most users will want to divert all of their calls to voice-mailboxes at some time. These sorts of management needs call for a great deal of network intelligence. At BellSouth we are exploring ways to bring Advanced Intelligent Network capabilities into our wireless systems.

In the U.S. this will probably mean connection to the wired intelligent network -- but in countries where the infrastructure is less developed, it may be more effective to integrate the necessary intelligence directly into the wireless networks.

Personal Number is one of the most discussed intelligent network features. This service allows a caller to dial one number and be routed to the proper phone -- home, office, car or portable -- depending on the time of day. It also allows the caller to connect to a fax machine if desired, and the system defaults to voice mail. BellSouth is currently trialing a Personal Number Service constructing on the AT&T Service Circuit Node and connected to the cellular MTSO.

Intelligence and interconnection of wired and wireline -- and also multiple wireless -- networks is at the heart of what the customer is expecting from personal communications in the future.

5. Other Applications for Wireless

In addition to providing personal communications types of services, the future of wireless communications also includes providing wireless solutions in traditionally wired communications situations. An excellent example is wireless alternate access solutions.

For example, a PBX within a building can be connected to a large directional antenna on the top of the building. That antenna is served by a local cellsite which sends signals directly to interexchange carriers or to the PSTN. Again, digital conversion can provide the necessary capacity increases to use the existing cellular spectrum in many countries in this fashion.

6. Mobile Data

It is impossible to leave any discussion of future wireless communications without mentioning mobile data. Mobile Data is emerging as the next growth area of the rapidly expanding wireless communications industry. In fact, wireless data networks are where cellular was eight years ago -- poised for dramatic growth.

A critical element in the growth of mobile data is the evolution of an open architecture, shared pubic mobile data network. This kind of network is a vast improvement over private mobile data networks because it lowers costs since they are shared by a large public user base, provides greater flexibility since an open architecture allows unlimited terminal equipment choices, and moves the need for spectrum coordination, network management and maintenance from the end-user to the network operator.

Public mobile data networks based on the Mobitex™ technology are already being built in the United States, the United Kingdom, the Netherlands, Finland, and Norway -- and similar networks are under consideration in most of the rest of western Europe, parts of Latin America and Australia.

In the future, the lines between wireless data and voice will become much less pronounced -- and may ultimately disappear. Customers are interested in communications solutions, and wireless carriers will integrate the technologies and networks necessary to provide those solutions.

6. Conclusion

Though technological innovation is important to the evolution of wireless systems. Customer needs should be the driver in the development of wireless systems and services for the future. Technology will, in the end, evolve to meet these needs.

Market research shows that future wireless customers will want more varied, more intelligent, and lower cost wireless services. Through capacity enhancing technolgies such as digital conversion and microcells, and integration of wireless networks with each other, the intelligent network, and mobile data systems many existing wireless carriers will be able to evolve to meet these needs.

Digital Cellular Opportunities in the Pacific Region

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ABSTRACT

Analog has become "the A word". Many technologists don't even use the word in mixed technical company anymore. "Digital" is the "darling" of the technical and even commercial communities these days. Let's see if these statements are deserved, and what "digital" could mean to wireless cellular telephony.

It should first be established that virtually all signalling done on existing analog cellular systems is actually digital. So bits and bauds, frames and fields, sync and lock, error correction and codes, etc., are nothing new to cellular. Therefore, when we speak of analog and digital, we are describing the nature of only the speech or end user generated information signals that the system is carrying between the end users.

When most of us think of "digital", at least for telephony, we are thinking of the Pulse Code Modulation (PCM) that has served telephony for many years. While there are different versions of PCM, most employ a 64 Kbit rate to digitize analog signals in the voice frequency spectrum of 300 to about 3000 Hz. We quickly realize that if we are to achieve as many "channels per Megahertz" of cellular spectrum available as possible, such PCM would be a very poor choice for the analog to digital (A to D) process. It simply requires a wideband channel for such a high bit rate, which is exactly the opposite of the narrow channels (real or "effectively"), that the next generation of cellular is looking for.

This requirement points us in the direction of newer, more sophisticated A to D processes, operating at much lower bit rates. PCM can be considered a "brute force" process, having virtually no "intelligence". New technology processes operate at much lower bit rates and are properly called Voice Coders, or vocoders for short. While they provide the A to D function, they are specifically designed to operate with analog voice signals as an input and output, which is why they are called vocoders. Present technology vocoders (there are several types), operate in about the 8 to 13 Kbit range. Obviously, if they are to sound reasonably as good as "standard" 64 Kbit PCM, each vocoder "bit" must carry much more information than a PCM bit. This means that an incorrectly recovered vocoder bit will have a much larger adverse effect on the audio quality. To minimize this effect, it is common practice to employ "Error Correction Bits" in the vocoder process. The number of these bits generally approaches the actual vocoder bit rate.

A ramification of needing the Error Correction Bits is that they represent "overhead". That means they take time to send and receive, yet they are not the actual "carrier" of the digitized voice. The time that they take up represents "throughput delay", meaning that the recovered analog speech at the receiving end of the system has been delayed in time. Typical delay times for present vocoders is about 0.1 second. The significance of a delay that long is that "echo" signals, returning from the far end in a full duplex system (signals can pass in both directions at the same time), will be very annoying to the person speaking. For this reason, echo canceling circuits must be employed on all "talk circuits" employed between the Mobile Telephone Switching Office (MTSO), and the Public Switched Telephone Network (PSTN). This requirement is likely to remain, far into the future, and perhaps forever. Therefore, the complexity and cost of echo canceling should always be factored into digital cellular.

There is one more issue on vocoders that should be noted. They are constantly being worked on to "improve" them. Improvements are primarily in the areas of better fidelity to approach analog, lower bit rates to permit more users per Megahertz, versatility to digitize signals other than voice, and more "robustness" to reduce errors. The significance of this ongoing effort is that there will likely be "several generations of digital" over the next decade or so. This will cause the need for "mixed systems", to operate with end user terminals using different technology, depending on when they were purchased. So the industry will experience transitions, much like the initial "analog to digital" transition, going forward in time.

That ends the general digital "tutorial". The two main reasons for the transition to digital are the greatly increased capacity it promises over analog (eventually a 10 times increase), and the capability to eventually permit "data" to be passed between end users. So if we say that these exist, by some means and to some extent, then we can discuss the opportunities that they could bring to the Pacific and perhaps other regions.

To at least a certain extent, when we think of "wireless", we really have "moveable", or at least the capability to use the device anywhere we want to, in mind. Classic examples of this would be commercial radio or television sets for application in our place of residence. We would like to simply "plug it in", anywhere, and have it work. The word "portable", in this context, means that I could move the TV from the living room to the bedroom and it would still operate well. I simply need a source of operating power wherever I place the set. The signals that I want to hear and see are brought to me by a wireless medium, providing me with "placement" flexibility for my device. I don't have to wait for someone to come and "connect me" to some central distribution point. These are important aspects of "wireless" that we tend to forget about. Until, that is, the capability is taken away. Ask anyone who is currently "waiting for cable TV" in their area because wireless reception is either poor or nonexistent. Many people would not even consider living in a residence in such an area.

It is time to think of telephony in the same terms. Right now, telephony has "wired and wireless" end users. Most users are wired, both at home and where they work. A small percentage (usually less than 5% in a given area), are not only wired at home and work, but also wireless at virtually all points between, while they are in transit. The operative phrase here is "in transit". We have a mental (and advertising) image of wireless telephony end users driving or walking around, conducting business, or at least staying "in communication with the world", while they are moving. There is nothing wrong with this image. In fact, it has been the desired one. You use your wired phone when you are near it and your wireless one when you are not. The problem is, not everyone, or even physical place has a wired phone.

Every non-wireless connectivity technology requires some form of conducting "medium" between its end users and its distribution point(s). Traditionally this medium has been a pair of copper wires, run point-to -point (but rarely "as the crow flies"), between the end points. This works very well, as long as the end points are not too far apart. The copper wires are even used to bring operating power to the end user's phone, which is a real "plus" during commercial power outages since the phone still can work. The "problem" is the copper wire itself. It can be the last part of the system to be provided and is typically the first part of it to fail. It is fragile, whether run underground or overhead. Its "natural enemies" are both man (accidental damage), and nature with its destructive forces and just plain "wear and tear". And, of course as the number of users per unit of area becomes more and more sparse, wire becomes less and less cost effective. Fibre optics are not very effective for "line per subscriber" applications typically done with wire. They require "carriers and modulation", much the same as radio, while still needing a point-to-point physical connecting medium, which does not bring operating power to the end user instrument. Therefore, fibre optics are generally not considered to be a reasonable alternative to wire.

Non-wireless connectivity is virtually always time consuming. It can take months and even years to "wire" phones, even after the decision has been made to do so. Such delays are not always limited strictly to rural areas. Dense urban areas have been shown to take long times as well. Some of the large Eastern European cities that have just recently been "opened" to the world, exposing an amazing lack of telephone lines and telecommunications circuits are examples of the glacial time periods needed to wire them. Some of them talk in terms of "the next century" before everyone who wants just basic phone service can have it.

Finally, there is the inevitable need for "temporary" telephone service. There never seems to be a shortage of natural disasters and/or "special events" that take place in an area that normally does not require phone service, or worse yet has had phone service, and is now suddenly without it. Recent (1992) disasters in Hawaii and Florida are classic examples of areas that have been hurt badly by lack of basic telephony that has still not been completely restored. The PSTN was not devastated by these events. It was the line per subscriber connections that were destroyed and will require brutally long times to restore. In such cases, a "rapid deployment" telephone system, which may be made operational very quickly, and then taken out and moved to the next "requirement", or left to serve a new unpredicted market, is highly desirable.

Therefore, needs seem to exist for temporary and even permanent wireless telephony that can be rapidly and cost effectively employed. The problems have been lack of capacity and the need for a separate switching center for the cellular wireless technology of "today". But we must consider our application. For the most part, we are not trying to serve moving subscribers. That eliminates the need for "handoffs" (the need to switch calls in progress from one cell coverage area to another), which is one of the primary reasons for needing a special, dedicated cellular switching center. The users are essentially "fixed" in location, at least down to a particular home or building area. New digital, and yes even (gasp), analog techniques are providing cellular systems with capacity capability increases of from 300 to 1000%. So if a completely standard existing PSTN switch could "run" the system, complete with billing, we would have virtually every "building block" needed to put a system together. The only thing we could probably never have is "a radio channel per subscriber". However, a PSTN end office switch operates on a "line per subscriber" basis. This creates a fundamental difference which must be addressed. This difference is resolved by employment of a commercially available device called a Digital Loop Concentrator, or DLC. The DLC takes standard line per subscriber analog loop circuits from a PSTN switch, and converts them to standard 24 channel 1.544 Mbps or 30 channel 2.048 Mbps digital PCM span line formats. In the process, it can concentrate a large number of loops into fewer span lines than would normally be needed. So while any loop connected to the DLC can be sent over the span, not all can be handled at the same time. The concentration ratio determines what percentage can be used at the same time. At the other end of the span line(s), a standard channel bank will return the digital PCM to the analog domain.

By now, it should be somewhat obvious that we are attempting to create a type of cell site, to serve "fixed location" users. We would want as high a capacity as possible because we are targeting the traditional fixed location end user rather than the typical cellular system mobile user. There are usually more fixed location users than "mobiles, and they tend to have different usage habits, namely more calls, of longer duration. We would want the cell site radios and the heart of the end users telephone to be standard, high volume, low cost, cellular equipment of some type. Cellular wireless end user phones are lower in cost than any other form of wireless phones. Call delivery to the end users will be via the PSTN end office. It will place ringing voltage/signal on the dedicated subscriber loop. We will need a relatively simple computer and data base to detect that signal and convert it into a command for the cell site to page that unit on the cell's control channel. We would use a different control channel frequency from a mobile cellular system, so only our fixed units would monitor it and "hear" these pages. This technique also keeps true mobile units from "locking" to our fixed system control channel and attempting to enter this system which cannot support them. (We have no data base for the mobile system, nor a dedicated switch for it). For call originations from our fixed users, the system simply activates the dedicated subscriber line for that number by completing the loop circuit and causing loop current to flow, just as a standard wired phone does. Our computer and data base would then deliver the dialed digits from the originating end user. The end office would perform billing on this based on the number called and duration of the call etc. The procedure is exactly the same as for wired phones into this office. Indeed, this office cannot tell which phones it services are physically wired to it and which are wireless. That is the whole idea.

The bottom line here is a "marriage" between the wired and wireless technologies of today and tomorrow, having each do what it does best. A typical wired loop to a home is rarely used more than 5% of the time. A business phone might be used as heavily as 10% of the time. The rest of the time, the wired loop just lays there, vulnerable and corroding. The old "party line" (several users time sharing a single loop) was/is a poor solution since a single circuit cannot provide any trunking efficiency. When any user can use any channel, and the number of channels can be made large (over 100), efficiency is raised tremendously, making blocking quite low for even a large number of users per channel (at least 10 and perhaps as high as 20). Existing analog cellular techniques can provide at least a hundred channels per cell and the promised digital techniques will permit even much higher numbers of channels. The cost of a cell site, much like that of any fixed telephony "plant" is reduced dramatically when a common location and its associated common equipment are shared by more and more individual circuits, of any type.

The concept is relatively simple. It's a PSTN switch connected directly to a cellular base site, connecting the end users to "the network". It can be deployed very quickly (probably a month or so), and all the wireless phones in its domain become operational at the same time if the area is "preloaded" with subscriber units. These units are cellular in nature, using small power supplies and batteries for operational power. Short of the network or cell site "going down", there isn't much that can knock the system out. It can "precede" wire in "boom" areas. It can be used "instead" of wires where the population density may never justify sparse long lines. It can "replace" wires after a disaster, until normal service is restored. There really isn't much it can't be used for with respect to telephony. Typical "data" (FAX etc.) passes nicely over analog cellular channels and the new digital techniques are being designed with data in mind.

We should recognize this as a new telephony "tool" that is starting to be applied already in some countries. The tool can only get even bigger and better as the digital cellular technologies begin coming on line and "maturing" with respect to size, cost, and performance. "Standard" cellular will drive those issues, and since the concept is applicable to any cellular technique, the technology chosen can be literally the one that makes the most sense for a particular country or application, "all things considered". That's a rather nice position for a "decision maker" to be in. Usually it's just the opposite and they have a gun pointed to their heads.

CELSAT'S HYBRID PERSONAL COMMUNICATIONS SYSTEM

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1. ABSTRACT

This paper describes the first hybrid (satellite and ground based) cellular telephone system to be proposed to the United States Federal Communications Commission (FCC). Costs are projected to be remarkably low, for example, the satellite cost per phone call will be less than one cent per minute. The system will cover vast areas and provide new features including: compressed video, paging, high speed fax, high speed data, position determination, and improved quality voice-all using the same basic transceiver. Calls can be placed or received anywhere in the United States with a small, very low power handset using the satellite in remote areas and ground cells in congested areas.

INTRODUCTION

The Hybrid Personal Communications System (HPCS) concept described in this paper offers a low-cost solution to many application and end user requirements for wireless personal/mobile communications which are presently either grossly under served, served only at a very high price, cannot be totally served by one provider, or for which, without this HPCS, stand no chance of being met.

This system concept is larger and more comprehensive than any single radio-based personal communications system or service ever before proposed to the FCC. In terms of potential U.S. subscribers, it is larger than the current capacity of all the existing cellular systems combined, plus all the proposed MSS/RDSS satellite systems, even if all were operated together as one huge domestic space/ground radio communications network.

SYSTEM FEATURES

Specific features of Celsat's HPCS include the following:

One small, low cost, lightweight, low power mobile telephone provides high-quality digital voice using satellite cells, grounds cells, or micro cells.

Highest speed mobile system:
- Fax (Group 3 or Group 4)
- Data (bandwidth on demand up to 144K bits/sec)

Compressed video:
- Picture phone
- Other specialized applications

Accurate, real time position determination

Privacy

Lowest RF Power - 0.1 watt (average) for a voice call

Broadcast capability - U.S. or regional
- Music, news, information, compressed video, paging

The system example given in this paper assumes operation over the United States utilizing the frequency bands of 1610 to 1626.5 MHz and 2483.5 to 2500 MHz. More generally, the performance parameters and features can be achieved with suitable bands carefully selected in the range of 1 to 3 GHz and over typically vast territories anywhere in the world.

Celsat's technology allows a dramatic breakthrough in PCS (or FPLMTS) economics. The satellite provides very high capacity coverage of "thin routes" (rural and remote areas) at the lowest cost possible, thus giving all U.S. citizens access to PCS. Celsat's hybrid system allows a unique trade-off between ground and space capacity unavailable in other systems. Since the satellite provides universal roaming, this trade-off permits the lowest cost deployment of the ground system. Specifically, because of poorer propagation in the 2.0 GHz band, PCS systems will typically require more cells than conventional cellular at 900 MHz. However, Celsat's HPCS requires ground cells only to meet demand and not to provide for remote coverage. This results in not only the lowest cost, but also superior coverage and seamless roaming.

Celsat's HPCS will also achieve a new standard of spectral utilization and efficiency -- over 56,000 voice circuits serving the U.S. in the first generation space subsystem alone. This space-only capacity exceeds competing systems by an order of magnitude. In addition, and in the same spectral allocation, a massive ground network (in excess of 1,000,000 voice circuits) can be built.

BACKGROUND

The continuing and seemingly insatiable demand for conventional cellular services, alone, is indisputable -- the need for more and improved personal, portable and mobile cellular services is also growing, with no end in sight in many markets. As the many applications for mixed-use and even single purpose voice, data, and position determination services unanimously attest, there exists a similarly undisputed, demand for such basic services in certain applications for which satellite technology offers the <u>only</u> satisfactory solution.

As for the shortcomings, each planned or existing wireless personal/mobile system and/or technology has one or another major disadvantage. For example, both the proposed mixed-use MSS/RDSS mobile satellite systems and existing ground cellular telephone systems fall far short of the capacity needed to satisfy even existing demand, let alone the more contemporary requirements anticipated for later this decade and on into the early 21st century. Current wireless transmission and/or multiplexing schemes either permit only packet-type data transfer, or otherwise lack the continuity necessary for high speed transactions. None of the emerging ground-based technologies offers ubiquitous coverage; conventional analog cellular cannot offer privacy; satellite-based paging cannot offer voice communications or significant other information delivery; neither cellular nor PCN offers position determination; initial PCN systems and cellular subscribers cannot automatically receive communications while outside their home system area; both MSS and ground cellular systems are expensive to use; neither today's conventional cellular nor MSS can reliably transmit asynchronous data or data at bit rates above 9600 bps; and ground cellular suffers from frequently dropped and blocked calls, and noise interference. These are among the most significant limitations -- all of which can be removed with HPCS.

Finally, while spread spectrum code division multiple access (SS CDMA or "CDMA") technology would bring substantial relief to cellular's privacy, noise, dropout and capacity problems, the cellular industry has yet to recover its investment in analog systems and therefore will probably change only in areas of saturation. There is still a significant probability that the industry ultimately will split its system conversions between TDMA, CDMA and yet other alternatives including NAMPS. As a result, at worst, CDMA might be passed over as the cellular technology of choice; at best, it will be adopted in only a fraction of the nation's cellular systems resulting in either a high degree of incompatibility or the need for expensive dual mode transceivers.

Several of the proposed mobile satellite service applications, on the other hand, plan to use CDMA, but their respective system designs lack sufficient capacity to achieve maximum cost effectiveness in terms of their ability potentially to reduce the cost of handsets and supporting infrastructure components. While deployment of CDMA in PCN networks could possibly ensure a role for CDMA technology, the capital intensiveness required to achieve satisfactory coverage in stand-alone PCN systems leaves its economic viability yet to be proven.

Together, these trends and developments substantiate Celsat's position that many present and near future personal/mobile services and market applications -- many of which, either for lack of coverage, capacity, or functionality, cannot be served at all by existing or proposed alternative systems -- could be served very efficiently by one super high capacity, *hybrid* space/ground CDMA-based digital telecommunications network capable of a broad range of data rates and functions. Celsat has designed such a system.

The system architecture described in subsequent pages is unique and, to Celsat's knowledge, has never been previously proposed. This configuration of high technology elements, results in superior performance, seamless communications, low cost and other functional capabilities heretofore not attainable. Other configurations might be feasible, but Celsat has no knowledge of any that would be as well suited to a super high capacity HPCS.

Section 1 presents an overview of Celsat's Celstar HPCS. Section 2 provides a discussion of Celsat's approach to the use of CDMA. Some basic orbit considerations are given in Section 3.

1. CELSTAR HYBRID CONCEPT OVERVIEW

The Celstar system is designed to set a new standard of service, cost effectiveness, and spectral efficiency in mobile communications. The system will provide full geographic coverage (voice, data, picture, compressed video and position location) for mobile users anywhere within the United States, covering rural as well as metropolitan areas. Full communications coverage without position determination will also be available in Hawaii, Alaska, and the Virgin Islands. The concept promises significant spectrum management advances in terms of maximum spectral utilization efficiency as well as minimum interference generation and susceptibility.

The key to the ability to provide this range of service and economy is a satellite system architecture which is fully complementary to and integrated with a new ground-based cellular system (see Figure 1). Together they form a fully compatible and complementary hybrid space/ground

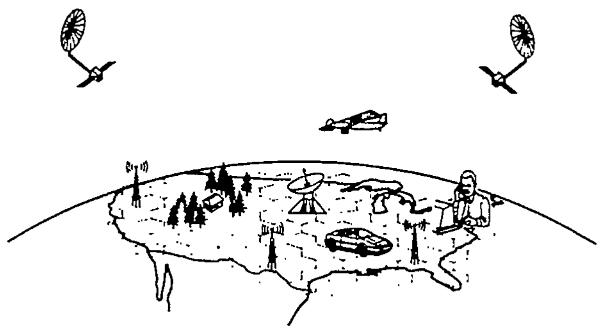

Figure 1. The Celstar HPCS Architecture

cellular network seamlessly operating in the same frequency band (see Figure 2). The basic modulation and multiple access protocol of the Celstar system is designed to fit the emerging standards of the CDMA ground cellular system, but it will operate in a new frequency band. High density metropolitan areas will thus be served mostly by Celstar's ground-based cellular nodes, architecturally similar to present practice. Rural areas, where ground cellular service is not economical, will be served in the Celstar system by a network of "super-cells" defined by the ground footprints of a high gain, multi-beam satellite antennas. Both utilize the same basic user handheld "shirt pocket" unit. Making full use of today's state-of-the-art in large multi-beam satellite antenna design technology, such super cells are ellipses with dimension that vary with the satellite/ground geometry and with carrier frequency. The axes of such ellipses are typically on the order of 200 x 400 miles and the entire U.S. is covered with an array of 149 such satellite super-cells. While the system is generally capable of operating in the range of 1 to 3 GHz, one specific frequency band design example is given here, to wit:

1.610 GHz to 1.6265 GHz (user transmits)
2.4835 GHz to 2.500 GHz (user receives)

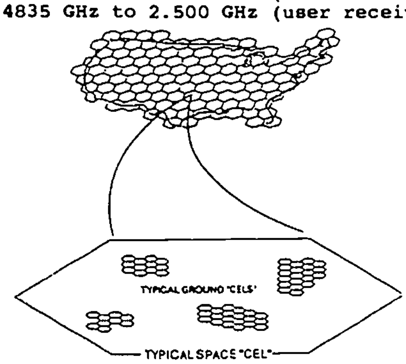

Figure 2. HPCN Grounds-Cells Dispersed Throughout Space-Cell

The overall Celstar HPCS consists of the following parts:

User Element

User Antenna

Near omnidirectional

User transceiver

Common, SS CDMA waveform

Commercial voice digital coding/decoding technology

Forward error correction coding/decoding

2-way, rx signal-sensing, tx power level control

Flexible support for other variable rate data services

Position presentation

Ground Element

Ground nodes (cell-sites)

Spread Spectrum CDMA cellular telephone technology transposed to new carrier frequency bands.

Multilateration position determination

Satellite Element

Satellite

Geosynchronous orbit

State-of-the-art large (20 meter diameter) UHF, multi-beam, imaging antenna

Extraordinary circuit capacity by virtue of high antenna power gain and large frequency reuse factor

Multiple (16) K-band backhaul links

2-way, signal-sensing tx power level control

Multilateration position determination

Satellite hubs

Ground entry points to the PSTN or other network

Network Control

Maintain log of each subscriber's current call(s), address(s), and location

Coordinates optimal allocation between ground and satellite resources

Coordinates transitions between cells, whether satellite ground or mixed. Coordinates ground/satellite resources and relays radio position determination requests.

A key feature of the design is transparent, effortless transition between ground and satellite relay resources as a user roams freely between areas covered by both ground and satellite nodes, and areas covered only by satellite nodes.

The satellite operates at geosynchronous orbit. The mobile link UHF satellite antenna is an imaging feed antenna, that is, the feed plane structure is in the image plane of the antenna and comprises an (diffraction limited) image of the ground coverage area, such as the United States (see Figure 3). The individual feed elements will consist of either isolated (e.g., cupped, half-wave or shorter) dipoles or crossed feeds.

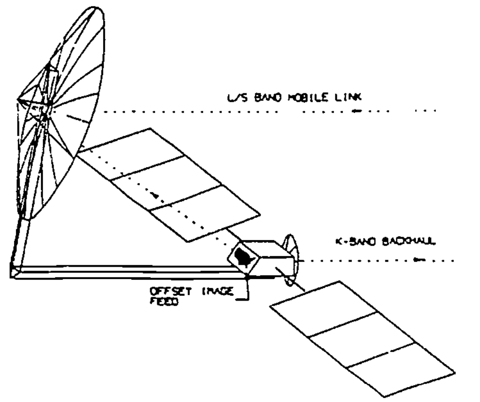

Figure 3. Celstar Satellite

The individual beam footprints of the mobile link multi-beam imaging antenna define satellite cells on the surface of the coverage area. Within each cell and between cells, all satellite link users use the same band for transmitting and a second band for receiving. The antenna pattern is such that this results in an effective total interference level from all users outside of any given cell of about 1.8 times that from the users of the same cell alone.

The satellite to ground hub or "backhaul" links are frequency multiplexed, with as many as 10 satellite to mobile cells served by a single backhaul link and ground station. This makes possible a flexible tradeoff between the number of ground stations to be built and distance and cost of regional landline circuits. The satellite backhaul (K-band) antennas have significantly wider beams than those serving the critical UHF mobile links. Therefore, the satellite backhaul radiation is in effect "broadcast" over all the 10 cells comprising a "backhaul cluster". Thus, with the same backhaul broadcast one can serve one ground station or many throughout the service area of the "backhaul cluster". The preference will vary from locality to locality, depending on local landline economics.

Generally, the multiple (10 or less) cells served by a single backhaul link will be contiguous, forming a "backhaul cluster". However, it is also possible, at modest K-band RF power cost, to provide special metropolitan multiplexes that serve a number of discontiguous metropolitan areas. Thus for example, it is possible to tie New York, Los Angeles, Chicago, Houston, Philadelphia, etc. together on a single metropolitan bus (see Figure 4). The primary mobile service for these areas would be from the much smaller ground cells and nodes. Optionally, however, the Celsat user in Los Angeles could select satellite links (by his/her dialed prefix code) for direct (via satellite) connection to, say, a New York destination, bypassing long distance landline charges. It is envisioned that only one such "metropolitan bus" would be provided.

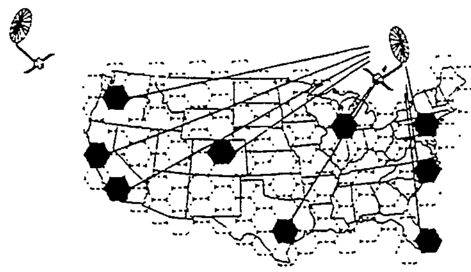

Figure 4. Illustrative HPCN Metropolitan Bus

A typical voice signal can be traced inbound from a mobile user through the various processing stages to the designated ground hub.

The analog voice waveform is first encoded using a state-of-the-art voice vector encoding algorithm. The numerical examples will be based upon 4.8 kbps CELP encoding which is expected to be practical in ASIC within several years. Implementation prior to such time could use 8 kbps. It is one of the very important features of SS CDMA, however, that the long-term impact of such an interim design change is minimal. Whenever improved voice encoder performance becomes available it can be incorporated compatibly into the SS-CDMA multiplex, alongside the older standard, without sudden obsolescence of the older user units. The more favorable call rate economics may then be expected to encourage a gradual obsolescence or upgrading of the less efficient older units.

The 4800 bps digital voice bit stream is digitally multiplexed with a 200 bps order wire and control functional data stream. These data are used for supervisory and power control. The resulting 5000 bps composite baseband is then FEC (Forward Error Correction) encoded.

The baseline for the present design calculations is convolutional, rate 1/3, K=7 encoding, with Viterbi 3-bit soft-decision decoding. This can be implemented in multi-sourced, single chip, off-the-shelf Application Specific Integrated Circuitry ("ASIC"), which also includes full duplex interleaver/scrambler/descrambler, error rate monitoring, and phase and bit synchronization. Error rate performance is 1 in 105 bit errors at Eb/No = 4.0 dB. It is anticipated that this field will also expand in the next two years, particularly in the direction of low-rate coding.

The signal is next spread spectrum modulated according to the unique transmit PRN sequence assigned to the particular subscriber. Taking account of time-shift options, the period of the basic PRN spreading code is long enough that there are an effectively unlimited number of such codes so they may be permanently assigned and serve as unique access keys for each subscriber mobile unit. In order to take advantage of time-shift address coding in this way, the user must have a fairly accurate time base. This is accomplished by requiring each user initially to synchronize to a pilot time reference broadcast from each ground and satellite node. With transit time delay compensation this initial course synch system will provide absolute time at the user within about 2 msec, independent of user position within any given satellite cell. The PRN sequence will be at a maximum chip frequency consistent with the spectral band assignment, typically 1 to 1.3 Mbps in the baseline design.

The individual spread signal is now amplified by a variable gain amplifier to a level calculated in the power control unit to return a fixed signal level to the ground hub. This calculation is based upon the observed received signal level as an indicator of the current path loss. If the path level variations were static, this would result in effectively perfect compensation. For dynamic variations which occur primarily in the vicinity of the mobile, such as going behind a tree or building, the downcoming path perturbation information is generally less than a microsecond (1000 feet) late when it reaches the mobile receiver, and may be another microsecond late by the time the precompensated signal reencounters the obstruction on the return path to the hub. So for the inbound (mobile-to-hub) path as well as both paths for the ground cellular, very fast--almost perfect--path compensation is achieved. For the outbound (hub-to-mobile) satellite path on the other hand, the sensing signal is 1/4 second late by the time it arrives at the ground hub and another 1/4 second late by the time the pre-compensated signal reencounters the obstruction near the mobile on the outbound path. Thus, for the outbound path (hub-to-mobile) it is only the slow path variation components, less than about 1 Hz, that are effectively compensated by this system.

Finally, the spread-spectrum signal is fed to the omnidirectional mobile antenna and radiated to the satellite.

The ground hub consists of a number of independently assigned and operating linear transceivers just like that at the mobile. One of these is assigned to each active mobile link. The demodulating and deprocessing operations follow on a one-to-one inverse basis the corresponding processing and modulation operations described for the transceiver.

A summary of the satellite key link parameters is contained in Table 1.

Table 1. Key Link Parameters

Transponder Configuration	Full-duplex, K-Band - UHF Bent pipe, 10x Freq. Div. Multiplex on backhaul
On-Board Processing	None
U.S. Satellite EVG Capacity (Space segment only.)	58,900 5Kbps voice circuits
UHF Reflecter	20 meter deployed mesh
UHF Gain	51.2/47.4 dB, on center: 48.2/46.8 dB avg. over cell
UHF Polarization	RHC
UHF Beams (feeds)	149 extended U.S. coverage
Cell Size (miles, mid-CONUS)	174 EW x 212 NS hex major diameter
Coverage at 10° Min. Elevation	Conterminous U.S., plus Alaska, Hawaii, P.R./V.I.
Transmitter EIRP per Beam, S-Band down-link	58.8 dBW/58.8
L-Band Receiver, G/T	+ 20.2 dB/°K
K-Band Satellite Receiver G/T	+ 20.8 dB/°K
K-Band Reflectors, Up/Dn	1.5/2.0 m
K-Band Polarization	RHC
No. K-Band Backhaul Beams, (hub stations)	15-20
K-Band Freq. Multiplex, Up	10 x 13.875 MHz Chnls/Beam + 5 MHz, TT&C
K-Band Freq. Multiplex, Down	10 x 12.75 MHz Chnls/Beam + 5 MHz, TT&C
K-Band EIRP per Beam, Up	44.1 dBW avg.
K-Band EIRP per Beam, Down	37.8 dBW avg.
Downlink BW to Hub	132.5 MHz
Flux Density at Earth	2.4 GHz/ -138.8 dBW/m²/4kHz. 184 GHz/ -158.4 dBW/m²/4kHz

The antenna is of a larger size than deployable antennas used commercially to date, but it represents no major new technical challenges. Several U.S. manufacturers are capable of producing the required antenna to the necessary specifications and reliability. The rest of the payload consists of conventional "bent pipe" transponder technology, albeit there are substantially more UHF band transponders than are typically launched.

In the unlikely event of temporary incapacity of either satellite in space, the other active satellite will have enough reserve power to serve the entire CONUS with nearly 60% of its normal system capacity. CONUS capacity, even under such extreme circumstances, would only drop to about 32,000 voice circuits or equivalent capacity.

2. CELSTAR'S USE OF CDMA

Key to several of the advances in the proposed system is the use of spread spectrum Code-Division Multiple-Access (CDMA).

In a Frequency Division Multiple Access (FDMA) cellular system, as under the present standard, there is a minimum cluster size, N, required to insure sufficient geometrical separation between co-channel users to avoid unacceptable co-channel interference. This cluster size ranges typically from 7 to 14 or more cells depending on propagation topography. The significance of this from a spectral utilization efficiency standpoint is that for a given total system allocation bandwidth, the bandwidth that can be used in any one cell, and therefore the number of channels that can be accommodated in a cell, is inversely proportional to N. For example, with N=7, only one-seventh of the total system allocation bandwidth can be utilized in each cell.

By contrast, in the Celstar CDMA system the actual cluster number is 1; i.e., each cell uses the full channel bandwidth. Other users in or near the same cell interfere, but not fatally as would be the case in a FDMA system. Rather, the total received power of all such co-band users interferes as random noise, attenuated by the directivity of the antenna beam which defines the super-cells, and by the "processing gain", that is the ratio of total bandwidth to user band-bandwidth.

Multipath is perhaps the number one curse of conventional mobile radio telephone. By contrast, in the Celstar system, the wide bandwidth inherent in spread spectrum is used to resolve the various components of multipath, and enable them to be combined constructively, in a three-fold, delay tracking RAKE receiver to provide a high degree of immunity to fading. This principle has been demonstrated by Qualcomm with great success in the recent series of ground cellular CDMA field trials in San Diego. (See "Next Generation Cellular - Results of the Field Trials," CTIA, December 4-5, 1991, Washington, D.C.)

The same RAKE mechanism provides the basis for soft handover, with enhanced signal performance at the critical maximum range by utilizing the two nearly equal signals from the two (or three) competing transmitters and beams as components of a time diversity pair (or triad).

This has also been demonstrated effectively in the above referenced San Diego CDMA cellular field trials.

In Celstar the total bandwidth for each link is first divided into 1.25 MHz subbands. Each subband in each cell is then shared by about 40 simultaneous users using Code Division Multiple Access. This has several important advantages:

1. It is compatible with the emerging standard for ground cellular CDMA.
2. The resolution provided is adequate to support an RDSS ranging accuracy objective of 300 yards (normal mode) and to resolve the major components of urban multipath.
3. The lower sampling range makes feasible RAKE implementation with existing DSP chips.
4. The frequency subband separation enables an important degree of flexibility in management of narrow band (1.25 MHz) interference either to or from the Celsat system.

CDMA affords special advantages with respect to both generated and tolerated interference.

The system design, for both the ground-based and satellite-based links, is based upon a cumulative interference level (noise power spectral density) at maximum channel loading, about equal to or somewhat less than that of thermal noise alone. Both up-link or outbound, and down-link or in-bound transmitters are continuously power controlled to ensure that each user link continuously and dynamically uses minimum radiated power consistent with this criterion. Thus, the worst case (i.e., under maximal channel loading) interference to a narrow band user would be less than 3 dB degradation of absolute sensitivity, which is quite acceptable.

One of the important side benefits of spread spectrum CDMA is the flexibility that it affords in terms of baseband services. Frequency or time division multiplex structures must manage a strategy which becomes quite complex and inefficient when called upon to accommodate a diverse and dynamically changing mix of different base-bandwidth services. By contrast, in the CDMA mix, there are no such constraining relations between the baseband services other than the total power allocated to all other band sharing services. This means, for example, that it is possible to mix services ranging from minimal data ranges of, say, 75 bps to fast data or compressed video of up to 144 kilobits per second. This baseband flexibility will become of special importance to the Emergency Radio Service, which may be called upon to provide a wide range of baseband service ranging from slow physiological monitoring to pictures and compressed video.

While the art of voice encoding is itself well aged, the impact of powerful microprocessor capabilities and the concept of algorithms such as vector quantization have triggered a significant resurgence of research and breakthrough results in recent years. High communications quality encoding (almost full intelligibility but with slight noticeable unnaturalness) has been demonstrated as low as 2.4 kbps, but with presently unacceptable computational complexity. Efforts to simplify these algorithms and reduce them to ASICs are showing promising initial results. Although the immediate next generation of digital cellular radio may utilize existing demonstrated 8 kpbs hybrid encoding, we believe that commercial 4 kbps voice ASICs will be available within a few years.

The Celstar system CDMA approach gracefully accommodates such anticipated dynamic improvements in encoding performance. New, updated user sets, taking advantage of more powerful encoding algorithms (and either reduced rates or improved fidelity), will operate compatibly in the same wideband RF channel, with sets built to older obsolescent standards, as well as other diverse data and picture services. There is no rate compatibility constraint, only the overall signal power constraint. This CDMA system is designed for growth.

Another important benefit of the choice of SS CDMA is that it provides for almost arbitrarily powerful, low rate Forward Error Correction coding at no cost in terms of lost circuit capacity. In FDMA or TDMA, the redundancy necessary to implement such coding must be paid for directly in terms of reduced circuit capacity. For example, rate 1/2 FEC coding (50% redundancy) reduces the number of band-limited allocatable TDMA or FDMA voice circuits by almost 1/2. By contrast, in CDMA, such coding does not reduce the number of available circuits, in fact, to the same extent (several dB) that it improves the system sensitivity to noise and interference, it also improves the tolerance to in-band interference and correspondingly <u>increases</u> the number of users that can be accommodated in-band. In other words, the circuit capacity has been improved rather than sacrificed due to FEC encoding. In effect, the redundancy necessary to support FEC is already there in CDMA, and may be used for FEC at no cost in terms of circuit capacity.

Under normal circumstances in a two-way conversation each user is active only 35-40% of the time (including both listening periods and pauses between utterances). In a typically power limited communication link, this represents a potential gain of 4 to 4.5 dB or increase of 2.5 to 2.8 times circuit capacity, if advantage can be taken of these gaps. To capitalize on this in a FDMA system leads to a rather complex and limited, centrally coordinated dynamic channel reallocation system such as TASI or DSI. With CDMA on the other hand, there is no problem of channel reassignment--everyone is already using the same channel. Each channel then needs only VOX control to turn itself off between utterances, independent of all other channels, and the full 4 to 4.5 dB power gain is realized. When a circuit is in the "off" mode, means must be provided to maintain spread spectrum chip synchronization. However, this is easily accomplished at negligible power cost by a low power "keep-alive" signal at a level of the order of 10 dB less than that of the peak "on" signal.

In the Celsat system each user transmits a wide-band, code spread signal, in the common allocated subchannel bandwidth, 1.25 MHz for the nominal baseline system. In order to isolate a particular user signal and demodulate the information on it, the receiver must recreate a local replica of the pseudo-noise signal used for spectrum spreading by that user, and adjust its timing to exactly match that of the incoming signal. The techniques for doing so are well known. Having made this replica timing adjustment, the receiver inherently has available a precise estimate of the time-of-arrival of the signal. In order for the spread detection to operate, this time must have a precision of about 0.3 microseconds or 300 feet of range. Additionally it is planned that the user clock and code phase would be locked to the received pilot signal phase from his controlling node, thus enabling round trip delay, or range measurement. In conjunction with receptions of each user signal at several ground or satellite nodes which will always be monitoring the signal, this provides the basis for Celsat's position measuring system, capable of position accuracy well within 300 yards. This service is available at very little added system complexity, at very low cost, and without special operator requirements.[1]

3. ORBITS

Celsat has completed detailed studies and evaluated the tradeoffs between various orbit possibilities suitable for its hybrid proposal, including LEO, MEO and GEO orbits, and selected GEO as the clear choice notwithstanding that several other potential mobile satellite service providers have selected both LEO and MEO orbits for their respective space-based mobile service (see Table 2).

Table 2

CELSAT OUT-PERFORMS PROPOSED SATELLITE SYSTEMS

PROPOSAL	EQUIVALENT VOICE CIRCUITS, U.S.	ANNUAL COST PER EQUIVALENT VOICE CIRCUIT (SATELLITE)	FREQUENCY EFFICIENCY (EQUIVALENT VOICE CIRCUITS PER MHz)	SUBSCRIBER UNIT AVERAGE POWER	NUMBER OF SATELLITES
CELSAT	56,800	$640	1903	0.1 WATT	2
LORAL/QUALCOMM	6,500	$8,000	197	1.0 WATT	24
MOTOROLA	4,400	$19,000	419	0.4 WATT	66
TRW	4,600	$6,000	139	0.6 WATT	12
ELLIPSAT	864	$19,000	26	6 WATTS	24
CONSTELLATION	200	$60,000	12	2.0 WATT	48

Celsat's choice of a geostationary orbit yields much greater overall space capacity at a fraction of the cost of LEO or MEO systems. A summary of the relative merits of GEO vs. LEO/MEO is given below.

GEO

- 1/4 sec time delay
  - No impact on FAX or data
  - Doesn't exist for ground portion of Celstar hybrid network
- Price at 25¢/minute
- 56,800 U.S. voice circuits
- Continuous, 24-hours per day operation with one satellite ($220M)
- Lowest power (0.1 watts) subscriber transmitter
- Earliest possible implementation

LEO/MEO

- Typically small time delay
  - Motorola's Iridium system is an exception with possible delays in excess of GEO delays
- Price up to $3/minute
- 6,500 U.S. voice circuits maximum
- Continuous, 24-hour per day operation requires 12 to 66 satellites ($450M to $2,100M)
- 0.5 watts or more subscriber transmitter

Celsat's specific orbit locations are determined by the following constraints:

- Full visibility of both satellites anywhere within CONUS
- Good position determination capability anywhere within CONUS
- Ability to serve P.R./V.I. from eastern-most satellite
- Ability to serve Alaska/Hawaii from western-most satellite

The final orbit locations at 76 W and 116 W longitude were selected to provide mutual coverage of CONUS with good geometry for position determination while also being able to serve the remote points of Alaska, Hawaii, Puerto Rico and the Virgin Islands.

The estimated operational lifetime is derived in the normal fashion for geosynchronous communications spacecraft. The elements which ordinarily limit life include expenditure of propulsion fuel; solar array degradation with time; and battery life. For Celstar's purposes these have been sized for 12.5 year spacecraft life. Its reliability has been calculated following standard industry practices, and has been calculated to be 0.6 for a 12.5 year life.

[1]Accommodation can be made for special users to broadcast at the full 16.5 MHz bandwidth for much higher position determination accuracy

SUMMARY

This paper has presented an overview of Celsat's Celstar HPCS. A new system is used with code division multiple access employing forward error correction coding to enhance the effective gain and selectivity of the system. Multiple beam, high gain antennas are disposed in the satellite nodes to establish the satellite cells, and by coupling the extra gain obtained with FEC to the high gain satellite node antennas, enough gain is created in the satellite part of the system such that a user need only use a small, mobile handset with a non-directional antenna for communications with both ground nodes and satellite nodes. User position information is also available. The system provides a relatively massive satellite capacity (56,000 equivalent voice circuits) in a modest 33 MHz of bandwidth. The satellite cost per circuit is an order of magnitude less than that of any of the recently proposed LEO systems. So low, in fact, that Celsat can be profitable while charging less than half of current ground-based cellular prices.

Celsat intends to provide a new class of mobile phone service that will allow people to carry portable phones with their individual phone numbers everywhere they go (shopping, golf course, boating, hiking, auto, airplane, etc.) and "stay in touch." Thus, calls can be placed or received anywhere in the U.S. with a small, very low-power handset, using the satellite in remote areas and ground cells in congested areas. In many ways, the system will resemble today's cellular system, but with higher quality, lower price, and more features.

Celsat will provide new features for a cellular system: video (Picture Phone), nationwide paging, high-speed fax, high-speed data, position determination, and improved quality voice-all using the same basic transceiver.

Further details related to this system can be obtained from the following sources:

- U.S. Patent Number 5,073,900 dated December 17, 1991
- Celsat's Petition For Rulemaking, February 6, 1992 (FCC RM 7927)
- Celsat's Request for a Pioneer's Preference, February 10, 1992 (FCC ET File No. PP-28)
- Consolidated Reply of Celsat, Inc. to Comments and Oppositions, submitted to the FCC April 23, 1992
- Celsat Comments to FCC, Gen. Docket No. 90-314, ET Docket No. 92-100, 92-9, etc., November 8, 1992

INTERNATIONAL DIGITAL TV SERVICE VIA INTELSAT

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ABSTRACT

The digital television era is coming. This era will see digital television signals relayed worldwide for news, sports and entertainment, but increasingly for education and business purposes. For the past five years, COMSAT, in conjunction with its foreign partners and INTELSAT, has conducted extensive field trials and laboratory simulations resulting in a wealth of data for dimensioning networks for the transmission of digital TV via INTELSAT satellites. These tests have employed the very latest in digital TV technologies and have encompassed the spectrum of digital bit rates from 6 Mbps to 140 Mbps. The tests have also included both conventional and high-definition television (HDTV) production standard formats.

INTRODUCTION

The commercialization of digital TV via INTELSAT began four years ago when COMSAT and KDD (Kokusai Denshin Denwa Co., Ltd.), the U.S. and Japanese Signatories to INTELSAT, field-tested and commercialized digital HDTV at 120/140 Mbps over an INTELSAT V satellite in the Pacific Ocean Region. This early work laid the foundation for commercial digital HDTV transmissions in 1992 of 60 Mbps HDTV over an INTELSAT V satellite in the Indian Ocean Region from Albertville, France and Barcelona, Spain to Japan for the Winter and Summer Olympics, respectively.

In early 1992, anticipating the inevitable conversion of analog to digital conventional TV[1] over the INTELSAT system, COMSAT Laboratories commenced satellite simulation testing of available NTSC-based 45 Mbps and lower rate TV Codecs and Modems to determine the satellite operating parameters needed by system engineers to dimension their international TV networks on the INTELSAT system.

This paper provides an overview of the international field trials and commercial transmissions of HDTV as well as the results of simulation testing of digital TV in INTELSAT transponders in the presence and absence of conventional analog TV. The paper also addresses the future potential of both digital TV and digital HDTV using new generations of INTELSAT satellites, namely INTELSAT K, INTELSAT VII and INTELSAT VIII, all of which have higher power to provide higher quality and to encourage the use of smaller earth stations than those used today for the transmission and reception of international TV and HDTV programming.

HDTV VIA INTELSAT

ANALOG TRANSMISSION

One of the ironies in international telecommunications of recent years is that analog and digital HDTV, based on the NHK-developed 1125/60 production standard, was commercialized over INTELSAT before the development of digital conventional TV; that is, conventional TV based on current-day production standards such as 525/60 or 625/50. It all began with MUSE. NHK (Japan Broadcasting Corp.) developed the MUSE system, based on the 1125/60 production standard to broadcast HDTV signals via satellites using frequency modulation with a carrier bandwidth of 27 MHz. While the MUSE technique employs an analog mode of transmission it relies on digital processing of the baseband TV signal. Transmission experiments using the MUSE signal via INTELSAT satellites began in 1987, followed by international transmissions from Japan to Australia and Korea to Japan in 1988 (the latter for the Summer Olympics); from Canada to Japan and from Italy to Japan in 1990 (the latter for World Cup Soccer) (1). All of these transmissions employed a double- or triple-hop configuration using an INTELSAT V satellite, a Japanese domestic satellite and (sometimes) another domestic satellite such as AUSSAT or ANIK.

In 1989, Scientific-Atlanta developed the HDB-MAC system, based on the 1125/60 standard, to broadcast HDTV signals via satellites also using frequency modulation but with a carrier bandwidth of 36 MHz. Like MUSE, HDB-MAC relies on analog transmission but employs digital baseband processing. In 1990, the HDB-MAC system was used in the first international two-way video conference via INTELSAT between Hong Kong and the U.S. using a two-hop satellite configuration (1).

DIGITAL TRANSMISSION

In mid-1989, the first international digital HDTV transmission tests were conducted over an INTELSAT V satellite between the U.S. and Japan using the DITs 120/140 Mbps Codec. KDD and Canon developed the DITs Codec, also based on the 1125/60 production standard, to broadcast HDTV signals via satellite using digital modulation and a carrier bandwidth of some 60 MHz, thereby requiring a 72-MHz INTELSAT satellite transponder (2). The DITs HDTV Codec takes a full-baseband HDTV signal and compresses the signal by a factor of roughly five down to 140 Mbps or 120 Mbps. The output rate is selectable by switch. The higher rate, 140 Mbps, is a standard rate in the international digital hierarchy, and 120 Mbps is the standard rate in the INTELSAT TDMA system.

In addition to the DITs Codec, the other key digital technology used in the transmission tests was the 140 Mbps Coded Octal Phase Shift Keying (COPSK) Modem developed by COMSAT Laboratories. (This Modem was, in fact, the prototype for units now being used for satellite restoration of undersea fiber optic cables). A 120 Mbps Modem was also used in the tests. This Modem employed QPSK or Quadrature Phase Shift Keying, the now-common digital modulation technique used in most telecommunication satellite systems.

During the field-trial, HDTV transmission tests were conducted in all possible satellite configurations or connectivities, including C-C band and Ku-Ku band loopback tests at both 120 and 140 Mbps using a C-band Standard A (30 meter) earth station in the U.S. and 5.5, 3.3 and 2.6 meter Ku-band earth stations in Japan.

Prior to transmission testing, the threshold Bit Error Rate (BER) of the DITs Codec had been determined in the laboratory. It was found that the threshold BER at which the influence of transmission errors can be ignored is 1×10^{-4}. Moreover, Intermediate Frequency (IF) loopback tests in the laboratory indicated a Carrier-to-Noise Ratio (CNR) of 12.5 dB would be needed to obtain a BER of 1×10^{-4}. The IF loopback tests included everything but the satellite link. The objective of the field trial was to determine for each configuration tested, the CNR required to produce the necessary BER of 1×10^{-4}. With this information in hand, systems engineers could then dimension a transmission system — determine earth station sizes — for commercial delivery of DITs HDTV via satellite.

The field trial indicated that with the satellite link inserted, a CNR degradation of about 1 dB resulted, with slight variations between the various configurations tested. It was concluded that the CNR required to obtain the threshold BER of 1×10^{-4} was 13.5 dB for 140 COPSK DITs transmission and 13.0 dB for 120 Mbps QPSK DITs transmission.

With the above information, appropriate transmission configurations for DITs HDTV exchange between the U.S. and Japan were determined using an INTELSAT V, a 13.0 dB CNR for a threshold BER of 1×10^{-4}, 2 dB downlink margin and INTELSAT standard Ku-band earth stations, viz: Standard E3 (8 meter), E2 (5.5 meter) and E1 (3.5 meter). It was then concluded that it would be possible to exchange DITs HDTV via INTELSAT using small transportable earth stations in the E1 to E3 class (3.5 - 8 meters in diameter) and achieve a 99% or greater availability.

Further, for E1 (3.5 meter) receive stations, it proved to be desirable for the uplinking station to be an E3 (8 meter), or larger station. For E2 (5.5 meter) receive stations, uplinking stations of E2 (5.5 meter) or larger proved desirable.

After the field trial in October, 1989, the first commercial DITs 120 Mbps HDTV transmission occurred between Japan and the U.S. over an INTELSAT V satellite delivering HD programming to the Society of Motion Pictures and Television Engineers Conference in Los Angeles. The receiving station outside the conference hall was an E2 (5.5 meter).

As a result of the DITs field trial and technological advancements in the laboratory, NHK developed an improved Codec known as 60 Mbps Digital MUSE, again based on the 1125/60 production standard with a carrier bandwidth of 31 MHz. The Digital MUSE bandwidth of 31 MHz provides a more cost-effective match to INTELSAT capacity, while the bit rate of 60 Mbps was selected to deliver a high-quality HD signal via INTELSAT to Japan for redistribution over Japanese domestic satellites.

Digital MUSE was first used over an INTELSAT V in the Indian Ocean Region in February, 1992 to deliver HD programming from the Winter Olympics in Albertville, France to Japan using a 3.7 meter Ku-band uplink earth station in France and a 34 meter Standard A receive earth station in Japan. HD coverage of the 1992 Summer Olympics in Barcelona, Spain followed, the only difference being the use of a 7-meter Ku-band uplink earth station.

DIGITAL TV VIA INTELSAT

SIMULATION TESTING

Conventional analog TV transmission which is based on either the NTSC 525/60 or PAL 625/50 production standards is expected to be converted to digital TV in the near future due to the increasing use of digital TV production techniques along with advances in video compression and the availability of reasonably priced Codec and Modem equipment. Within the studio, the use of digital component and composite video is common. The high bit rates involved (in excess of 80 Mbps for D-2 composite video) have deterred the use of these formats for transmission outside the studio. Sophisticated video compression Codecs can reduce the bit rate to 20-45 Mbps with minimal loss in perceived TV signal quality, and well below 20 Mbps with perceivable but acceptable loss in TV signal quality.

For TV transmission, a common scenario in the INTELSAT network is to have two FM/TV signals occupying a 72 MHz transponder with each FM/TV signal occupying a bandwidth of 30 MHz. In order to reduce the effects of the TWTA nonlinearity on the TV signals and to reduce intermodulation, the transponder output is backed off by some 2 dB. As television transmission gradually evolves from all analog to all digital, it is likely that the case will arise where one of the two signals is a 45 Mbps digital TV signal and the other is a 30 MHz analog FM/TV signal. It is therefore important to study the issues relating to the co-existence of analog and digital TV in a single transponder. To this end, COMSAT Laboratories undertook INTELSAT satellite simulator testing in late 1991. The testing was performed on two different 45 Mbps video Codecs using two different 45 Mbps QPSK Modems (3).

The first order of business was to determine 45 Mbps [illegible] TV performance in thermal noise and with adjacent and co-channel analog TV interference in a simulated satellite environment. The results could then be used by system engineers to obtain accurate link budgets and system margins for dimensioning networks for the transmission of 45 Mbps digital TV over INTELSAT. It was found that the threshold CNR (in a carrier bandwidth of 30 MHz) was 11.0 dB for one Codec and 11.5 dB for the other when operating near TWTA saturation (the normal operating point for two carrier operation) using QPSK modulation with rate 7/8 convolution coding. The threshold CNR for both Codecs corresponded to a BER of approximately 1×10^{-4}. Interestingly, the tests found that operation near TWTA saturation caused an increase of 0.5 dB in the threshold CNR for both Codecs. Moreover, the tests revealed that both co-channel and adjacent channel interference impacted the threshold CNR for both Codecs some 8 dB less than typical figures for analog FM/TV transmission, providing further evidence of the robustness of digital TV transmission.

To illustrate the reduction in earth station size that can be obtained by 45 Mbps digital TV transmission, consider first a 30 MHz FM/TV link in a single 72- or 36-MHz transponder on an INTELSAT V satellite. Such a link requires a new Standard A (18 meter) receive earth station to achieve a 15 dB CNR to yield a signal-to-noise ratio of 52 dB, which is the generally accepted value for international broadcast quality.

Alternatively, in digital video transmission, if the link can provide a CNR above threshold then the displayed picture is virtually noise free. For the 45 Mbps Codecs tested, the threshold CNR was about 11 dB. All other parameters remaining the same, the downlink for 45 Mbps digital TV can be replaced with a Standard B (11 meter) earth station. This results in a receive CNR of 12 dB providing a noise free TV picture with a 1 dB margin even though the Forward Error Correction (FEC) of the tested 45 Mbps Codecs was not optimized for satellite transmission. A more appropriate channel coding scheme — a multiple error correcting block code or a concatenated Reed Solomon/Convolution code — likely would yield a threshold CNR < 9 dB for the same 45 Mbps Codecs. This would permit the use of a Standard F-3 (9 meter) receive earth station for the same link. In sum, switching from analog FM/TV to optimized 45 Mbps digital TV could reduce receive earth station size from 18 meters to 9 meters — quite a savings indeed!

In mid-1992, second phase testing began with emphasis on measuring the interference from 45 Mbps digital TV into analog TV at various levels of transponder saturation (4). The test results showed that the interference from a 45 Mbps digital TV signal is more severe than from an analog FM/TV signal. The interference from the 45 Mbps digital TV carrier manifests itself as a decrease in the signal-to-noise ratio and an increase in FM threshold in the adjacent FM/TV carrier. The interference also increases the closer the TWTA operates to saturation. It was also found that operating the 45 Mbps digital TV channel at a 2 dB lower power level than the adjacent analog FM/TV could reduce these interference effects.

In order to confirm the results of the hardware simulation, software simulation was also performed. This simulation confirmed that a 45 Mbps digital TV carrier created higher power intermodulation products than an analog FM/TV carrier, and that these intermodulation products decrease in power as the 45 Mbps digital carrier power level was reduced. It should be emphasized that operating the 45 Mbps digital TV carrier at a lower power level is a viable option because of the 45 Mbps digital TV advantages discussed above that enable operation at CNRs that are much lower than the analog FM/TV threshold CNR.

To complete the simulation testing, COMSAT Laboratories also evaluated low-rate digital TV on the INTELSAT satellite simulator and found that the threshold CNR for compressed 6.6 Mbps digital TV was 8.0 dB (in a carrier bandwidth of 5 MHz), when operated at a TWTA backoff level appropriate for multicarrier operation.

COMMERCIAL TRANSMISSIONS

While thousands of 45 Mbps digital Codecs are now in use in terrestrial systems worldwide, carrying voice, data and TV, no 45 Mbps digital TV has yet been transmitted over INTELSAT. Moreover, time division multiplex (TDM) equipment which compress several video channels, usually 2, 3 or 4 into 45 Mbps are also now available from several manufacturers. This technology also has yet to be used over INTELSAT, but indications are that 45 Mbps digital TV, with or without TDM compressed video, will be used on INTELSAT before 1994. One significant step, the first use of compressed 6.6 Mbps digital TV on INTELSAT, is now being planned for early 1993 between Hong Kong and the U.S.

FUTURE POTENTIAL OF DIGITAL TV VIA INTELSAT

In the next several years, INTELSAT will be replacing its current fleet of INTELSAT V satellites with new generation INTELSAT VII and INTELSAT VIII satellites. These satellites have higher e.i.r.p. than the current INTELSAT V satellites. At C-band, the INTELSAT VII and INTELSAT VIII have 33 dBW and 36 dBW e.i.r.p. at beam-edge, 4 dB and 7 dB higher than the INTELSAT V satellite, while at Ku-band they have 47 dBW e.i.r.p. at beam-edge, some 5 dB higher e.i.r.p. in the East Spot beam, with about the same e.i.r.p. in the West Spot beam as the INTELSAT V satellite. The increase in e.i.r.p. can be used to cater to the use of smaller-size antennas and/or to improve picture quality. The most dramatic reduction in antenna size for future digital TV transmission is expected to occur at C-band.

It should be possible, for example, to receive high quality 60 Mbps Digital MUSE and 45 Mbps digital TV via an INTELSAT VII or INTELSAT VIII satellite at C-band with 6-9 meter earth station antennas rather than the 18 meter earth station antennas used today. Moreover, ten high quality compressed 6.6 Mbps digital TV carriers could be accommodated in either the Ku- or C-band 72 MHz transponders on the INTELSAT VII or INTELSAT VIII, and received by earth station antenna sizes of 6-9 meters at C-band and 3-4.5 meters at Ku-band and achieve outstanding availability. The most exciting capability already available is the INTELSAT K satellite now operating in the Atlantic basin. This Ku-band satellite with broadcast satellite parameters, 50 dBW peak e.i.r.p. and 54 MHz transponders, offers exciting possibilities for international digital TV delivery. For example, high availability 45 Mbps Digital TV could be obtained with antenna sizes as small as 2.4 meters.

CONCLUSION

HDTV via INTELSAT is a commercial reality, while digital TV is on the threshold of commercial reality. Two different digital HDTV systems have been employed in commercial end-to-end settings delivering a wide range of HDTV programming in a variety of earth station configurations involving two- and three-hop satellite links. The first use of compressed digital conventional TV on INTELSAT is scheduled for early 1993. Moreover, as the INTELSAT system is replenished with new generation INTELSAT VII and VIII satellites in the next several years, improvements are anticipated in the delivery of international digital TV or HDTV through the use of smaller-size antennas coupled with attainment of better picture quality.

Footnotes

(1) Based on conventional, current day production standard formats such as NTSC.

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Emerging Technologies and Future Satellites

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1. Abstract

In the past 20 years the world has seen many changes in the way organizations conduct their everyday business operations. The need for communications has increased in importance with the shift from an industrial-based economy to an information-based economy. It is now difficult for businesses and individuals to remain competitive in this ever-changing society, without up-to-the-minute information provided by the most up-to-date communications systems.

As communications requirements change, so do communications systems, and satellite service providers have adapted their networks to meet these changing needs. In 1992 Telesat took another step towards fulfilling the communications needs of Canadian businesses with the construction and launch of its latest series of satellites, the Anik Es. This paper will examine the on-going communications evolution and look beyond the year 2000 at the next generation of satellites.

To be a part of that world satellite service providers have to understand the needs of the markets they are trying to serve. They also have to be aware of the communications initiatives being studied by terrestrial network operators and the technological options available which will allow them to meet the challenges these communications developments present.

Introduction

Technological developments affect everything we do in telecommunications, and it is obvious that emerging technologies will affect the design of the next generation of commercial satellites. So to be a part of the communications networks of the future, satellite service providers have to understand the needs of the markets they are trying to serve, they have to be aware of the communications initiatives being studied by terrestrial network operators and they have to look at the technological options available which will allow them to meet the challenges these communications developments present.

To understand this it is important to understand how market trends create a demand for communications solutions and how that demand determines which technologies are incorporated into telecommunications infrastructures. Only then can we understand the technological options available to satellite operators.

Market Trends

Today's corporations have become increasingly more dependent on telecommunications systems to conduct their everyday business. Telecommunications systems are always getting larger, faster and more complex, and increasingly greater demands on these systems are being made. If we look at the way business operations have evolved over the past thirty years, we can see how telecommunications systems have developed and kept pace with that evolution.

In the 1960s businesses operated differently. PCs, LANs, cellular phones, and fax machines were still far off in the future, and the main business communications tools were the telephone, and, in some cases, the telex. What couldn't be handled over the telephone and telex was handled with face-to-face meetings, and the speed or pace of business was determined, to a large extent, by these two methods of communications.

At this time satellite was primarily a service for television broadcast, as back-up for terrestrial services, and for long haul telephone traffic. There were no VSATs, no mobile satellite services, no BTV services and little or no voice, data, or image (VDI) satellite applications.

In the area of data networking, computing power was very expensive. Organizationswith sophisticated data communications needs would contract out their computing requirements to companies equipped to generate large batches of information within a short time. By the 1980s advances in computer technology made it possible for organizations to actually buy their own small computer, and by the end of the decade computers evolved to the point where they could actually be placed on each desktop, giving the power of data communications directly to the communicators. This move to desktop computers led to the development of local area computer networks and increased the communicating power of each organization.

Today's data networks are fast, reliable, and incredibly sophisticated. Inter-networking architectures such as Local Area Networks, Metropolitan Area Networks, and Wide Area Networks allow for seamless communication between various locations of an organization, and these seamless networks are already evolving into the next century's global networks, networks that will allow organizations to communicate with offices anywhere around the world.

So we are now on the threshold of the "global village" that has been discussed for so long.

In this environment telecommunications service providers have developed new services and new applications to fulfill the need for fast and timely business information exchange. The telephone companies have increased the efficiency of their voice networks and added such services as teleconferencing. They have developed new data services to replace the telex, and introduced a v. 'iety of services operating at different speeds to meet th needs of any business. And satellite communications companies have developed satellite-based services to meet these business needs.

Where satellite was once perceived solely as a service for television broadcast, or as back-up for terrestrial services and for long haul telephone traffic, it is now an alternative communications service in its own right. VSATS are in widespread use, business television is now an affordable option for most organizations, teleports have been created in cities around the world, and a whole host of VDI applications are now possible using these satellite facilities. Today, satellite offers an alternative telecommunications solution to the communications management problem, either as a complete network, or as part of a communications mix which includes terrestrial components.

So what does all this mean for the future?

While market trends create demand for communications solutions, market demand determines which technologies are developed into telecommunications infrastructures.

Market Demand

Today's advances in computer technology and inter-networking architectures are allowing seamless communications between various locations, and this seamless communications is in turn allowing companies to expand beyond their cities and countries.

With this in mind we can look ahead and expect that in the mid to late 1990s the increased processing power of computers, the increased speed of inter-networking architecture and the wide availability of user-friendly applications will integrate data, voice and video applications to create seamless multimedia communications. This seamless multimedia communications will be available on a global level, so just as data communications became the life-stream of organizations in the 1970s and 1980s, multimedia communications will become the lifestream of organizations in the late 1990s and into the 21st century.

Terrestrial communications providers are already in tune with this trend. They have been working on a number of communications initiatives to address the demand for communications solutions that this trend will create. Their efforts are aimed at achieving six primary network development objectives: rapid service provisioning, higher speed bearer services, network operator programmability, vendor and technology independence, portability of services, and mobility for customers.

A large number of network development initiatives are in progress to meet these objectives. Networks developed with these objectives in mind will provide a plethora of services to the end-users at economical costs by maximizing the use of the resources in the network. The work being done to reach these objectives can be grouped into five broad categories or concepts.

The first is the local, metropolitan, and wide area network concept, or the LAN/MAN/WAN concept. This concept originated with the computer industry, but as computers have proliferated in the business and domestic environment, network operators have assumed the responsibility of providing inter-networking solutions. Their efforts were initially aimed at providing reliable local area networks, but, recently, because of the globalization of business activities, these local area networks are being connected by metropolitan area networks and wide area networks. They are getting more sophisticated and are operating and higher and higher speeds.

The second initiative is known as Broadband ISDN. The original narrowband Integrated Services Digital Network began in the early 1980s as a means of consolidating a large number of network architectures into one. The driving force behind these activities was a desire to provide a full range of services and deliver better performance. This work has continued into the 1990s, and today an increasing number of network architectures are being consolidated, with digitization contributing to this work.

Broadband ISDN builds on narrowband ISDN to provide much higher speeds and a further means of integrating all applications. In the near future we will see this being achieved by Synchronous Optical Networks (SONET) and Asynchronous Transfer Mode (ATM) technologies.

The third initiative being pursued is the intelligent network. This initiative introduces modularity into the network infrastructure that can be arranged and re-arranged to provide specific functions or services. Terrestrial network operators have been investigating this concept for almost ten years in their efforts to become vendor and technology independent and provide new services to the end-user. Once implemented, it will eventually allow the end-user to configure services on a subscribed portion of the network. Intelligent network capabilities are already finding their way into voice networks and will eventually be phased into other networks.

The fourth concept is personal communications services. Over the last several years we have seen a strong trend towards wireless communications for voice and low rate data applications. This trend will continue and eventually allow the end-user mobility and portability of services. We can expect wireless networks to be developed based on existing PSTN networks, developing Broadband ISDN networks, and Intelligent Network concepts.

Finally, the fifth initiative being pursued is known as integrated network management. Considerable research and development time has been applied in this area to develop a single infrastructure to consolidate all operational, maintenance and administrative network systems. But this concept will need significantly more research and development manpower to make it a reality.

Those are the five initiatives being pursued by terrestrial service providers. Once in place, networks developed using these concepts will become formidable competitive forces in the metro, urban and select rural areas, and they will compete even more fiercely with satellite networks for customers.

At Telesat we believe that satellite networks have a place in this competitive environment. We know that satellite operators planning for their future place in this environment must study the five terrestrial initiatives in order to develop their own infrastructures. And we realize that although satellite networks can't equal the capacity of the terrestrial networks, they can provide a fully flexible network to serve the metro, urban and rural areas, with the capability to also serve all remote areas. But satellite operators must begin to plan for the future now, so they can develop satellite systems that will be able to meet the needs of all customers.

Telesat launched it's Anik E satellites last year with that in mind. The Anik Es are large, dual-band satellites with more transponder power, more on-board redundancy, and more switching capability than any previous satellites. Both Anik Es will be in use beyond the end of this century, and were designed to address the fundamental changes we foresee taking place in the communications business.

We have also developed a geostationary mobile satellite system over the past several years in close liaison with the Canadian Department of Communications and NASA, and, more recently, with the American Mobile Satellite Corporation. In 1994 we plan to launch the first MSAT satellite and offer complete mobile services from that platform.

But these satellites are only the first steps towards accommodating the communications needs of the future. To meet the challenges that will emerge from terrestrial service providers, future satellites will have to be more powerful and more intelligent. They will need this power in order to process the increased flow of customer information as quickly and efficiently as possible.

So what will the satellite system of the future look like?

Bigger Not Necessarily Better

Keeping in mind how the terrestrial networks are developing, we can get a rough idea of what we will need to do to meet the needs of evolving markets.

Until now, bigger has been better in the satellite world. Satellites like our Anik Es were needed to address the traffic needs of both the broadcast market and the VDI market. But those markets are rapidly developing and segmenting into smaller markets, and what was good ten years ago is not necessarily going to be good for the next generation of satellites. The developing segments of the broadcast market and VDI market will all have different needs, and they will require different capabilities from a satellite.

Four On-Board Processing (OBP) options are available to satellite operators to help address those needs.

The first is to concentrate on developing the OBP capabilities of the transponder. This will be suitable for point-to-multi-point broadcast satellites like our Anik Es and will produce satellites capable of serving the needs of the video market, the Direct Broadcast Satellite (DBS) market, the Direct To Home (DTH) market and Digital Audio Broadcast. They will also be capable of handling point-to-point one-way broadcast services, such as paging and video-on-demand.

The second option is to work on the space switch architecture. This is similar to the first option but provides better performance. It is most suitable for point-to-multi-point broadcast and for point-to-point services.

The third option is with fast packet architecture. This is most suitable for point-to-multi-point interactive services, and for mult-point-to-multi-point interactive services. It supports other services, like point-to-point interactive applications, but in doing so it tends to over-process.

Finally, a hybrid system combining some or all of the elements of space switch and fast packet architecture is possible. This is suitable for most services, except for multi-point broadcast.

In tackling these options, satellite operators have two alternatives when designing their satellites.

First, they can include one or more OBP options on a multi-purpose satellite. But combining all these options into one satellite to handle all the needs of all markets, and, therefore, all traffic, would require a very large, very bulky, and very expensive satellite. This would increase the operations risk and potential for disaster in case of a failure. Bigger, then, is not better if we are putting all our market segment eggs into one satellite basket.

The alternative is to develop and launch multiple Lightsats with specific processing capabilities to handle the specific needs of a market. For example, a Lightsat could be launched to handle the needs of the voice market, and another for the low-bit data market. Lightsats could also be launched to handle the needs of the DTH or DBS market. In this scenario, small becomes beautiful as the risk factor and potential for failure that is possible with large, multi-purpose satellites is reduced.

What will the solution be?

Although I can't tell you which of these alternatives will be chosen by satellite operators, I can tell you that how the markets develop and what they demand in terms of service will determine what is eventually launched. We may even see satellite operators around the world considering the advantages of launching a combination of satellite platforms to serve their different market segments.

At Telesat we have programs dedicated to studying these possibilities, including advanced satellites with on-board switching/processing capabilities in both Ku and Ka-bands. Broadbeam versus narrowbeam coverages are being investigated at frequencies such as C, Ku, Ka, and L-bands. And the possibility of inter-satellite communications is also being considered. But these are just a few of the new technologies that we are studying, as we keep an eye on the initiatives being studied by terrestrial operators.

In Canada we are working based on the fact that a telecommunications infrastructure already exists. But for nations where a telecommunications infrastructure has yet to be established, the choices which must be made are different. These countries arebasically working with a clean slate. They have the advantage that all this ground work has already been established, and the human resources and the research are available for the development of an infrastructure tailored to the needs of the market.

Those trying to develop a telecommunications system based on the capabilities of satellite, should first determine what the role of satellite is going to be in an overall infrastructure, rather than on its own. Neither the terrestrial nor the satellite base should be seen as independent of the other. If a true telecommunications infrastructure is going to exist, each network must have a role to play in it.

In these countries, satellite technology can be used to buy time for the development of the most effective and efficient terrestrial or hybrid infrastructure available. Satellite should be considered as an interim step to the realization of a full telecommunications infrastructure. That infrastructure could eventually include the best of the terrestrial systems available.

and the best of the satellite systems available. By drawing on the experience and technology already established by telecommunications providers around the world, developing countries have the ability to create the best telecommunications infrastructure for them.

But whatever the market situation is, if satellite service providers are going to compete effectively and retain a place in the communications systems of the next century, they must study the emerging technologies that will affect the design of the next generation of commercial satellites. As the communications requirements of satellite service customers evolve, so must communications systems, and satellite networks must adapt to meet those changing needs.

KOREASAT Technology Development and Services

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KOREASAT is the first generation satellite for the Republic of Korea. It uses the advanced digital technology for direct broadcasting and fixed satellite services in Korea. It will provide basic satellite communications facilities with small low-cost remote stations for rural and remote areas presently having inadequate or no telecommunication facilities. It will also provide high speed data and video distributions for business television and other professional program services such as tele-educational video networks. High quality color television and high definition TV will also be available anywhere in Korea. It will certainly play a major role in the Korean communications network in the 21st century.

1. INTRODUCTION

KOREASAT system is designed to provide Ku-band satellite communications services for the Republic of Korea. The GE Series 3000 spacecraft platform (Figure 1) for KOREASAT system utilizes a single fixed antenna capable of simultaneous circular polarization direct broadcasting service(DBS) and linear polarization fixed satellite service(FSS). KOREASAT is designed based on the similar reflector as the Advanced Communications Technology Satellite(ACTS) to implement three 27 MHz DBS channels with the transmit EIRP of 59.4 dBW and the receive G/T of 12.6 dB/K (Figure 2), and twelve 36 MHz FSS channels with the transmit EIRP of 50.2 dBW and the receive G/T of 13.4 dB/K (Figure 3).

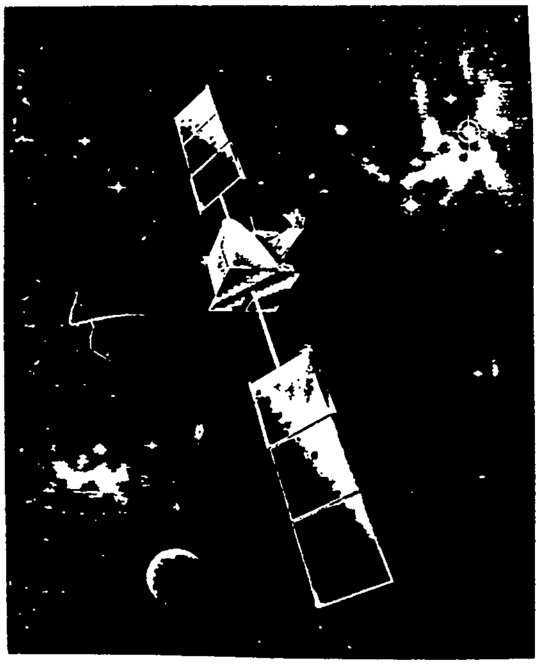

FIGURE 1 SPACECRAFT

The two spacecraft system constellation is co-located at 116 degree east longitude with a beam pointing center at 127.5 degree east and 36 degree west and with on-station accuracy of 0.05 degrees in N-S and E-W for the service period of 10 years. KOREASAT spacecrafts are scheduled to be launched into a geosynchronous orbital location in 1995.

2. KOREASAT DEVELOPMENT

KOREASAT system is currently designed and developed by the General Electric(GE) team and Korean partners in accordance with the Korea Telecom's requirement specifications. The GE team consists of GE Astro-Space (GE ASTRO) in U.S. as the prime contractor and Matra Marconi Space(MMS) in England as the subcontractor. Korean partners comprise of Goldstar Information & Communications(Goldstar) and Korean Air Aerospace (Korean Air) in Korea.

With experience in all aspects of commercial communications satellites for more than 20 years, GE ASTRO is responsible for the spacecraft antennas, spacecraft bus and ground segment software. MMS is responsible for the spacecraft payload and the ground control facilities. Goldstar and Korean Air are responsible for the backup ground control facilities, spacecraft bus structure for the solar panels, and technology development for the next generation of KOREASAT.

McDonnell Douglas(MD) in U.S. will provide the DELTA II launch vehicle for launch services to deliver two KOREASAT spacecrafts to the geosynchronous orbit and Halla Engineering & Heavy Industries(Halla), Korean partner, will participate in the design of the launch vehicle hardware.

3. KOREAN INDUSTRY PARTICIPATION

Goldstar will participate under a subcontract with GE ASTRO in manufacturing of (i) Command, Ranging and Telemetry (CR&T) Module that includes a time code translator/generator, a command generator, a range tone processor, a phase meter, two telemetry processors, a status display, and two subcarrier discriminators to generate uplink commands and range signals and to receive and process downlink telemetry and ranging signals, (ii) Static Spacecraft Simulator that includes the hardware and software necessary to receive, decode, decrypt and authenticate baseband command tones and to generate four 70 MHz simulated telemetry stream signals in real time to provide functional simulation of two KOREASAT satellites in geosynchronous orbit, and (iii) Telemetry, Command and Ranging(TC&R) system that is comprised of the Command Receiver and Beacon Transmitter to provide the means for monitoring and commanding the spacecraft.

Goldstar will also be involved under a subcontract with MMS in the design of (i) Communications System Monitor/In Orbit Test(CSM/IOT) that provides traffic measurement and monitoring of the KOREASAT spacecrafts for in-orbit test, routine payload monitoring, anomaly investigation, and trend analysis, (ii) secondary Telemetry, Tracking and Command(TTC) baseband subsystem, and Control and Monitor(C&M) subsystem, and (iii) payload equipment that includes FSS channel amplifier with ALC, FSS channel amplifier with fixed gain, and DBS channel amplifier.

Korea Air will fabricate, test and deliver under a subcontract with GE ASTRO the KOREASAT structure system that includes (i) Series 3000 rectangular box structures with aluminum honeycomb panels excluding bulkhead panel and transponder panel, (ii) six solar array panel substrates, and (iii) secondary structure items.

Halla will manufacture under a subcontract with MD four sets of the Solid Rocket Motor Nose Cones for nine boost augmentation graphite expoxy motors, four sets of nine Solid Rocket Motor Nose Cone Adapters, and two sets of the third stage Payload Attach Fittings.

4. KOREASAT SERVICES

KOREASAT is intended to provide a variety of satellite business services over the territory of the Republic of Korea by utilizing advanced digital technologies. The range of FSS services covers low/medium speed data transfer by the very small aperture terminal(VSAT), low speed voice and data circuits by the demand-assigned multiple access/single channel per carrier(DAMA/SCPC) method, and high speed integrated services by the TDMA technique (Figure 4). The primary Telemetry, Tracking

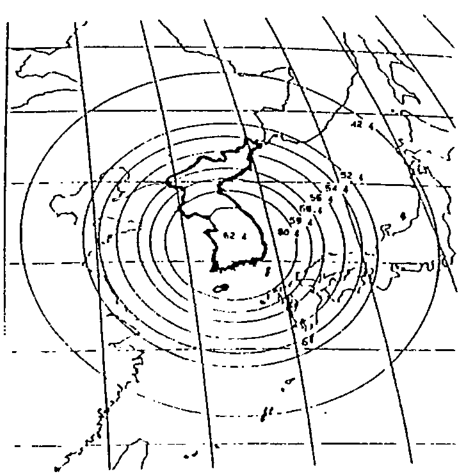

FIGURE 2 TYPICAL DBS EIRP CONTOURS

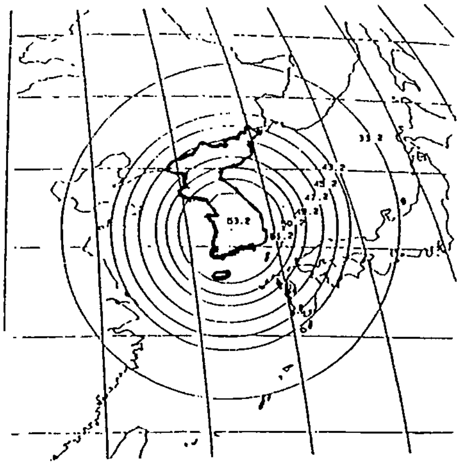

FIGURE 3 TYPICAL FSS EIRP CONTOURS

and Command(TTC) station collocated with a Satellite Control Center(SCC) and a Network Control Center (NCC) supports the KOREASAT services. The Communication System Monitor(CSM) at the primary TTC monitors all transponder activities of two KOREASAT spacecrafts and optimizes the use of communications network for all service links.

5. VSAT SERVICES

The VSAT networks are arranged in star configurations, usually having a corporate headquarters or other centralized data center at the host site, with the branch offices or other remote sites connected to the host by the satellite links. The VSAT system uses four(4) FSS channels to provide a low/medium speed data communications system between a host computer and a large number of dispersed remote computer terminals or between two remotes via the VSAT central station(VCS) for a cost-effective bypass of terrestrial facilities.This system is especially suitable when the data flow is generally large from the host to the remote systems for low speed data transfer, facsimile and digital voice.

The satellite station associated with the host computer uses a reasonably large antenna up to 8 meters in diameter, while the VSAT remote station(VRS) uses a very small antenna down to 1.2 meters in diameter. The VSAT system supports inbound and outbound data rates up to 64 Kbps and a transmission bit error ratio(BER) of better than 10-E8. The VCS hardware is capable of supporting up to 40 outbound and 120 inbound carriers depending upon the VCS sizing, types of carriers, antenna sizes, satellite performance, etc. One VCS system is able to terminate the traffic from 20 to 500 VRS systems and designed to allow modular growth up to 4,096 VRSs.

The VSAT system is currently developed by a team of Korean industries and MPR Teltech in Canada by enhancing the existing DS2100 system.

6. DAMA/SCPC SERVICES

The DAMA/SCPC system uses one(1) FSS channel to support fully meshed communications among the remote stations with a single satellite hop. This system is a satellite based digital voice and data communications network suitable for thin-route connections among a large number of earth stations.These telecommunication services include analog and digital telephony managed on a dynamic call-by-call basis and data circuits managed on a demand assigned basis. It uses call-by-call DAMA for voice and data circuits via SCPC communication paths between earth stations anywhere in the system.

This system supports 1,200 SCPC single way traffic channels, 2,000 remote DAMA terminals, 10,000 SCPC channel units through the use one FSS channel and the system capacity can be increased up to three(3) FSS channels. The system performs Mean Call Processing throughput of 5 calls/sec, Peak Call Processing throughput of 500 calls in 25 sec, and 4 sec Call Setup Time. BER averaged over 10 minutes does not exceed 10E-6 for a 32 Kbps voice communication and BER for data communication does not exceed 10E-7 for more than 2.09% of any year. The overall system availability will be better than 99.80% for the voice communication path, 99.81% for the data communication path, and 99.89% for the service information path.

The DAMA/SCPC system is currently developed by a team of Korean industries and Alenia Spazio in Italy.

7. HIGH-SPEED DATA SERVICES

The high speed integrated services use two(2) FSS channels for high speed data transfer between stations and four(4) FSS channels for video relay which include satellite news gathering(SNG), TV receive only(TVRO), CATV, and TV relay. The high speed data transfer services between stations include high speed computer file transfer, high speed facsimile, telegraph/telex, digital voice, and video conferencing. These services also include temporary backup transmission of data due to outage of terrestrial lines or traffic overflow. These equipment for the high speed integrated services will be developed by Korean industries.

8. DBS SERVICES

Each KOREASAT satellite utilizes three DBS channels of 120W TWTs out of six available DBS channels to provide Korean viewers with high quality NTSC color television, multiplexed analog components(MAC) television, and high definition television(HDTV).

DBS payload provides (i) Left-hand circularly polarized (LHCP) receive and transmit antenna, (ii) Two redundant pairs of low noise amplifiers(LNAs) with redundancy switching, (iii) Two receivers with input filtering and redundant RF switching, (iv) Input multiplexers to provide separate amplification paths for six channels, (v) Six RF channel amplifiers with redundant input/output switch networks, (vi) An output multiplexer assembly combining all six channels to antenna, (vii) A commandable channel gain control for each RF channel, and (viii) An automatic level control function for each channel to provide proper TWTA saturation over a 15-dB dynamic range.

The frequency and polarization plans for the DBS payload assign six channels of 27 MHz bandwidth in accordance with the Final Act of WARC-77 for operation over any three active channels on each of two spacecrafts to provide 1.5-dB margin over the 59.4 dBW requirement at the edge of coverage area(Figure2). DBS performance also provides 0.2-dB EIRP margin at the edge of coverage and 1.8-dB G/T margin even when operating under the worst-case pointing conditions.

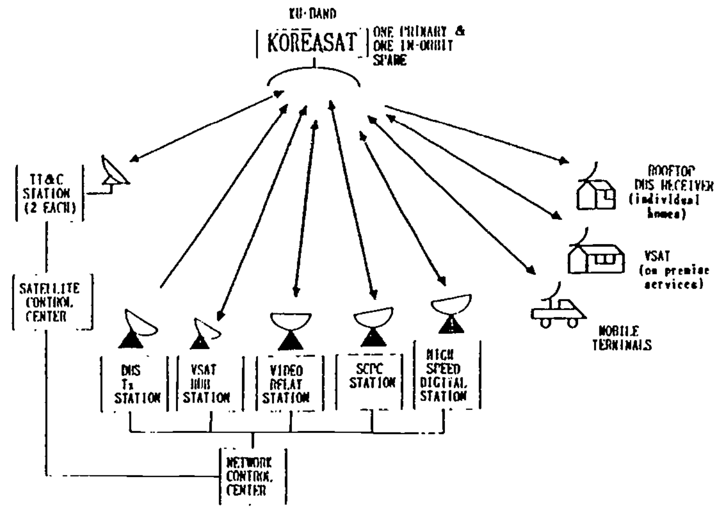

FIGURE 4 OVERALL CONFIGURATION OF KOREASAT SERVICES

Typical EIRP over the mainland of Korea may be greater than 62 dBW but the peak EIRP radiated is less than 63.6 dBW as required by the CCIR Radio Regulations. Receive cross-polarization and receive gain outside the coverage area also meet the requirements of the Radio Regulations.

9. OJT PLAN

GE ASTRO and MMS perform the On-the-Job Training(OJT) to provide Korean engineers from the beginning of the design phase to the post-launch phase with indepth, hand-on, learning experiences in all activities of the KOREASAT spacecrafts, payloads, and ground equipment. 30 engineers from various Korean industries and Korean Research Institutes are assigned for OJT during design, construction, and test phases, three engineers during launch phase, and three engineers during operation and maintenance.

The communication antenna, the bus subsystems, and the mission analysis and operations OJT will be performed at the GE ASTRO facilities in East Windsor, N.J. The payload and ground equipment OJT will be performed at the MMS facilities in Portmouth, Bohramwood and Watford, England. OJT for final spacecraft integration, assembly and tests will also be completed at the GE ASTRO facilities.

Korean engineers will team with GE ASTRO and MMS engineers and contribute to the system and subsystem design, analyses, manufacturing, integration, testing, launch, and mission operation activities. They will participate in preparation of (i) System and subsystem performance specification documentation, (ii) Design review documents for systems, subsystems, and components, and (iii) Performance analyses. After completion of the spacecraft and ground station integration and test, a small group of OJT engineers will contribute to the prelaunch and launch activities.

MD also performs the OJT program to provide 24 Korean engineers with the technology of launch services and hand-on experiences at the MD premises in order for them to gain sufficient and comprehensive knowledge and technical know-how in the field of launch vehicle design and assembly, launch and mission integration, and launch operations.

At the Huntington Beach facility in California, Korean engineers will assist in the overall tasks including (i) Development of the mission peculiar support drawings and documentation for two spacecrafts, (ii) Development of mission specification, and (iii) Compatibility analyses. At the Pueblo facility Corolado, they will participate in the launch vehicle assembly, production, checkout, and quality control activities. At the Cape Canaveral launch site facility in Florida, they will be involved in launch vehicle processing, spacecraft integration, and launch operations.

It is recognized that through the OJT program Korean engineers will be able to acquire commercially available technology and experience in design, manufacturing, and integration of the communication satellites and launch vehicles as well as satellite operations and launch operations to pave the way for the next generation of KOREASAT.

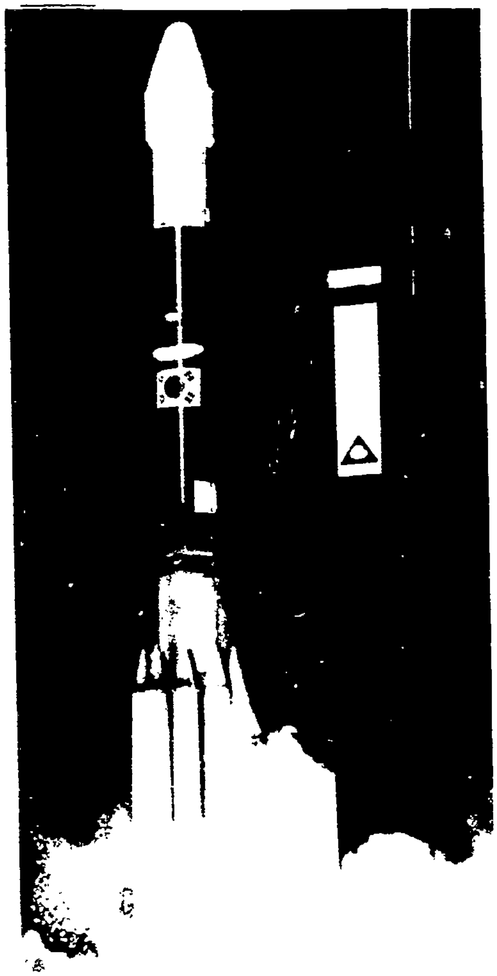

FIGURE 5 LAUNCH VEHICLE FOR KOREASAT SYSTEM

10. CONCLUSION

KOREASAT is the first generation of communication satellites in the Republic of Korea. It is under design and development by the GE team and Korean industries according to the Korea Telecom's specifications and scheduled to be launched by the Delta II in 1995 (Figure 5). There is a growing awareness among Korean enterprises of the great potential of satellite business systems, offering users immediate, wideband, long-distance services which can not at present be easily provided on terrestrial networks. Satellite communications are especially attractive and cost-effective for business owners with large distributed processing needs or video services whose operations are already constrained by the limitations of land lines. The utilization of KOREASAT spacecrafts may be maximized by new technology and service development such as digital compression, ultra-small aperture terminal (USAT), and mobile communications. The demand for new services in high speed data transmission of various rates and direct broadcasting service(DBS) will increase significantly in the next decade in Korea.

BUILDING TELECOM NETWORKS TO THE PEOPLE'S REPUBLIC OF CHINA

Infrastructure and Services
The Hong Kong Gateway

Flora Tung
Director of International Operations
Hongkong Telecom

1. Abstract

An economic revolution in China has captured the attention of the world's businesses. China, with outside participation, is investing in industrial development and special economic zones that have already made it the fastest growing economy in the world's fastest-growing economic region – the Asia-Pacific Rim. While this revolution began in the southern province of Guangdong (formerly Canton), it is now progressing up the coastline and into the central provinces of the world's most populous nation.

To support this economic powerhouse, China is modernizing its infrastructure in an ambitious program that includes the provision of high-quality telecommunications demanded by multinational companies. One of its closest partners in this effort is Hongkong Telecom which, by its unique position on the Pacific Rim, is the Telecom Gateway to China.

2. Economic Overview – The Four Little Dragons and China

The Organization of Economic Cooperation and Development (OECD) says that the center of global economic gravity is shifting to the Asia-Pacific region, which will account for one-third of the world's production by 2010, compared with about one-quarter in 1990. By 2040, OECD says, half of the globe's output will come from Asia.

These projections are supported by Japan's Ministry of Finance. The Ministry report that in 2015, Asia's $12.4 trillion GNP will represent 35 percent of the combined $35.9 trillion GNP of Asia, North America and Europe.

Put in another perspective, the Asian Development Bank said last November that Asian GDP is expected to reach 7.1 percent in 1992 vs. 1.3 percent in the U.S. Economic growth in China is expected to double from 5.2 percent in 1990 to 12.2 percent in 1992. In China's southern province of Guangdong, growth is more than 13 percent. It's clear where growth-minded global companies should be setting their sights and their sites.

While some of the region's nations are growing faster than others, virtually no area on the Asia-Pacific Rim is being left out of the action. Japan is the current leader, posting a $3.369 trillion GDP in 1991. But the high cost of doing business in Japan, where an average hourly compensation in wages and benefits in the manufacturing sector is more than $14.00, has caused entrepreneurial eyes to focus on less costly regions.

Although substantial overseas investment (including Japanese) is flowing to most countries on the Rim, among the favored targets have been the four little dragons: Hong Kong, Singapore, Taiwan and South Korea. To these is being added the big dragon, China, where an economic revolution is transforming the world's most populous nation into a world-class investment opportunity, manufacturing center and the world's largest untapped market.

Indeed, Guangdong province (formerly Canton province), just north of Hong Kong, has set for itself the objective of becoming the fifth little dragon. As described by William Overholt, Governor of the American Chamber of Commerce in Hong Kong in a presentation to the Senate Foreign Relations Committee last April, Asia is the fastest growing part of the world economy and southern China is the fastest growing part of Asia.

A look at statistics (Fig. 1) shows how these five regions compare with each other in 1991 Gross Domestic Product, per capita GDP, population and average hourly pay. Figures for Japan are given as a comparison. These statistics show that the four dragons are relatively equal in terms of labor costs. And they also show why many nations are targeting China as a good place to set up manufacturing operations both to meet local demand and for export.

A wealth of other statistics support the notion that the Asia-Pacific Rim, and especially China, is an outstanding business opportunity for global-minded companies. More and more companies -- and countries -- are getting the message. But Hong Kong has taken the lead by providing 80 percent of the foreign investment in China. The total during the 1980s was $23 billion, 80 percent of which was in Guangdong, which has 16,000 Hong Kong-based companies employing an estimated 3 million. The arrangement is reciprocal. China has invested some $10 billion in Hong Kong, including Hongkong Telecom. It is the third largest investor in Hong Kong manufacturing after the U.S. and Japan.

The long, friendly and mutually beneficial relationship between Hong Kong and China is also evidenced by the two regions being each others' major trading partner. Bilateral trade between Hong Kong and China in 1991 reached $49.6 billion, or nearly 37 percent of China's total trade. China's share of Hong Kong's global trade jumped from 9.3 percent in 1978 to 32.4 percent or $64.2 billion in 1991. In turn, Hong Kong is China's largest export market, taking nearly 45 percent, or $32.1 billion of the 1991 total. This is a 24.2 percent increase over 1990.

China has been Hong Kong's largest supplier since 1982. It is the principal supplier of raw materials and semi-manufactures, consumer goods and foodstuffs, and second largest supplier of capital goods and fuels. In turn, Hong Kong is a principal supplier to China, accounting for more than 24 percent, or $17.5 billion, of China's total imports in 1991. Hong Kong's major domestic export items to China in 1991 included textiles, telecommunications equipment, polymerization and copolymerization products, watches, clocks and clothing.

To support this and other activity, more than 42 million passenger journeys were made between Hong Kong and China in 1991, compared with just under 10 million for 1981. Some 11 million tons of cargo was moved across the border in almost 6 million vehicle journeys during the same period.

3. Hong Kong – The Business Connection

This introduction to the dynamic economy of the region and the close economic and personal ties between Hong Kong and China supports the proposition that for global companies, the most logical way to enter the China market is through Hong Kong. We now can move to an overview of the telecom infrastructure supporting access to China and its economic development zones.

3.1 Trans-Oceanic Cable Systems

Recent announcements of ambitious new undersea cable projects underscore the importance being placed on the economic opportunities developing throughout the Asia-Pacific Rim. Indeed, it is hard to believe that when the first trans-Pacific digital cable, the 560 Megabit TPC-3/Haw-4, was installed in 1989, a full fifteen years had elapsed since the turnup of the analog TPC-2/Haw-3 cable. In 1990, the 1,260 Megabit North Pacific Cable went into service.

Last November, TPC-4 with 1,120 Megabits of capacity, was inaugurated just after carriers announced plans for the 5 Gigabit TPC-5 system. In addition to these systems, the Haw-5, PacRim East/Tasman-2/PacRim West project will be phased in through 1994.

But the Pacific will soon lose its monopoly as a route for trans-oceanic fiber cable access to the Far East. Digital fiber paths westward are being mapped through the 1,120 Megabit Sea-Me-We 2 and 5 Gigabit Sea-Me-We 3 and FLAG (Fiber Optic Link Around the Globe) projects to Europe. The latter would be the world's largest fiber optic cable at 15,000 miles.

3.2 Regional Cable Systems

Hong Kong is served by two cable landing stations, one at Deepwater Bay and the other at Cape Daguilar, that provide fiber access to the trans-oceanic systems. The Hong Kong-Japan-Korea cable and Hong Kong-Taiwan cables, both with 250 Megabits of capacity, connect with TPC-3 through Japan or the Guam- Philippines-Taiwan cables, and with the North Pacific Cable through the Miura-Chikura cable in Japan.

Additional capacity, interconnects and reliability will stem from completion this year of the 1,130 Megabit Asia-Pacific Cable connecting Hong Kong with Singapore, the Philippines, Taiwan and Japan. Next year the Hong Kong-Guam-Philippines cable will provide an additional 560 Megabits of capacity. And, as announced last November, plans are being made for a 5 Gigabit Asia-Pacific Cable Network linking Hong Kong, Brunei, Guam, Japan, Indonesia, South Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand.

3.3 Satellite Access

Hongkong Telecom's Stanley Earth Station is the territory's satellite hub. In addition to providing access to AsiaSat, the Stanley facility has antennas directed at the 60 and 63 degree Indian Ocean Region Intelsat satellites and the 174, 177 and 180 degree Pacific Ocean Region Intelsat satellites. Backup antennas are available for the 66 degree IOR and 183 degree POR restoration spacecraft.

3.4 Business Access

These long-haul and regional cable and satellite systems support the busiest telecommunications center on the Pacific Rim. More than 450 multinational firms hub their Asia-Pacific network in Hong Kong which, according to Communications Week International, commands some 60 percent of the Asia-Pacific hub market. The territory is home to 51 percent of all multinational corporations' regional headquarters in Asia.

According to China Business Review, Hong Kong's emergence over the last decade as the principal telecommunications hub in Asia was instrumental in cementing the territory's key role in the Pacific Rim.

Today more than 30,000 foreign companies have operations in Hong Kong. Pacific Telecommunications describes the territory as having one of the most advanced communications infrastructures in the world.

4. China Access

Coupling Hong Kong's accessability with its telecoms infrastructure, a strong case is make for the territory as the communications gateway to China. To date, Hong Kong provides the only fiber optic access to China. This is via the 4 x 140 Megabit cable linking Hong Kong, Shenzhen, Dongguan, Huizhou and Guangzhou, and the new 565 Megabit cable linking Hong Kong and Shenzhen. Beyond these main trunk systems, a rapidly expanding web of international private leased circuits (IPLCs) support international businesses operating in China's Special Economic and Industrial Development zones.

A report on transit capacity within the People's Republic of China and services now being offered there will be covered in a separate paper. I will conclude these remarks with an overview of services jointly being offered by Hongkong Telecom and China's provincial telecommunications administrations.

IPLCs terminating in or transiting Hong Kong now serve more than 70 global companies with operations in China. An example is the high-speed circuit supporting the operations of DuPont Agricultural Chemicals Ltd. in Shanghai, which provides access to the company's Hong Kong hub and on to company data centers in Singapore, Germany and the U.S.

More recently, One-Stop Shopping agreements were signed between Hongkong Telecom and telecommunications administrations in China's three major gateway cities -- Beijing, Shanghai and Guangdong. When coupled with similar agreements Hongkong Telecom has with 22 other administrations in 14 countries, these comprehensive service packages greatly facilitate provisioning and managing international networks supporting commerce between major industrial nations.

Last September public videoconferencing was inaugurated between Hong Kong and Beijing. Since then, similar services were turned up in Shanghai and Guangzhou.

Other services offered between Hong Kong and China include international direct dialing, facsimile and mobile telecommunications.

5. Conclusion

Hongkong Telecom has enjoyed a close working relationship with its counterparts in China for more than 20 years. Results of this relationship include several highly successful joint ventures such as the Shenda Telephone Company in Shenzhen and a specialized communications network for oil rigs operating the South China Sea. Organizations seeking to participate in China's economic revolution, or strengthen ties with China's scientific, academic and research institutions, welcome the telecommunications infrastructure being built to facilitate interaction with a dynamic and growing member of the Asia-Pacific community.

FIGURE 1

The Four Dragons and China

	GDP ($US Billion)	Per Capita GDP	Population (million)	Average Hourly Compensation
Hong Kong	82.7	15,180	5.8	$3.58
Singapore	40.0	15,108	2.8	4.38
So. Korea	283.5	6,117	43.3	4.32
Taiwan	175.7	6,837	20.4	4.42
China	371.2	2,656	1,139.0	0.24
Japan	3,369.7	14,311	123.9	14.41

Source: Fortune Oct. 5, 1992

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TUESDAY, January 19, 1993

Morning Plenary

NOTES

NEW COMMUNICATION TECHNOLOGIES
APPLIED TO SERVICES OF SOCIAL BENEFIT

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1. ABSTRACT

The implementation of Telecommunications services in rural, suburban or underprivileged areas has been a challenge in developing countries, but also in countries with a greater financial and material infrastructure.

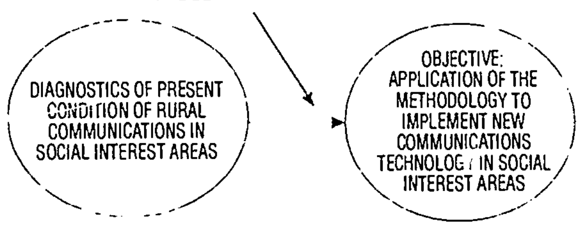
The obstacles faced by developing countries in order to provide minimum communications services for their populations' situation has created a great disparity between the people who currently enjoy the benefits of communications and those that do not. This disparity has become accentuated in some nations due to the social and demographic conditions (1) (2).

This project supported by the Organization of American States (Project No. MEC07328) hopes to establish a new focus in the implementation and operation of communication services in rural, suburban and underprivileged areas, applying creative concepts which differ markedly from the traditional concept of rural communications. This concept simply consists in applying a methodology which would permit the utilization of new technologies to the advantage of the rural population, thereby having an impact on bettering the quality of life at the short, medium and long term.

2. INTRODUCTION

The methodology developed for the project will include strategies and lines of action of an international character so that the results of the project as well as the experience gained could be implemented in different countries with the necessary local adaptations.

STRATEGIES AND LINES OF ACTION FOR THE PROJECT



CASE STUDY:	STATES:
MEXICO	SONORA, GUERRERO AND VERACRUZ

Figure 1

The concept used in this project to provide telecommunications services in social interest areas does not consist only of installing a telephone in a particular town, but those communications services that could be necessary to stimulate education and development or to solve a basic problem of health, security or procurement of food supply (3).

SOCIAL INTEREST AREAS

- RURAL AREAS
- SUBURBAN AREAS
- EXTREME POVERTY AREAS
- ETHNIC AREAS
- REMOTE AREAS WITH DIFFICULT ACCESS

Figure 2

AREAS OF IMPACT OF NEW COMMUNICATIONS TECHNOLOGIES

- AGRICULTURE
- EDUCATION
- HEALTH
- TOURISM
- ENVIRONMENT
- PROTECTION FROM NATURAL DISASTERS
- METHEOROLOGY
- SECURITY SERVICES

Figure 3

One of the factors that will enrich the development of the project is the participation of the population which will be on the receiving end of the services. The communities will play an important role in defining the project's applications. In this way, from the very beginning of the implementation process of the communications infrastructure, the individuals and community involved in receiving the results of the project, develop a sense of commitment and an awareness of the utilitarian nature of the installed system. This process contributes to the betterment of the maintenance services as well as to appropriate care being taken in the handling of the installed equipment.

The new telecommunications technologies which will have a global impact during the nineties as well as potential applications for rural, suburban or underprivileged areas that have been considered in this project are:

NEW TECHNOLOGIES CONSIDERED IN THIS PROJECT

- DIGITAL MICROWAVE
- DIGITAL RAM
- FIBER OPTICS SYSTEMS
- VSAT SYSTEMS
- MOBILE SATELLITE SYSTEMS
- SPREAD SPECTRUM SYSTEMS
- CELLULAR SYSTEMS

Figure 4

3. DESCRIPTION OF THE METHODOLOGY

The vision for the development of this project consists in the application of new communications technologies to improve the quality of life of the population. Then the goal of the project is not the technology itself, but the application of a methodology that makes better use and planning of the material, human and financial resources available for the people of the villages or suburban areas and for the providers of systems and telecommunications administrations.

APPLICATION OF NEW TECHNOLOGIES IN SOCIAL INTEREST AREAS

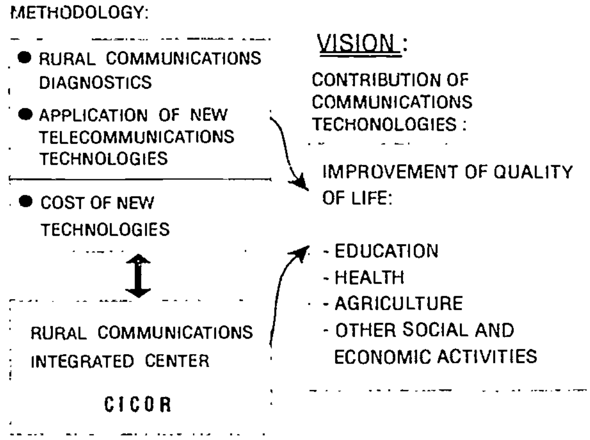


Figure 5

The methodology to provide telecommunications services in social interest areas is divided in two basic blocks or segments. The first block consists of a data base information tool that includes socio-economic, geographical and infrastructure information of the populations to be served. The second block makes use of this data base to generate technology cost information by means of decision trees that consid r weighting factors to obtain initial investment cost, value added services costs, maintenance cost and other costs that are fundamental to install and operate the communications infrastructure in base of point to point links from the objective site to the interconnect point to the national telephone network.

The final result of the methodology consists of the configuration of an entity defined as the RURAL COMMUNICATIONS INTEGRATED CENTER (CICOR in spanish) where the communications infrastructure will be located and operated.

New technologies have the capacity to provide digital services that can offer voice and data channels that can at the same time expand to value added services that would be implemented according to the political, socio-economic and cultural characteristics of the towns. These value added services are integrated in the CICOR as described in figures 7 and 8 and a description of the cost analysis process is described in figure 9.

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DESCRIPTION OF THE METODOLOGY

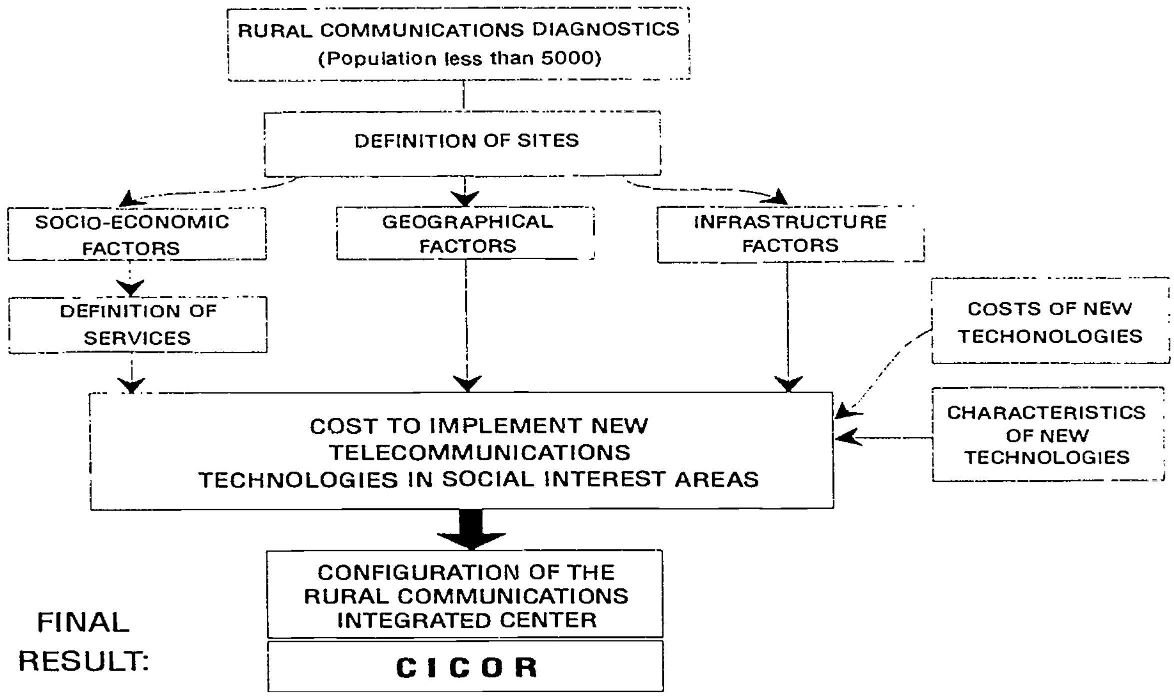

Figure 6

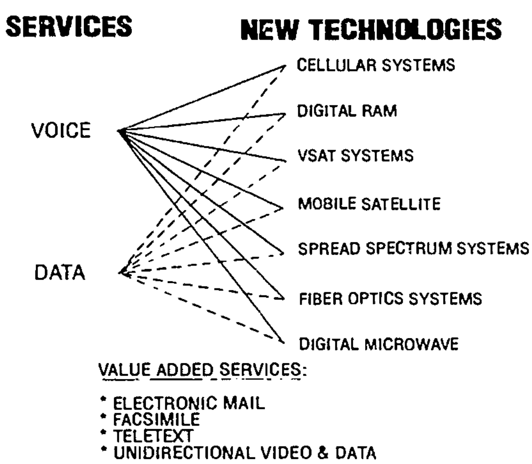

Figure 7

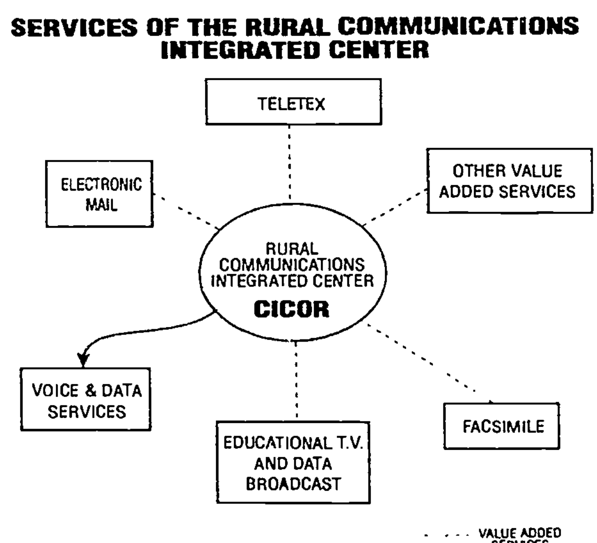

Figure 8

OPERATIONAL DIAGRAM TO OBTAIN COSTS OF NEW TECHNOLOGIES

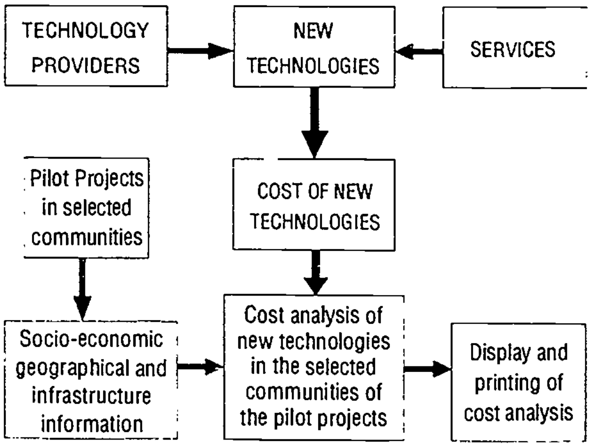

Figure 9

4. CONCLUSIONS

The application of new technologies to provide telecommunications services in social interest areas opens the door to structure and develop rural communications integrated centers (CICOR's) in wich a diversity of services can be offered and new schemes of financing and operation can be applied in order to create new formulas in the process of implementing sustainable development of emerging communities in search of improving their quality of life.

In synthesis, the present socio-economic condition of underprivileged people requires the integration of remote, isolated, poor, or socially marginated nucleus to overcome the disparities in the access of information and services. The lack of communications infrastructure has an important cost in itself, that is why strategies and proposals like the one presented in this article are necessary to contribute to the betterment of the human development index of the afflicted populations of the world.

It is important to reiterate the idea of extrapolating the concepts used in this methodology to other areas in the Americas with the necessary local adaptations. The lack of a methodology that focuses on human objectives more than in the use of new information technologies, have created misunderstanding and confussion and lost of financial and material resources in many instances.

We hope that the ideas proposed in this article will contribute to a better planning and implementation of those necessary communications services that the population requires. In this respect, the methodology presented constitutes also a decision making tool for communications authorities and operators to develop strategies and lines of action with emphasis on the communities' needs and not just only on the return of investment or other economic and technical aspects.

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THE IMAGING ADVANTAGE FOR DEVELOPING COUNTRIES

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The designation of the 1990s as the "Age of Information" stresses the important role the management of information is playing for successful organizations in the current world market. Organizations that have a well-executed plan for the management and flow of business-critical information will have definite cost and performance advantages. These advantages will yield larger numbers of satisfied clients, which in turn will provide a shorter route to success for developing organizations and countries trying to compete in today's complex market environments.

A recent study reveals that paper continues to be the dominant medium (95%) of information exchange in business today. Computers currently manage only one percent of information on-line, with the remaining four (4)percent stored off-line in magnetic or microfilm archives. This ratio may not be quite the same for the telecommunications industry, but the fact remains that most outside transactions, even in the developed countries, tend to be through paper billing and paper vendor invoicing processes.

Paper-intensive environments can create massive problems for telecommunications companies, such as:

- loss of control of critical processes
- inability to share information (simultaneous use)
- inability to deal with massive amounts of data
- lost or misplaced files
- high cost of storage space
- low access to archival data
- inferior customer service

In addition to these massive problems, the paper process requires a large organizational support structure to manage the flow of paper documents, with no efficient means of document control. Document control is critical not only from the standpoint of getting the document to the individuals required for processing, but to ensure company-critical information is maintained in a secure environment.

The problem that must be solved is how to move these paper-intensive environments into the realm of computer-controlled information management. Imaging technology coupled with workflow management software provides the "missing links" that allow organizations to control over fifty percent (50%) of the information and eighty percent of the processes through the use of computers. This increase in effectiveness can be accomplished without massive amounts of additional capital investment through careful utilization of the client's current computer resources.

Imaging technology is particularly beneficial to developing countries which may be characterized by paper-intensive problems further complicated by language requirements. The ability to store scanned documents in their original form reduces the need for extensive localized data translation and speeds the automation of critical processes. Scanned documents can be stored on a page-by- page basis or characterized by chapter, book or folder notations. These documents are exact duplicates of the paper original but with the added functionality of being easily distributed and stored under computer control.

Large numbers of documents can be stored on-line through the use of optical disks, an essential part of imaging technology. Optical storage can provide a virtually endless amount of storage in extremely compact space. Access to the documents is obtained through workstations equipped with window icons to provide user- friendly interfaces that reduce the cost and time to train operators. Once stored under the control of a server system, the documents are available to all authorized users simultaneously, unlike paper processes that service a single user. Out-of-file conditions are eliminated and updates or changes to documents are strictly controlled through system security.

Distribution of document data is made easy through the use of "FAX" and "Print" queues for remote sites or for batch processing of daily hard copy requests. Workstation views of customer data (billing information) reduce errors and confusion in handling customer queries and provide instant reprint capability in cases where bills have been lost. The need for archival processes such as microfilming of customer billing data is eliminated since instant access is maintained through the use of optical libraries.

Although there are many benefits to imaging, the broadest benefits can be achieved when imaging technology is combined with other tools to provide a total business solution. The most important of these tools is the file structure. It is critical that the file structure be "object" oriented. In order for the solution or system approach to be considered "object" oriented, it must accommodate varying file structures and be able to launch the appropriate application program regardless of the file type to be stored or retrieved. To characterize this approach more fully, a word processing file (WordPerfect or other) could be stored and retrieved as a file type. When this file is retrieved at the request of the workstation operator the application (WordPerfect or other) is automatically started at the workstation and the data requested is placed in the appropriate screen format.

In practice, this approach will accommodate image files, word processing files, spreadsheet files, and customer billing print files--all retrieved/stored under the same object file manager. These files are all available to the workstation for display in differing windows with their respective applications running. To facilitate this process, each workstation is equipped with a graphical user interface (GUI) that provides the required windows and the mechanism for moving from one application to another. By combining these display capabilities with the object service, the workstation operator has all the necessary tools to complete the assigned tasks. Data can be moved between window applications to reduce the amount of time spent in retyping and to allow real-time sharing of business-critical information.

In addition to these standard file types, special file types such as voice and full-motion video are also usable with object file service. This enlarges the potential for dealing with problems that were previously impossible to solve. Voice data storage added to the customer file allows the customer service representative to have an exact record of requested transactions and provides an audit trail for future reference. Other scenarios can be provided that are equally rewarding, with the final result being increased productivity and customer satisfaction.

The overall philosophy that should be followed is to provide the data required to complete the task in its "natural state" in the client's "native environment" for maximum productivity and to convey the most information. The "native state" is provided through the use of object file management, since each file is maintained as an extension of the application that originally generated it.

It has been demonstrated that imaging technology and object file management are important elements of the total solution. The remaining key element is a "software engine" to run these services and to move the data in a logical path or workflow. Workflow software provides the "engine" to ensure files are moved between users in a flow that at a minimum simulates paper processes currently in use and at best streamlines these processes. Workflow software monitors the activities at each workstation under a user pre-defined process to ensure timely completion of tasks and automatic routing to other users within the system.

In addition to routing information, workflow software can automatically feed database tables and enter customer data in pre-defined response formats for the generation of letters of response to inquiries. It provides the path for data to flow in a proactive environment that differs from the standard mail management formats. If responses are not received in pre-determined time frames at each step of the process, the data is automatically routed to supervisors for review. The tasks can then be reassigned by the supervisor or released for reassignment by the workflow software. Because the workflow software is rules-based and time-sensitive, management can rely upon it to reduce unnecessary work, eliminate errors, avoid lapses in control of critical processes and comply with statutory or corporate requirements.

Another problem that is solved by the use of workflow software is the problem of work load balancing. Two important aspects of work load balancing are the ability to automatically route data based on pre-defined rules and to direct special cases to individuals who are equipped to handle them as special tasks. An example of the first case could be as simple as a customer service representative being out sick. Transactions or processes normally routed to that individual could automatically be re-routed to other representatives. This balancing of work load would ensure timely task completion and would be transparent to the other users of the system. The second case could be exemplified by requiring that special cases of customer requests be handled by an individual or group of individuals (i.e., fiber optic service). The workflow software would be constructed to provide these cases to the selected group on a priority basis and provide additional work load only after these cases are completed. This would ensure that each client received the correct service representative to provide a timely solution or response.

Process flows handled by the workflow software will change as the developing organization changes. It is necessary to have workflow software that can be changed in real time and at the customer's site. This flexible formatting keeps the cost of maintaining the system at reasonable levels and provides for continuous process improvement. Continuous improvement is the key to success in the marketplace.

Workflow software in combination with imaging technology and object file management make up the basic set of tools required to provide the total business solution. It is important to now consider how these tools can be applied to obtain maximum benefit at the lowest implementation cost.

One factor mentioned earlier was to provide the solution in the client's "native environment". In this case, the "native environment" relates to making use of existing assets rather than purchasing or creating new ones. Existing assets can be in the form of hardware (host computer, workstations, network), software (existing databases, workstation programs) or training (word processing, spreadsheet, database).

To preserve assets with regard to the hardware, the solution software should run in any host machine capable of supporting UNIX. The workstations supported should be either PC, Macintosh, or a combination of both. All standard types of scanners and printers should be supported and available to mix and match in the overall system.

The most significant software asset usually resides in the database, which may be resident on a non-UNIX host. The solution software should have the ability to link the existing database to the new applications through the use of standard window procedures. This database information would then be available to the users at the workstation. The workstation software should also be constructed to take advantage of local applications such as spreadsheets and word processing. This yields benefits in return on investment in these software packages as well as the retention of training invested in their use.

Now that the important aspects of providing a business solution have been explored, it is equally important to have a plan of implementation that fits the individual organization. In developing countries it is essential to have a rollout strategy that provides a pilot stage for assessment with the capability to expand on a department-by-department basis until the entire organization is automated. It is unrealistic to think that any organization can successfully go from design to enterprise wide implementation without the benefit of corrections and adjustments that are bound to be the result of careful pilot testing.

The pilot may be an entire department which provides baseline hardware, third party applications and workflow processes. The baseline system must be constructed to provide for growth within the department and to share data across networks with other departments. This is easily accomplished through the use of server volume maps and a centralized database. The volume maps carry not only the location of the object, but the server address on which the data can be found. Using this method, users on the network may obtain data from any server on the network (including remotes) and the data appears at the workstation as seamlessly as it would if it were from the local server. This important feature is not available on all types of small imaging systems and it is absolutely essential to maintain logical and orderly growth paths.

In addition to the pilot system characteristics, a milestone strategy should be put in place at the same time the system design document is completed. This strategy will provide a road map for future implementations and an audit trail of planned activities versus actual. Without this strategy it is impossible to be certain where the organization is with regard to the enterprise-wide automation. Developing countries and organizations should spend most of their concern and time in the up-front study of system requirements and making sure that the processes are beneficial to the operation prior to the pilot implementation. This will yield a pilot that is not only beneficial to the initiating department, but provides a logical start to enterprise-wide automation.

Finally, after reviewing and discussing the key elements of a successful imaging technology solution, have the problems associated with paper-intensive environments mentioned earlier been solved? A review of the problems reveals the following:

Problem	Solution
Loss of control of critical processes	Workflow software
Inability to share workstations information images	Network with document
Inability to deal with massive amounts of data	Optical disk storage
Lost or misplaced files document	Image management software & images
High cost of storage	Optical disk storage
Low access to archival data	On-line documents
Inferior customer service	Object file structure, workflow software, On-line document images

It is evident that in addition to answering these problems the use of imaging technology greatly expands the horizons of developing countries and organizations. It begins to level the playing field in the world marketplace. Cincinnati Bell Information Systems (CBIS) is dedicated to bringing world class business solutions that apply to the global community. All of the principles discussed in this presentation are incorporated in CBIS solutions.

THE INEQUALITY OF EQUAL ACCOUNTING RATES

PRESENTED BY

Peter Jackson, Regional Director Asia Pacific, Cable & Wireless Plc (Hong Kong) and John Sullivan, Regional Manager Asia Pacific, Cable & Wireless Plc (London).

Telecommunications is one of today's most dynamic industries yet the method of charging for international telephone calls has remained largely unchanged for a number of years. The settlement system has been labelled arcane and the charge levels exorbitant. Is this the time for change? How would developing nations be affected by a move away from the present accounting rate system?

During recent years the charges for inter-national telephone calls have become an emotive issue with consumers, the media and the regulators.

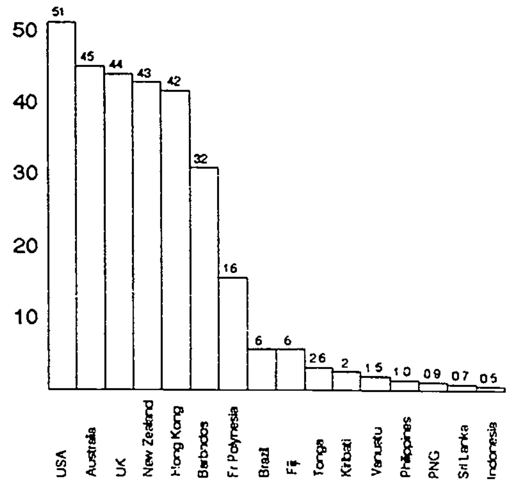
In the second half of the eighties the Federal Communications Commission in the US, concerned about the high outpayment being made by the US carriers to overseas administrations, which today is over US$ 3 billion made international accounting policies a political issue. The eighties also saw the introduction of competition into what had always been monopoly markets. Firstly, in the USA with the break-up of "Ma Bell", then the licensing of Mercury Communications in the UK and more recently with Clear in New Zealand and Optus in Australia.

Around the same time consumer awareness was fuelled by Hugo Dixon, the telecommunications correspondent of the London Financial Times who, in a series of articles in the late 1980's alleged that collusion between the major telecoms operators in the USA, UK and Europe had maintained artificially high international collection charges, the price paid by the consumer, when technology had been driving down the costs of providing the services.

All these factors have combined to put pressure on collection charges and accounting rates. It is this pressure which is of particular concern to operators of telecoms in developing countries.

Since the public switched telephone network became available in the early part of this century it has developed rapidly. In the USA there are now 1.25 exchange lines per household and over 80 telephones per 100 of the population. Western Europe, Australia and New Zealand are approaching that magic figure of one line per h· ·hold while the developing world lags far be ·d. The highest density in the Asia Pacific region, excluding Hawaii, is French Polynesia with around 25 telephones per 100 inhabitants, typically the density is below 10 per cent.

Telephone lines / 100 of Population



It is ideological to suggest that in the short, or even the medium term, the majority of Pacific Islands will approach the telephone density of 42 per 100 inhabitants of the island of Barbados in the West Indies, let alone that of the first world countries. But if their economies are to grow and attract investment from overseas, there must be freely available and reliable telecommunications in the islands of the Pacific and it is the revenue derived from international traffic which will support the funding of their telecommunications development.

Particularly, as in many cases traffic to and from developed countries is not symetrical and they receive a net inpayment through the accounting rate mechanism.

The first world has, over the years used the income from its international services to finance system development while keeping domestic telephone charges below cost. It has cross-subsidised its domestic services from international revenue, allowing them to grow and prosper.

In many cases the developing world has had to use the foreign exchange obtained from international traffic to fund the provision of basic social services and development. Any significant global downward trend in accounting rates would deny it this opportunity.

The CCITT have recently, by an overwhelming majority, passed recommendation D140, which lays down the principle of cost oriented accounting for international telephone services. The principle of cost oriented pricing is fundamentally sound but it is the application of that principle which can become unfair, generating greater profits for the telecoms operators in the developed world while denying developing countries the funds which will enable their systems to grow and their economies the chance to prosper.

Looking back to an earlier period, the present day dichotomy between accounting rates and collection charges did not exist, the collection charges (the prices paid by the consumer in local currency) were derived from the international settlement rates which were expressed in Gold Francs, the ITU unit of currency.

The ending of the Bretton Woods exchange regime forced administrations to agree definitions within the CCITT which clearly distinguished between collection charges and accounting rates. Collection charges were specifically made a matter of concern only to the country in which they applied while accounting rates became subject to bilateral agreement between the corresponding administrations.

The effect of this has been to leave accounting rates largely unchanged for many years while collection charges have been affected by market forces, competition and regulatory bodies. The situation has been reached where there is little or no relationship between accounting rates and collection charges.

CCITT recommendation D140 now seeks to re-establish the relationship by stating;

> *"that administrations should seek to lower the provisioning costs of international telephone services"*
>
> *and*
>
> *"that administrations should strive to offer customers high quality international telephone services at the lowest possible prices".*

In short, it recommends that both accounting rates and collection charges should be cost oriented. As stated previously, it is not the principle of this recommendation but the application of it that must give cause for concern. Three fundamental questions need to be considered;

> What are the cost elements involved in providing the service?
>
> How are these costs calculated?
>
> How are these costs, which will vary country by country, reflected in the international accounting rate?

Recommendation D140 goes on to state;

> *"that too great a dissymmetry between the charges applicable in each direction of the same relation may contribute to the distortion of the balance of traffic and encourage the retention of high accounting rates".*

Currently, most developing countries benefit from an imbalance of telephone traffic, sending only half, or even less, of the traffic they receive from their major, developed correspondents.

It is interesting that the telephone density and the per capita GDP are generally reflected in the ratio of incoming to outgoing traffic of that country.

ROUTE	IN/ OUT RATIO	TELE- PHONE DENSITY	GDP/ CAPITA US$
FIJI - AUSTRALIA	1.9	9%	1200
TONGA - AUSTRALIA	4.5	4%	530
BARBADOS - USA	1.97	42%	4800
GRENADA - USA	5.0	7%	970
SEYCHELLES - UK	1.9	21%	2500

Of course, where this imbalance is significant, it is in the interests of the recipient to maintain the level of foreign currency revenue it receives from it and in practice there is very little that can be done in the short term to redress the situation.

Whilst demand for international telephone calls is to an extent elastic it is affected much more by the level of disposable income than the actual cost of the service, particularly where developing countries are concerned.

Currently the price of a telephone call from Tonga to Australia is cheaper than it is in the reverse direction, yet there continues to be an imbalance of over 4:1 on the route. Even when AOTC, the Australian administration, increased its collection charges in 1990, exacerbating the price differential, there was no significant change to the balance of traffic.

It is the consumers' relative ability to pay, rather than the price of the service, that unbalances the traffic. This is particularly significant in the case of island nations which have large communities of relatively prosperous expatriates living and working overseas.

It is little wonder that the accounting and collection rate mechanisms have been in turmoil over the last few years. Reductions in accounting rates will not, in isolation, solve the problem. The link between them and collection charges must be re-established and perhaps go even further in order to maintain and increase the revenue available to developing countries.

Reliable and freely available telecoms are vital to economic development. Telephone penetration, GDP and traffic flows are generally clearly linked and it is the increase in prosperity of the recipient which will rebalance the traffic. Tinkering with collection charges and accounting rates is unlikely to solve the problem.

It can easily be argued that it is in the long term interests of both parties to ensure that sufficient revenue continues to be available to fund system expansion and to ensure that the application, even on a phased basis, of cost oriented accounting rates does not mitigate against this.

Firstly, it will be necessary for administrations to agree on the elements to be used in determining the cost base from which accounting rates will be derived.

Recommendation D140 defines these elements in broad terms;

> *"that the remuneration for the use of telecommunications facilities made available to administrations should cover the costs incurred in providing those facilities such as:*
>
> - *network costs*
> - *financial costs*
> - *overhead costs"*

Beginning with the network costs, the interpretation of what these cover is bound to differ between administrations.

Firstly, how much of the national network should be included?

- the handset or customer's equipment?
- the localloop?
- the local switch?
- the national transmission network?
- the national transit switching?
- the connection to the international gateway?

All these are costs to the national telecoms operator and the levels will vary considerably between countries. The drivers of these costs would include;

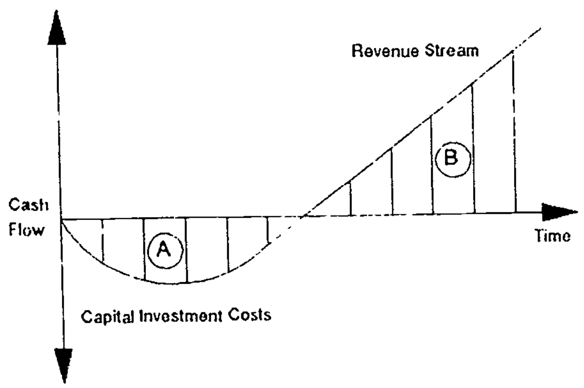
- **geographic situation** - developing countries usually have to provide service to remote communities at a capital cost per line many times greater than that for system expansion in the urban and sub-urban areas of first world countries.
- **economies of scale** - these include the bulk purchasing power of large administrations, the relative efficiency of a large labour force, the availability of expensive mechanical aids, spares holdings and redundancy philosophies.
- **Equipment sourcing** - large first world countries usually enjoy the benefits of local equipment manufacture, avoiding the high transport and insurance costs and import duties experienced by the developing world.
- **country infrastructure costs** - the cost and availability of local transport, power etc.
- **labour costs** - the lower wage levels associated with developing countries are balanced by the need to bring in ex-patriate support at a high cost and the expense of sending staff overseas for training.

It would be surprising if the costs of providing and maintaining the national network in a developing country were not two or even three times higher than those in a first world nation.

Similarly, the unit costs of providing and operating the international services will be significantly lower for developed countries. They will enjoy the economies of scale in the provisioning switching equipment, earth stations, transmission equipment and cables. They will benefit in terms of operating costs by being able, through greater use of digitalization and circuit multiplication techniques, to derive a larger number of speech channels from a given space segment or cable capacity.

Secondly, the financing costs of developing countries will be significantly higher. It is unlikely that they will have reached the stage where they are generating sufficient revenue to cover operating costs and fund ongoing development. They are likely to be affected by the availability of convertible currency to finance foreign currency expenditure.

The costs financing are also likely to be higher because of the risk factors involved.



It is likely that telecoms operators in most developed countries will have moved to above the line in the diagram where they are very much cash positive and generating sufficient cash to finance ongoing development as well as make dividend payments to their shareholders. Major development is a sunk cost from which they are now reaping the benefits.

It is axiomatic that countries with low telephone penetration are still below the line and their ability to move above it depends on the level of revenue derived from their capital investment, particularly their investment in the international services.

Finally, overhead costs are also likely to be significantly higher for developing countries, as they are affected by the same factors as net-work costs, such as economies of scale.

Having considered which elements might reasonably constitute the cost base, the calculation of these costs presents a much more difficult proposition. Whilst it is clear that costs will vary between developed and developing countries there will be wide variations within these groups.

I suggest that it would impractical for every country to calculate its network costs, have them globally accepted as realistic and then used as the driver in determining the basis for accounting rate settlements. The result would be a wide range of accounting rates within the same region, anomalies between regions, and with the CCITT seeking to re-establish the link between accounting rates and collection charges, a pricing structure confusing to the average consumer.

If the world is to take the next step towards cost oriented accounting rates a relatively simple and just system, which neither penalises the efficient nor favours the inefficient operator, must be established. Regrettably, there is no quick fix.

However, one possible solution would be to follow the example of Europe by utilising the TEUREM system (Tariffs for Europe and Mediterranean Basin), establishing benchmarks for the various cost elements of providing international telecommunications.

Variances against these benchmarks would be justified by country specific parameters, taking into account telephone penetration and the cost of financing future development.

The introduction of a banding system would simplify its application with countries with similar parameters being slotted into the same band.

It would be surprising if this exercise did not re-inforce the findings of previous studies such as the Maitland Commission in 1984 and the 1990 study carried out by the ITU that cost levels in developing countries are roughly twice those of first world nations.

If, as is likely, that this proves to be the case how will these differing cost levels be reflected in accounting rates?

Firstly, we need to re-consider the present method of calculating settlements between administrations; "The Accounting Rate Equation".

The Accounting Rate Equation.

$$\left(\text{collection charge} \times \text{traffic out}\right) - \left(\text{traffic out} \times \frac{1}{2}\ \text{accounting rate}\right) + \left(\text{traffic in} \times \frac{1}{2}\ \text{accounting rate}\right) = \text{revenue}$$

In a very simplified situation where we would have:

a = 400 minutes of traffic from country A to country B.
b = 200 minutes of traffic from country B to country A.
c = collection charge of $1.0 in both countries.
d = accounting rate of 80 cents equally divided.

$$(c \times a) - \left(\frac{a \times d}{2}\right) + \left(\frac{b \times d}{2}\right) = \text{net revenue}$$

$$(1.0 \times 400) - \left(\frac{400 \times 0.8}{2}\right) + \left(\frac{200 \times 0.8}{2}\right) = \$320 \text{ net revenue to A.}$$

and

$$(1.0 \times 200) - \left(\frac{200 \times 0.8}{2}\right) + \left(\frac{400 \times 0.8}{2}\right) = \$280 \text{ net revenue to B.}$$

In this simplistic example, with equal accounting and collection charges country A receives 12 1/2% move than country B.

However, with all other things being equal, any reduction in the accounting rate increases revenue to country A whilst reducing the revenue to country B; a situation operators in developing countries are not unfamiliar with. Clearly this system is by no means perfect and any cost orientation is purely co-incidental. If we go with worldwide opinion towards the introduction of a cost based system, can a mechanism be developed that does not mitigate against the interests of developing countries?

One method would be to retain the present accounting rate equation with the division reflecting the differing cost levels. A banding system would avoid having many differing apportionments and keep the system relatively simple.

If we look at our simplified example again but modifying it and substituting a 70 cents accounting rate divided 30 cents and 40 cents for A & B respectively the situation changes thus;

(1.00 X 400 - 160) + 60 = $ 300 Revenue for A.

and

(1.00 X 200 - 60) + 160 = $ 300 Revenue for B.

In this situation the application of unequal shares in the accounting rate results in equal shares in revenue, a situation many would regard as fair particularly if the $1.00 collection charge can be demonstrated as reflecting actual cost plus reasonable profit.

Of course these examples are all very simplistic and life in the real world is not as easy as this but I believe that a system of unequal apportionment of cost based accounting rates would be an improvement on the status quo, which perpetuates inequality. We are of course still left with the problem of agreeing cost levels which will no doubt will still remain unresolved in the short and perhaps medium term.

There are however other options available to replace the present system. Recently a number of papers have been written proposing an access charge or termination fee in place of the accounting rate mechanism. This scheme proposes that all carriers pay the same rate for terminating calls in a particular country.

The termination fee proposal is gaining support in a number of quarters but not all supporters are willing to recognise that to be applied on a fair and just basis it must vary from country to country. It must reflect the differing levels of cost which exist throughout the world. Again this could be achieved through a banding system, but would the result be any differing from an unequal division of the accounting rate?

Whatever the outcome of the CCITT Recommendation D140, whether it retains the current system, whether agreement can be reached on unequal shares or whether we end up with a termination fee, there are many other factors to be considered.

- The major carriers, in the US driven by the FCC's expectation of a 50% reduction in accounting rates on major routes and outside the US by other factors, will continue to strive to reduce their level of outpayments.

- Competition, with new entrants coming into the market, will leverage collection charges which in turn will force the established players to review the levels of accounting rate if they are to remain competitive.

- Resale is expanding into the PSTN with the obvious effects on traffic flows and collection charges.

- The introduction and expansion of calling card services with Home Direct and Home Beyond services increasing the dissymmetry in traffic flows. This in turn places even greater pressure on developing countries to reduce accounting rates whether or not they are cost based.

- The established principle of distance related charging which although in consumers' eyes appears reasonable, less and less reflects the costs of providing services, particularly over satellite systems. The retention of distance based accounting has recently been recommended by TAS (Regional Tariff Group for Asia and Oceania) at their meeting in October last year.

As has been stated earlier there can be no quick fix to the accounting rate dilemma; the world is changing too rapidly. The danger is that in seeking one, the gap between developing and developed countries will continue to widen not only in the telecommunications field but in terms of social and economic prosperity.

THE DYNAMICS AND IMPACT OF U.S. TELECOM POLICY
ON ACCOUNTING RATES AND INTERNATIONAL SIMPLE RESALE

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I. ABSTRACT

The U.S. Federal Communications Commission ("FCC") has entered the realpolitik of the international telecom industry through its policy initiatives on accounting rates and simple resale. In each case the FCC is seeking to change the behavior of non-U.S. entities; its accounting rate policy is a mechanism to pressure non-U.S. carriers to accept lower accounting rates and its simple resale policy is a mechanism to pressure other countries to liberalize their telecom markets. For non-U.S. carriers, a realistic appraisal of the FCC's policies is essential to a fully-informed managing of relations with U.S. carriers and to a better understanding of telecom opportunities in the U.S.

II. ACCOUNTING RATES AND THE U.S. TRADE DEFICIT

Accounting rates determine how much money the telecom carrier who originates an international call is obligated to pay to the foreign carrier who terminates the call. Typically, accounting rates are specified in currencies such as gold francs, special drawing rights, or U.S. dollars. The amount which the originating carrier owes to the terminating carrier is usually 50% of the accounting rate. For example, if the accounting rate is $1.30 per minute, the originating carrier would normally owe 50% of that amount (or $0.65) to the foreign carrier for its role in terminating the call. The FCC refers to the $0.65 charge as a "settlement rate."

The FCC has monitored or regulated accounting rates for more than 50 years. For most of that period the FCC focused upon record services. It was not until 1986 that the FCC's interest centered upon international message telephone service ("IMTS"). Historically, the FCC's principal concern was to prevent "whipsawing." Whipsawing can occur when one country (such as the U.S.) has several competing telecom carriers while a foreign country has a monopoly carrier. The FCC has been concerned that the monopoly foreign carrier will try to use its bargaining leverage to negotiate unfair rates and terms with competing U.S. carriers, in effect playing off the U.S. carriers against each other. To prevent that, the FCC adopted the Uniform Settlements Policy to require all U.S. carriers to have the same accounting rate arrangements on the same route. The FCC changed the name of the policy to the International Settlements Policy as the FCC became willing to accept some non-uniformity in the reduction of accounting rate levels.

The FCC continues to monitor accounting rate practices for evidence of whipsawing. In July 1990 the FCC rejected AT&T's USADirect Service and MCI's CALL USA service for Spain due to whipsawing concerns. However, whipsawing has now largely been replaced by the U.S. telecom trade deficit as the primary factor motivating the FCC's accounting rates policies. The deficit is now approximately $3 billion annually and the FCC has estimated that it could balloon to $7 billion per year by 1996 based on current trends.

The deficit is the net settlement outpayments by all U.S. carriers in a given year. Because most carriers originate and terminate traffic on a particular international route, payments from one carrier to another carrier are made, with a few exceptions, only on a net basis. If traffic is balanced evenly between two countries, each carrier owes an identical amount to the other carrier and no settlement payments are necessary on a net basis. When there is an imbalance between originating and terminating traffic on a particular route, one carrier must make settlement payments to the other carrier. The U.S. telecom trade deficit occurs because U.S. outgoing IMTS traffic far exceeds U.S. incoming IMTS traffic for many countries. As a result, U.S. carriers owe more to foreign carriers for the termination of U.S.-originated calls than foreign carriers owe to U.S. carriers for the termination of foreign-originated calls. Although accounting rate levels do not by themselves create the traffic imbalance, higher accounting rates will lead to a higher trade deficit for a given traffic imbalance.

III. THE FCC'S ACCOUNTING RATE POLICY

The FCC has placed a high priority on reducing the U.S. telecom trade deficit by lowering accounting rates across the board. In November 1992 the FCC adopted so-called accounting rate benchmarks for virtually all regions of the world. The accounting rate benchmark for Europe is $0.46-$0.78 per minute (or a settlement rate of $0.23-$0.39/minute); the accounting rate benchmark for Asia and other regions is $0.78-$1.20 per minute (or a settlement rate of $0.39-$0.60/minute). According to the FCC, it expects most non-U.S. carriers to agree to accounting rates at these benchmark levels within two years and all carriers to do so within five years. The FCC's expectation stems in part from CCITT Recommendation D.140, which requires accounting rates to be cost-oriented and non-discriminatory. The FCC expects lower accounting rates to effect a 50% reduction in total net settlement outpayments by U.S. carriers.

Although the FCC claims that the benchmarks reflect declining international service costs, the FCC has never developed an empirical and economic methodology for identifying or measuring those costs. The FCC once suggested that AT&T's fully distributed costing ("FDC") methodology would be appropriate, but the FCC has largely abandoned the FDC methodology for domestic interexchange services and no U.S. carrier supported its use for IMTS. Nor did the FCC comment upon assertions by non-U.S. carriers that they have conducted studies verifying the cost basis of existing accounting rate levels. As a result, it remains a matter of speculation whether existing accounting rate levels, or the FCC's benchmarks, more closely reflect international service costs. It is a precarious balancing act for the FCC to dictate specific benchmarks for the purpose of aligning accounting rates more closely with costs when the FCC lacks any economic methodology for building cost-oriented accounting rates from the ground up.

Despite the substantial uncertainty whether the FCC's benchmarks are cost-oriented, the FCC has engaged in tough talk on what it may do if non-U.S. carriers do not agree to lower accounting rates in line with those benchmarks. The FCC has stated that it has the authority to prescribe unilaterally an accounting rate for a particular international route. If a non-U.S. carrier rejects the FCC-prescribed accounting rate, the only alternatives would be a sender-keep-all arrangement or the termination of direct relations between U.S. carriers and the foreign country. Although the FCC has not yet sought to prescribe an accounting rate for a non-U.S. carrier, the FCC has required the five largest U.S. international carriers (AT&T, MCI, Sprint, TRT/FTC and GTE-Hawaiian) to file reports by January 1, 1993 and January 1, 1994 regarding their progress in negotiating lower accounting rates.

Because the unilateral prescription of an accounting rate by the FCC is an extreme sanction, and one which arguably violates ITU regulations, the FCC may be reluctant to exercise its alleged prescription authority. To date, the FCC has shied away from the more provocative options, such as AT&T's proposal for a 60-day fast-track complaint procedure which U.S. carriers could invoke against non-U.S. carriers who refuse to lower the accounting rate. The FCC also has declined to insert conditions in the international service authorizations of U.S. carriers to require or encourage lower accounting rates. In November 1992 the FCC clarified that it would not seek to enforce its accounting rate benchmarks, which it described as "guidelines," at least until it has reviewed the January 1, 1993 progress reports and the impact of CCITT Recommendation D.140.

In assessing the likelihood of FCC action to enforce its accounting rate benchmarks, non-U.S. carriers should be aware of the largely political nature of the FCC's policies in this area. The FCC's accounting rate benchmarks are more the product of U.S. trade policy than of rigorous technical analyses of cost and traffic data. FCC Chairman Sikes stated bluntly in August 1991 that without fundamental reforms "this [accounting rate] issue could become a matter of trade policy and negotiations." As a result, accounting rate policy, like all U.S. trade policy, is intensely and essentially political. And like statistics which U.S. politicians use as election campaign fodder, one suspects that there is rather less to the FCC's accounting rate benchmarks than first meets the eye. The overriding attribute of these benchmarks is the trade result they would achieve -- a reduction of approximately 50% in the U.S. telecom trade deficit. The possibility should not be dismissed that the FCC devised its accounting rate benchmarks as much through reverse engineering from the desired trade result as from a technical telecom cost analysis.

IV. THE POTENTIAL IMPACT ON DEVELOPING COUNTRIES

If achieved, the FCC's accounting rate benchmarks could require significant concessions from many non-U.S. carriers. Table 1 lists accounting rate levels for the Asia-Pacific region in 1991. Although some of these rates have been negotiated downward since 1991, only two countries on this list (i.e., Australia and Singapore) currently have an accounting rate within benchmark levels. Significant reductions would be required for many other countries to meet benchmark levels. As Table 2 demonstrates, numerous countries in the Asia-Pacific region -- including Korea, the Philippines, Pakistan, Thailand, Hong Kong and Indonesia -- receive sizeable settlement outpayments from U.S. carriers. According to the FCC, net settlement payments to the Asia-Pacific region totalled $1.178 billion in 1990 for IMTS. Implementation of the FCC's new benchmarks could reduce overall payments to the Asia-Pacific region by more than $500 million per year.

The FCC's policy could harm those carriers from developing countries who rely upon net settlement payments from U.S. telecom carriers for a substantial portion of their gross revenues and hard currency. As one example, the Guyana Telephone & Telegraph Company Ltd. ("GTT"), located in a small developing country in South America, receives 75% of its total net revenues and 80% of its hard currency revenues from AT&T alone. Any substantial reduction or lengthy delay in these payments would impose a hardship upon GTT, which relies upon such payments to fund day-to-day operating expenses, short-term and long-term infrastructure improvements, and debt service. In some cases, a reduction in net settlement payments from U.S. carriers could cause a non-U.S. carrier to default on its loan obligations or become insolvent.

Reliance upon net settlement payments is a matter of necessity, not choice, for carriers in some developing countries. The equipment and infrastructure improvements which such carriers must undertake often require hard currency. Particularly when the native monetary currencies for those carriers are not readily convertible, U.S. settlement payments may represent an essential source of hard currency. The on-going global recession has dried up national treasuries in developing countries while nearly severing the umbilical cord between capital markets and many telecom carriers. In such an environment, the cost of capital can be prohibitively expensive, forcing carriers in developing countries to use net settlement payments, or accept the onerous terms that accompany supplier (or vendor) credits, in order to fund purchases of essential equipment as well as network maintenance and modernization.

Viewed in isolation from other factors, a reduction in the accounting rate level is almost never the preferred business option of a telecom carrier in a developing country. Lower accounting rates reduce net revenues and, possibly more important, reduce hard currency revenues. Lower accounting rates appear to make business sense for carriers in developing countries primarily when they are implemented as part of an integrated multi-year plan involving infrastructure modernization and substantial collection rate re-balancing. In that context, lower accounting rates can be instrumental in reducing collection rates, which in turn can stimulate international traffic growth and maximize carrier profitability. It is usually optimal if infrastructure development precedes significant reductions in accounting and collection rates. It may be unrealistic to expect that rate reductions will substantially stimulate traffic growth without infrastructure improvements when many carriers are experiencing difficulty in maintaining current traffic levels over existing network facilities.

The problem which developing countries may now have to face is being asked to accept lower accounting rates before it makes business sense for them to do so. At the risk of provoking unilateral actions by U.S. authorities, telecom carriers in developing countries should consider standing firm in resisting the trend toward lower accounting rates, at least for some period of time, when they believe the current accounting rate is cost-oriented. As several non-U.S. carriers and organizations have argued to the FCC, it is fallacious to develop a single accounting rate policy which applies to developed and developing countries alike (or to all developing countries as one category). The ITU conducted a study in 1990 indicating that the average telecom carrier in a developing country incurs costs to provide IMTS which are more than two times higher than the costs incurred by carriers in developed countries. The study also concluded that telecom service costs vary widely among developing countries, thereby making it virtually impossible to estimate any limited range of cost-oriented accounting rate benchmarks for developing countries. Without mentioning this study, the FCC adopted the same accounting rate benchmark for developed and developing countries in the Asia-Pacific region.

Developing countries should continue to push for a policy which rationally distinguishes between developed and developing countries and, at a minimum, which does not erect any presumption that the accounting rate for a developing country is not cost-oriented simply because it is higher than accounting rates for developed countries in the same region. Absent an economic cost measurement and allocation methodology, the FCC has no empirical basis at this time to conclude that accounting rates between the U.S. and developing countries are generally above cost. The first-hand experience of carriers in developing countries demonstrates that their costs can be increased by a variety of factors, including (i) the cost of capital; (ii) higher short-term expenditures to build a modern telecom network infrastructure; (iii) circuit loading and network efficiencies; (iv) economies of scale and scope; (v) network maintenance requirements; (vi) a less highly educated and trained population; (vii) the absence of a sophisticated economic and technical infrastructure within the country; (viii) a greater dependence upon transit arrangements and thin, long-haul routes; (ix) less route diversity; higher installation and overhead costs; and (x) greater contribution requirements. Particularly when a telecom carrier has initiated an ambitious capital improvements program for completion within a few years, it cannot be assumed automatically that a "high" accounting rate level is above actual IMTS costs.

Unfortunately, the political and trade contexts in which accounting rate policy is devised in the U.S. may overwhelm efforts to ensure rational treatment of developing countries. AT&T has estimated that 70% of its net settlement outpayments are made to carriers in developing countries, so reducing the U.S. telecom trade deficit significantly will depend upon lower accounting rates with developing countries. And the FCC continues to use politically-charged rhetoric in claiming that current accounting rate levels with developing countries are a "subsidy" and a type of "foreign aid." As a result, it may conflict with U.S. political imperatives for carriers in developing countries to defend current accounting rate arrangements. At the same time, while carriers with above-cost rates should endeavor to lower them in line with CCITT Recommendation D.140, carriers who believe their accounting rates are cost-oriented should not forget that they are entitled to resist lower accounting rates by refusing to accede to U.S. carrier demands.

Apart from accounting rates, other factors also play a prominent role in promoting telecom financing through privatization or infrastructure development for developing countries: (i) a simple, transparent and certain telecom regulatory regime; (ii) substantial flexibility to rebalance rates, streamline the labor force, and corporatize operations; (iii) well-developed domestic capital markets; (iv) favorable tax laws and dividend repatriation rules; (v) good prospects for economic growth within the country; (vi) clear ground rules governing the Government's ownership participation; (vii) favorable policies and practices regarding debt-equity swaps; (viii) preserving a carrier's monopoly status for some period of time; (ix) political, business and regulatory stability within the country; (x) experienced and efficient management; and (xi) a convertible currency. These and other, similar factors have a well-recognized impact upon a carrier's ability to privatize or to obtain financing for infrastructure improvements.

In addition, technology itself is a driving force behind the financing of telecom projects in developing countries. The last several years have witnessed the explosive growth of wireless technologies. Viewed initially as complementary or overlay technologies, these technologies are being scrutinized increasingly for their suitability to provide core telephony services which historically have been furnished via wireline facilities. There is increased optimism that wireless technology will prove able to "finance itself," at least in part, through the immediate traffic and revenue growth which it could generate.

Moreover, technology is beginning to change the way the market looks at telecom financing opportunities in developing countries. In the past, there was a tendency to view project financing and carrier financing as separate business opportunities. With the development of wireless and other technologies, the lines between these categories have blurred. Projects which once involved overlay networks now can be expanded to involve core telephony services as well. Project financing may become a more viable alternative to partial or full privatization. These and other factors may mitigate the impact of lower accounting rates upon telecom financing in developing countries.

V. ACCOUNTING RATE NEGOTIATIONS

The FCC's pressure for lower accounting rates has resulted, and will continue to result, in efforts by U.S. carriers to negotiate lower rates with non-U.S. carriers. Some industry observers have speculated that the FCC intended all along for its harsh language on accounting rate issues to be used by U.S. carriers as a negotiating tactic with non-U.S. carriers.

Regardless whether the FCC actually intends to undertake unilateral enforcement actions, the specter of FCC sanctions may give U.S. carriers additional bargaining leverage. If non-U.S. carriers believe the FCC is serious about unilateral actions, they might be more willing to accept proposals by U.S. carriers for lower accounting rates. By understanding the type of "game" that the FCC and U.S. carriers might be playing with respect to accounting rates, telecom carriers in the Asia-Pacific region can better adopt an informed negotiating posture.

It is possible that U.S. carriers could use a variety of tools for pressuring non-U.S. carriers to accept lower accounting rates. For example, they could threaten to "report" the carrier to the FCC in their 1993 or 1994 progress reports or otherwise initiate direct FCC enforcement action against the carrier. As another example, they could threaten to delay the introduction of new services or even to withhold unilaterally the net settlement payments which are due under the current operating agreement. By understanding the FCC's policies and role in accounting rate negotiations, non-U.S. carriers will be better able to analyze these situations and select appropriate options. One way to neutralize U.S. carrier demands might be to conduct a rigorous study to show that the current accounting rate is cost-oriented.

Non-U.S. carriers also must learn the dynamics of conducting concurrent negotiations with two or more U.S. carriers on accounting rates. It is possible that the U.S. carriers could work together, formally or informally, to "double team" a single non-U.S. carrier. For example, one U.S. carrier might make severe demands for the purpose of making another U.S. carrier's proposal seem more reasonable. Of course, when the U.S. carriers do not coordinate their negotiating strategies, it might be possible for a non-U.S. carrier to reverse this process by using the more reasonable proposal to undercut the demands of the more aggressive U.S. carrier.

U.S. carriers also may seek to expand the use of so-called growth-based accounting rates. In simplified form, this type of arrangement applies the current accounting rate only to existing traffic levels as measured from a base year. All growth in traffic is governed by a negotiated, lower accounting rate. These arrangements have been negotiated as a compromise between the U.S. carrier desiring a lower accounting rate and a non-U.S. carrier desiring to maintain the current level of net settlement payments. AT&T has negotiated growth-based arrangements for the countries listed in Table 3. The large majority of growth-based arrangements involve developing countries due to the larger traffic imbalance with the U.S. and AT&T's greater market power to force carriers in developing countries to accede to growth-based accounting rates.

Non-U.S. carriers should be aware that growth-based arrangements may be subject to conflicting perceptions. The FCC and possibly the U.S. carriers may view such arrangements as a transition to lower accounting rates for all international traffic. By contrast, the non-U.S. carrier may perceive a growth-based arrangement as a permanent accounting rate structure. These differing perceptions could lead to further conflict over accounting rates. In addition, the FCC has adopted a policy that non-U.S. carriers must be prepared to offer the same growth-based accounting rates to all U.S. carriers. The FCC has indicated that it will contact non-U.S. carriers who do not comply with this policy and, in extreme cases, could even prescribe a uniform rate unilaterally. Ironically, the FCC may have ensured some delay in the offering of lower accounting rates to all U.S. carriers by specifying the procedures which it will follow before initiating unilateral action.

Ultimately, non-U.S. carriers will have to assess whether they can achieve the best accounting rate arrangement by agreeing voluntarily to phased reductions with U.S. carriers, or by insisting upon the current accounting rate and risking unilateral FCC enforcement actions designed to compel adherence to the benchmark rate. Through its establishment of benchmarks and tough talk on accounting rates, the FCC hopes to prompt non-U.S. carriers to select the former option. The primary effect of the FCC's increasingly intrusive policies may be to involve the FCC as an active participant in negotiations with non-U.S. carriers who maintain high accounting rates. Whether through informal contacts or formal agency proceedings, the FCC may be more comfortable trying to broker accounting rate arrangements than in superseding carrier-to-carrier negotiations through unilateral prescriptions.

VI. INTERNATIONAL SIMPLE RESALE

In December 1991 the FCC announced the policy that U.S. common carriers will be permitted to provide switched services through the resale of international private line services (so-called simple resale) only when the relevant foreign country offers an "equivalent" opportunity for simple resale. The FCC did not specify criteria for "equivalence," but rather deferred to a case-by-case process for applying the standard to specific countries. The FCC has since clarified that its policy does not apply to the resale of international private lines to provide private line service. Further, the FCC continues to permit customers to interconnect international private lines to the U.S. public switched network so long as simple resale does not occur. The FCC devised and continues to implement its international simple resale policy based upon informal discussions with other countries.

The simple resale policy is designed to curb so-called "one-way resale" where foreign customers are able to bypass the IMTS accounting rate by sending switched traffic over private lines while U.S. customers are denied an "equivalent" opportunity due to interconnection or other restrictions in the foreign country. Such bypass aggravates the U.S. net traffic imbalance and, therefore, the U.S. telecom trade deficit. The FCC's simple resale policy also provides an incentive for other countries to liberalize their interconnection and resale policies. At the same time, the FCC recognizes that bypass provides strong market-based pressure for lower accounting rates. That pressure, and a desire not to interfere with existing customer-carrier arrangements, may explain why the FCC has not yet extended its simple resale policy to all situations where an international private line is interconnected to the U.S. public switched network.

AT&T is pressuring the FCC to apply the "equivalence" standard to every instance where an international private line is interconnected to the U.S. public switched network at a carrier's central office. (No party has asked for the standard to apply to interconnection through a customer's PBX.) The limited scope of the FCC's existing policy has been underscored by a dispute involving PLDT in the Philippines. PLDT has opposed an international private line service interconnected to the U.S. public switched network, which service is provided by Worldcom in the U.S. and Globe-Mackay Cable and Radio Corporation in the Philippines. Because no U.S. resale carrier is involved, the arrangement does not appear to be governed by the FCC's simple resale policy. The FCC recently asked for comments on AT&T's proposal to apply the "equivalence" standard to central office-interconnected private lines. AT&T's proposal dates back to February 1990 when AT&T sought a ruling by the FCC that certain private line interconnection arrangements between the U.S. and Canada were unlawful.

In November 1992 the FCC decided a test case for the simple resale policy involving the proposed resale of U.S.-Canada private lines by Fonorola and EMI. The FCC found that Canada does offer "equivalent" resale opportunities to U.S. carriers. The FCC found that Canada, while not yet permitting facilities-based competition, has a vigorous and competitive resale market. The FCC also noted that Canada accords non-discriminatory treatment to all resale carriers, whether Canadian or U.S. owned. Therefore, the FCC granted simple resale authority to Fonorola and EMI between the U.S. and Canada. However, in response to the Canadian policy prohibiting the bypass of Canadian facilities for intra-Canada or Canada-overseas traffic, the FCC limited Fonorola and EMI to providing direct (i.e., non-transit) traffic between the U.S. and Canada. The FCC also reserved the right to modify or rescind its decision should Canada stop affording "equivalent" resale opportunities to U.S. carriers.

The FCC has already been presented with the next application of the simple resale policy. In November 1992 ACC Global filed an application for authority to provide switched services through the resale of U.S.-U.K. private line services. The comparative openness of the U.S. and U.K. markets has been subject to extensive debate in the U.S. for some time. Based upon the FCC's decision that Canada offers "equivalent" resale opportunities, the presumption should be that the FCC will grant the application with conditions. While Sprint has been frustrated in its effort to enter the U.K. market on a facilities basis, the FCC did not hold facilities-based competition to be a relevant factor in granting authority to Fonorola and EMI for Canada. Nevertheless, the ACC Global application may be decided in the context of the on-going discussions between regulatory authorities in the U.S. and the U.K. regarding the pace and focus of telecom liberalization in the two countries.

Several issues remain to be decided. The FCC recently postponed any decision on whether the "equivalence" standard will apply to non-common carrier facilities, such as separate satellite systems and private fiber optic cables. AT&T has pressed the FCC to apply its policy to all facilities which permit a private line-type offering to be interconnected to the U.S. public switched network. However, the FCC did clarify that the "equivalence" standard does apply when private line facilities are purchased by a common carrier from a separate satellite system or a fiber optic cable system and then are used by a resale carrier to provide switched services to the public.

Some lingering uncertainty regards the difference between the purchase of private line "facilities" and "service" by a U.S. international carrier. In the former case, a common carrier is not regarded as a resale carrier, and therefore is not subject to the simple resale policy, when it provides switched service over facilities which it has purchased from another entity. In the latter case, a common carrier is regarded as a resale carrier, and therefore is subject to the simple resale rule, when it furnishes switched services to its own customers under private line service which it takes from another entity on a subscription basis. As parties become creative in portraying the acquisition of transmission capacity as a sale of facilities rather than the provision of a service, questions may be raised about the proper scope of the FCC's simple resale policy.

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Table 1

1991 ACCOUNTING RATES WITH U.S.

Country	Accounting Rate	
Afghanistan*	12.69	GF
American Samoa**	2.00	$
Australia**	0.68	SDR
Bangladesh*	2.25	$
Brunei*	2.00	$
China*	7.50	GF
Cook Island**	3.00	$
Fiji Island**	2.65	$
French Polynesia**	2.80	$
Hong Kong*	1.90	$
India*	2.25	$
Indonesia*	2.75	$
Japan*	1.13	SDR
Kiribati**	4.00	$
Korea, South*	1.90	$
Laos*	12.00	$
Macao*	2.20	$
Malaysia*	1.80/1.20	$
Myanmar*	5.00	$
Nauru**	2.00	$
Nepal*	2.00	$
New Caledonia**	2.80	$
New Hebrides**	4.00	$
New Zealand**	1.40	SDR
Norfolk Island**	3.00	$
Pakistan*	2.30	$
Papas New Guinea**	1.50	SDR
Philippines*	1.85/1.50	$
Singapore*	0.68	SDR
Soloman Island**	2.50	$
Sri Lanka*	2.20	$
Taiwan*	1.60	$
Thailand*	2.00	$
Tonga**	2.00	$
Western Samoa**	1.50	$

SDR = Special Drawing Rights
GF = Gold Francs
$ = U.S. Dollars

* = Asia
** = Oceania

Table 2

INTERNATIONAL MESSAGE TELEPHONE SERVICE OF THE UNITED STATES FOR THE ASIA-PACIFIC REGION IN 1990

Country	Originating in the United States			Terminating in the United States	
	Number of Minutes	US Carriers' Revenue	PTT Payments	Number of Minutes	US Carriers' Revenue
Afghanistan	72,098	$23,135	$231,947	20,589	$35,771
American Samoa	4,095,127	$2,860,805	$3,633,580	3,000,311	$2,913,542
Australia	93,632,044	$75,884,214	$52,229,388	87,290,798	$51,276,331
Bangladesh	9,944,816	$5,460,534	$11,649,922	878,942	$991,666
Brunei	343,763	$260,497	$330,339	191,210	$185,731
Caroline Island	50,135	$44,405	$38,650	102,981	$82,521
China	32,773,881	$7,616,547	$51,114,847	12,929,121	$20,244,867
Cook Island	74,920	$74,338	$158,897	39,723	$53,182
Fiji Island	2,841,7[illegible]3	$1,063,931	$3,847,705	850,355	$1,123,285
French Polynesia	1,297,542	$364,334	$1,699,622	498,383	$681,711
Hong Kong	85,438,746	$30,664,474	$91,672,488	67,240,303	$76,041,970
India	58,847,978	$65,923,440	$60,706,246	37,486,875	$40,704,124
Indonesia	25,441,797	$14,363,820	$26,487,953	10,049,962	$11,075,872
Japan	319,753,850	$147,320,543	$280,467,812	245,427,886	$224,868,101
Kiribati	30,769	$17,506	$57,331	16,849	$16,040
Korea, South	164,827,039	$73,268,079	$166,885,337	53,251,215	$56,313,228
Laos	86,153	$86,016	$197,428	34,739	$57,604
Macao	1,125,697	$99,089	$1,693,783	251,585	$297,149
Malaysia	21,995,320	$11,762,753	$21,548,730	8,012,262	$8,007,341
Myanmar	402,865	$185,350	$1,106,342	84,499	$199,226
Nauru	13,580	$22,370	$15,411	11,330	$7,224
Nepal	1,079,441	$1,273,282	$1,046,134	373,220	$362,459
New Caledonia	170,421	$36,184	$234,679	72,475	$106,795
New Hebrides	50,188	$62,389	$112,521	37,387	$64,796
New Zealand	18,249,650	$8,590,206	$19,970,976	14,399,678	$16,728,232
Norfolk Island	2,592	$5,080	$4,012	7,140	$8,835
Pakistan	42,905,865	$27,748,739	$47,940,843	4,153,767	$4,869,241
Papas New Guinea	919,520	$577,442	$837,632	773,342	$802,260
Philippines	165,041,692	$96,374,927	$156,642,894	17,768,639	$16,121,024
Singapore	33,994,575	$32,563,651	$18,623,089	27,519,649	$16,047,177
Soloman Islands, British	59,633	$20,095	$129,403	53,440	$92,043
Sri Lanka	3,559,826	$2,853,137	$3,670,779	896,403	$986,620
Taiwan	120,169,707	$62,973,195	$102,972,496	60,977,522	$54,848,566
Thailand	38,427,095	$15,594,3[illegible]0	$43,815,764	10,908,772	$12,435,726
Tonga	2,248,830	$2,330,448	$2,373,627	322,649	$248,471
Western Samoa	636,789	$893,589	$466,504	220,899	$173,655
Other	465,650	$698,849	$2,096,967	2,111,066	$2,043,091
Total	1,251,071,367	$689,961,733	$1,176,712,078	668,265,966	$621,115,479

Table 3

Countries With Whom U.S. Carriers Have Negotiated Growth-Based Accounting Rate Arrangements

Anguilla
Antigua
Brazil
British Virgin Islands
Cayman Island
Dominica
Grenada
Iran
Italy
Jamaica
Malaysia
Montserrat
Peru
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KNOWING WHAT TO ASK FOR:
Privatization of Telecommunications After the Digital Revolution
Guidelines for the Host Country

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1. ABSTRACT

Privatization of telecommunications has become a popular economic strategy that national governments will find more difficult to employ in the future. In the age of telecommunications technology convergence, privatization investments will become more volatile unless host countries act to stabilize the regulatory environment. "Regulate early and regulate often, but with a light hand" are three of the seven guidelines recommended here for countries considering telecom privatization.

2. INTRODUCTION: TELECOM PRIVATIZATION

Telecommunications privatization is now a popular strategy for accelerating the development of national economies and providing numerous other benefits as well -- creating new classes of equity shareholders, enhancing the return on their investments and obtaining critically needed telecommunications technologies and management expertise.

Since the tool of telecom privatization has proven to be both financially successful and politically acceptable in Great Britain, Japan, New Zealand, Chile and Mexico in the 1980s, there are now a long list of nations that are currently privatizing and deregulating their telecommunications sectors.(1) Indeed, privatizations are now under active consideration in more than 20 countries worldwide.

But if Phase I of telecom privatization during the '80s has proven popular, the second wave of privatization in the '90s will be far more complicated.

The dilemma for host governments is that today, when they are under greater pressure to ask for more from investors, they are less capable of enforcing their demands. The business environment has changed. The convergence of telecommunications technologies following the digital revolution has made the world more competitive than it was in the 1980s. Since there are often multiple communications technologies that may be used to provide similar services to consumers, the opportunities for by-passing governments and their regulations are multiplying. For host countries, knowing what to ask for from investors will be an increasingly subtle question.

This paper explores the basic question that now faces many host countries planning the privatization of their telecoms: What should they ask of telecom investors? When should the investor be sheltered from competition and for how long? How should host governments seek to benefit from the inevitable competition in telecommunications services?

- First, this paper reviews both the factors that have lead to the increasingly popular character of telecom privatization and the reasons that it will be difficult to use the tool effectively in the future.
- Second, privatization in the '90s, the age of technology convergence, will be different from the first phase, during the '80s, because the business environment has changed. This paper explores the competitive implications of this technology shift.
- Finally, to encourage successful telecom privatization in an era of growing competition, countries be have to be far clearer about the regulatory framework that will define the future rules of the game. This paper concludes with a discussion of seven specific guidelines that argue in favor of an early commitment to light handed regulation.

2.1 A Growing Interest In Privatization

The popularity of telecommunications privatization is readily understandable. Privatization, seen in the afterglow of the successes of Great Britain, Japan, Mexico and Chile, has been demonstrated in practice to be an effective tool for obtaining multiple benefits: access to sources of private investment capital, a vehicle for introducing of management efficiencies, for obtaining technologies that might otherwise be unavailable and providing local capital markets with an opportunity to share in the financial rewards that are available to those who have modernized their telecommunications systems and met growing business demands for state-of-the-art services. Indeed, the concept that modern telecommunications is an "essential link" in the development process has been well established for a decade(2).

Today, telecom modernization is a well accepted goal and privatization has received solid endorsement as a strategy for achieving it. For example, in 1992, the World Bank completed a series of studies examining "The Welfare Consequences of Selling Public Enterprises" and has published a multiple volume analysis of "Experience and Case Studies"(3). These and other recent studies examining the role of privatization as a tool to encourage investment have contributed to broad consensus in favor of the concept of modernization through telecom privatization(4).

The fact that world trade today requires modern telecommunications systems in order to permit global access has provided the strongest proof of all. Communication is needed in global trade to order, schedule, manufacture and transport goods internationally. The practice of providing goods to customers "just in time" to reduce inventory carrying costs and to respond more rapidly to market trends depends upon modern communications. Goods ranging from consumer electronics to apparel are often sold by country A, assembled in country B from parts manufactured in countries C and D and shipped to country E.

Modernization is an enabling step needed for economies to be competitive in the international marketplace. In fact, a recent article in the *Harvard Business Review* argued that for the modern corporation "Capabilities Based Competition" was the key to competitive strategy in the global marketplace(5). The concept is that for a corporation to be as successful as a global retailer like Wallmart now requires that companies master the intricacies of communications technology. As a result, successful global corporations will work most often in countries that make this possible.

Of course, the pattern that privatization will follow will not be the same everywhere in the world. In fact, . as modernization takes place in many countries, the variations and hybrid forms are likely to increase. Today, privatization seldom involves the wholesale transfer of assets to foreign ownership. Variations in the degree of ownership and in the extent to which telecom facilities are privatized present many different models. In some locations, selected services such as paging and cellular telephony are being privatized. In others, digital overlay networks and high speed data networks are the focus of the privatization process(6). But, whatever form and with whatever speed, many nations are headed toward the creation of private telecommunications enterprises.

2.2 The Troubled Second Wave

Unfortunately, the path to the second wave of telecom privatizations will not be a smooth as was the first. The reasons are abundant.

First, critics of privatization and policy makers from the national government have learned more about the process and will almost certainly ask more of future investors. The perception that investors already received "too good a deal" from politicians who "gave away the store" will cause some nations to clamp down on the process and to write more stringent regulations to place more serious demands on outside investors(7). In the future, if the critics have their way, it will be more difficult for the investor to obtain an exclusive franchise with long term guarantees.

Second, labor unions, government bureaucrats and others who are enfranchised by the current system and who may feel that they have reason to be concerned about modernization will be better equipped with arguments. The International Finance Corporation reports that there are numerous telecom privatization programs that have been stalled for just these reasons in many parts of the world(8). But whatever the cause, in the second wave, there will be greater pressure to demonstrate social benefits and to share the wealth.

Third, more nations are competing for access to capital markets. The popularity of telecom privatization will encourage more competition for limited investor attention and investment resources. What is more, while the lessons from past experience include Chile, Argentina, Mexico, Great Britain, New Zealand, Australia and Japan, the future nations scheduled to enter the competition are likely to have economies that offer less desirable or fundamentally different investment profiles. The second wave includes fundamentally different types of nations: centralized economies moving away from their socialist roots, developing nations that may still have substantial ties dating from their colonial days and modern, rapidly industrializing economies.

Finally, telecom privatizations all entail complicated steps that must be taken by host governments and telecoms: writing new investment laws, developing new regulations to protect national security and other social interests (e.g. universal service), the requirement to restructure management and train personnel during the transition to new management and new accounting systems, the renegotiation of labor and wage agreements and the installation of new telephony architecture needed to accommodate new rate structures (e.g. measuring local traffic). These tasks will not be accomplished easily.

Weighed down with these requirements and entering an increasingly contentious political environment, many host countries may be tempted to settle for less. They may decide to rely upon traditional public monopolies and hope for the best. Ministers of Communications may be especially reluctant to support modernization, restructuring and privatization when the added burden of the competitive consequences of technology convergence becomes apparent.

3. THE CHANGING BUSINESS ENVIRONMENT: TECHNOLOGICAL CONVERGENCE

The emerging business environment in which future telecom privatizations must take place will pose new difficulties for host countries. A variety of technology innovations, all fundamentally resulting from the digital revolution, are leading to the development of new communications media that are both fragmenting markets and dramatically increasing competition. The introduction of new microelectronics, the dissemination of computer technology, the introduction of mobile telephony, advances in high speed digital communications and the liberalization of satellite communications are all forces that are working toward the development of multiple substitutes that will facilitate future communications. Such technology substitutes will be combined in dozens of hybrid forms.

In essence, the communications networks of the future will conspire to defeat heavy handed regulatory regimes. Social and political demands may result in perpetuation of old monopolies or seek to create new tight government controls. But they are likely to be frustrated by the multiple technology choices that will be available to the future telecommunications consumer.

In the developed world, the introduction of personal communications systems to supplement cellular telephony can already be seen as a vehicle for opening new pathways and integrating new communications networks. Local loop telephone companies today find themselves competing with cellular television networks and bypass fiber optic networks to provide telephone service. The introduction of new satellites (separate systems, former Soviet satellites, domestic and regional satellite systems, plans for Low Earth Orbit satellites) all offer new possibilities for new VSAT networks and pathways that will bypass traditional bureaucratic structures. And these innovations are just the beginning.

In a recent client publication (investment research published by Goldman Sachs and Company in July, 1992 -- "Communacopia: A Digital Communications Bounty")(9), one investment bank has painted the picture of a future broadband digital network involving multiple technologies and services (cable, local telephony, long line carriers, broadcast networks, television stations, satellite transmission, PCs, data networks, PCS, and others) arrayed in increasingly interrelated customized networks. If the experience of competition in the U.S. long distance communications market is any measure, the growing competition among future media companies to provide customized communications services to meet varied user needs will result in substantial price reductions (35% in the U.S.) and service innovations that will create a future business environment that is radically different from that which has been known in the past.

For the host government privatizers of telecoms, this convergence of technology is likely to create both problems and opportunities.

The most significant problems will face those who may wish to rely upon monopoly structures to control traditional communications pathways. A common approach to privatization, often because it is demanded by the international investor, has been to transform state enterprises, or public monopolies, into private ones. Since telecommunications has historically been considered to be a natural monopoly, the approach is understandable(10). But whatever the motivation or strategy for seeking to protect markets, the new possibilities for technology by-pass make it increasingly difficult to protect monopoly structures without undermining the economic growth and efficiency that was being sought in the first place.

On the other hand, for nations that may seek to embrace competition, the technology revolution may offer opportunities as well. First, the move to the new competitive market is likely to be irresistible in any case. Customer demands for modern telecommunications services will force the modernization process forward. Over time, the jobs will move to those nations that can provide access to the global market. There could not be a more powerful stimulus to change.

For those countries that have sought to take advantage of competition (to maximize consumer welfare by obtaining competitive prices and better service) and those who are attempting to use competition to protect their economies from control from abroad, the convergence of technology and the increasingly competitive world that it will create offers new opportunities to gain control.

Most importantly, competition can aid those nations worried about how much to ask for. The answer will ultimately be found in the marketplace. Whether to divest national assets or to retain them in joint venture relationships at any given point in time is a question that can be answered by allowing the marketplace to set the price of divestiture and then analyzing whether optimal value would be obtained by selling or holding onto the enterprise.

Investors in privatization, however, will have some difficulty in hearing that more competition is good for everyone (themselves included). For the investor there is already plenty of uncertainty. The balance of this paper offers several examples of the way in which this interaction between investor and host country is taking place today. The vehicle through which the varied interests may be balanced is to be found in creating an effective regulatory process. The concluding section the paper offers guidelines for host country policy makers to use in considering the new regulatory scheme.

4. A TALE OF TWO COUNTIES: COMPETITION, PROBLEMS AND OPPORTUNITIES

Managed competition must work for both the host country and for the investor if it is to be sustained over time. The issues that are raised in trying to strike such a balance can be seen clearly in two recent examples drawn from consulting experience.

My firm, Putnam, Hayes & Bartlett has been working with the Russian government for nearly two years to assist in the privatization of key industries. In the course of this engagement, we have worked with a Russian joint venture to develop a telecommunications enterprise using Intersputnik satellites. The second example, is drawn from experience counseling a small island nation in the Pacific. This case offers what would seem to be the most remote possible comparison with the issues faced by the Russian Republic. But in fact, both case examples offer a perspective on the dynamics of the coming competitive market.

4.1 Russia, The Case for Regulation

The Russian telecommunications system is most definitely not modern by western standards. Since the Russian Republic's communications needs are so great, Moscow has been the focus of competition among many of the major telecommunications companies. At the time of the coup, there were fewer international communications circuits in existence than might have supplied a small apartment building. To address the need for international communications, multiple projects of every description are now in planning, if not in effect.

Potential investors, however, can plainly see that the uncertainties imposed by the Russian economy's legal and regulatory system and evolving telecommunications infrastructure are such that serious reform is lagging the nation's requirements. Given the expanse of the country's telecommunications needs, it might seem that there would be sufficient reasons for investors to be interested in Russia, almost without regard to the details. Investors, however, are circumspect in the face of competition when they do not receive guarantees that assure them of favored treatment in an uncertain business environment. As long as it is difficult for investors to see that they are acquiring unique facilities, competition will inhibit investment.

But, in Russia, it would be difficult for the government to modify this condition and make investors too comfortable. The uncertainties associated with the transformation of the entire economic system are so great that it would be difficult for the Russians to provide meaningful guarantees of exclusivity even if the government were to wish to do so. Here, property laws are not yet existent, foreign investor law is ambiguous, currency conversion is a problem. The business traditions of the west that rely upon the concept of enterprise, accounting standards and banking relationships are non-existent.

In Russia, since the uncertainty that characterizes the business environment is so great, free ranging competition is a practical reality. But as a result of the fact that the government cannot make assurances of monopoly control, the interim step -- management of competition -- becomes all important. Where it is impossible to guarantee the outcome (e.g.: a non-competitive market), the regulatory process that will govern the rules of the game in the interim becomes all that investors can rely upon.

The Russian case applies to many countries whose future telecommunications systems are uncertain. Even where political institutions may be stable, the evolving application of telecommunications technology is not. Investors have to be shown that regulatory clarity, due process and good faith policy consistency are attributes to be valued even above monopoly franchise guarantees which would be bypassed anyway.

The privatization process in such instances should focus on building a stable regulatory system for it cannot provide other meaningful guarantees. Indeed, in the post-digital age technology change is likely to become so common that, competition in a dependable regulatory environment will become more important as an incentive to investors than dubious promises of monopoly control would ever have been.

The argument that guarantees are all relative and competition is inevitable, however, does not mean that the host country should conclude that anything goes. From the host country's point of view, competition in measured doses will enhance value. Predatory competition, however, will be debilitating and encourage practices and may ultimately corrupt the economy.

The need for managed competition can be seen plainly in Russia; the example of the small island nation essentially demonstrates the same point. The two cases would seem to be as different from one another as could be possible. But both nations face the problem of the need to encourage competition to establish value. In the absence of a market it is difficult to properly value assets that might be transferred. In both cases, the central problem is to create market conditions that are fair to all.

4.2 Establishing Value in the Pacific

The small Pacific island nation sought advice in developing a strategy to guide its telecommunications privatization process. The small telecommunications system in existence today requires dramatic modernization that would seem to depend upon foreign investment. But since the system was small and relatively simple, the argument was made, there could be only one telecom provider. Competition did not seem feasible.

What is more, it seemed possible that with a small, simple system and one provider, regulation would be too expensive and cumbersome to be cost effective. Some argued that the only realistic regulation could come from social pressure rather than legal and economic strictures anyway. In other words, the case was being made by one investor and its allies that the only feasible privatization plan would be to create an unregulated private monopoly

An alternative approach that is readily available to a Pacific Island and to a Russian Federation alike would be to seek to manage competition to obtain the best value. In the modern telecommunications environment, there are numerous potential investors, even for a small system. Encouraging competitors to offer bids (on parts of the telecom system, if not the whole enterprise) provides a mechanism for soliciting comparative perspectives. Bidders might even be asked to propose innovative approaches to building a competitive market over time.

A bidding process could be used to solicit initial investors. But it should be seen as a one-time grand event. Because there will be changes over time it should also be an ongoing procedure subject to periodic review. Future modification is sensible since both the host country and the investor will have to be satisfied that they have obtained the best possible deal and the only way to be certain will be to subject the arrangement to the repeated test of the market.

4.3 Regulating Early and Often

In the case of the small island in the Pacific, as in the case of the Russian Federation, there is a perception on the part of the country that because it is seemingly defenseless in comparison with the well financed representatives of investors that it will have difficulty in understanding their proposals or in knowing what to ask for. The answer in both cases is that the market will provide answers by revealing the prices that the competitors are willing to bid. The solution in both instances is to develop a regulatory process to which the host country is unambiguously committed, that will provide due process and fairness for investors. What is more, the regulations must be written up front.

There are a number of reasons why it is important to write the regulations in the beginning.

- First, designing the regulations first is a recognition of the fact that privatization is a process and not an event. Investors must be able to have a realistic expectation that their returns will be realized, that they are being treated fairly, and that grievances will be given due process consideration.

- Second, the development of regulations is a realistic recognition of the fact that telecommunications systems must balance scarce commodities such as radio spectrum and must meet sometimes conflicting social objectives such as encouraging business development while also providing for social goals such as universal service.

- Third, the regulatory process seeks to establish equity and guides choices that must be made in order to set prices that are a fair balance between consumer value and investor return. Without knowing what will be charged and on what basis the charges will be regulated over time, it is impossible for an investor to accurately asses the value of telecom assets.

But developing regulations will require a series of decisions that are difficult at best -- how should prices be regulated over time? (price caps versus cost based regulation?) How should interconnection costs and network charges be allocated? How should services be packaged? (bundled for the marketplace?) How should rules be established concerning network bypass?

Simply outlining the questions highlights the point that regulation writing requires the development of institutions as well as rules. It is unlikely that in a dynamic sector such as telecommunications that the rules could be written correctly the first time. In the case of Japan, Great Britain and the U.S., telecommunications modernization has been accompanied by changes in industry structure and the creation of institutions needed to regulate the transition. Indeed, as much thought should be given to this process of institutional development as to the rule writing itself. In the end, the rule makers can cost more than the benefits that they produce. Even the best rules should be administered with a light hand.

5. KNOWING WHAT TO ASK FOR: SEVEN GUIDELINES FOR HOST GOVERNMENTS

To summarize, the process of telecom modernization is likely to continue to gather speed. The dynamics of the global market will demand communications access. The technology, in fact, competing technologies, will be available to provide it. Hence, the tool of telecom privatization that has been demonstrated to be a successful vehicle to facilitate international investment and technology development.

The second wave of telecommunications modernization will be different from the first, however, since the experience to date will encourage the critics to press for better deals and, at the same time, technology convergence will facilitate competitive access. Host countries will have to abandon traditional reliance upon monopoly structures and embrace the new competition to satisfy customer demands.

Seven guidelines that outline a path for doing so include the following:

5.1 #1 Embrace Competition

Competition, rather than monopoly, will be the dominant pattern of the telecommunications industry in the next decade because of the technological changes made possible by the digital revolution. Even if there were not economic efficiency and consumer welfare benefits that were conveyed by encouraging competition in the restructured telecommunications industry, the practical competitive reality of the information age suggests that host countries should seek to benefit from it rather than have their plans frustrated by it.

5.2 #2 Regulate Early...

In the telecommunications industry today there are so many competing interests at stake that they will only be balanced through the design and early announcement of the regulatory scheme. The benefits to be obtained by providing relative certainty to investors will outweigh the potential costs. While it may not be necessary to fully design a rate making scheme, nonetheless, when investors are able to calculate their potential stream of earnings they will be able to move more quickly to make commitments to create new ventures.

5.3 #3 ...And Regulate Often...

Realistically, it will be difficult to outline a regulatory scheme at an early stage that will anticipate all possible contingencies. Further, privatization should not be seen as an event but is instead a process(11) that must evolve over time. Thus, the regulatory scheme should anticipate the need for periodic adjustment and fine tuning.

Since there will be no single evaluation of the value of assets or businesses created by the telecom, market structures and institutions that can police the market and establish fairness will be needed. Principles of notice and redress and a concept of due process are essential if everyone, investors and consumers, are to believe that competition will be beneficial to all.

5.4 #4 ...With a Light Hand

Regulations may sometimes cost more than the benefits that they seek to obtain(12). Given the dynamic character of the evolving telecommunications marketplace, there are almost certainly consumer benefits to be obtained by permitting the competitors provide service using a variety of techniques over time. In the U.S. and in Great Britain the objective of encouraging innovation has been addressed through the development of a scheme of "light handed regulation"(13). At the same time, the regulators must balance competitive instinct with some degree of quality regulation to protect against service deterioration resulting from too light a regulatory hand.(14)

5.5 #5 Think Strategically About Implementation Tactics

Above all, the transformation of key industrial sectors and the transfer of significant wealth are highly charged issues and the process of privatization, as the World Bank notes, is likely to be very political. As a result, the multiple steps in the privatization process should be structured strategically to encourage the creation of a commercial entity first and the establishment of institutions that can support the privatization process. The host country should be careful not to permit the creation of enfranchised constituencies that will kill off the reforms before they are born.

5.6 #6 Optimize Long Term System Values, Not Individual Parts

To establish a process that will contribute to the best interests of the host country, value must be seen in the long term. By establishing policy guidelines as suggested above, the long term value of national assets can be analyzed in market terms and the host country is less likely to sell too soon or to hold on too long.

5.7 #7 Knowing What to Ask For: Know what its Worth

Host countries should recognize that the process of privatization and modernization requires a trade-off that balances competing objectives. Obtaining the "best price" means establishing a realistic balance among social and economic objectives and finding the best fit between investors and consumer interests. To know what to ask for requires that the host country meet its obligations first by writing regulations that genuinely express national goals and building institutions that will administer them in a fair and objective manner.

To establish value it will be necessary for investors to know the terms under which the new telecom will be permitted to do business. Without a sense for the regulatory scheme and the process that will be used to administer it, such evaluation will be purely hypothetical, investment will become more volatile and the best of intentions will be frustrated. But with skill, host countries should be able to use the competitive forces of the post-digital revolution world to achieve the most stable balance for the future.

Endnotes:

(1) A recent summary appearing in the Financial Times showed a long list of telecom privatization programs to be "Active" (Hungary, Israel, Panama, Portugal, Singapore, Uruguay) and "Planned" (Brazil, Costa Rica, Czechoslovakia, Honduras, Indonesia, Ireland, Kenya, Nigeria, South Korea, Sudan, Sweden and Taiwan). Recent telecom trade missions to and from Eastern Europe have brought back the news that active consideration of privatization is taking place in every one of the former Soviet Republics and Eastern Block countries. (Financial Times 15 October 92, "Privatisation Programmes: Momentum Remains Strong").

(2) Saunders, Robert J., Jeremy J. Warford and Bjorn Wellenius. 1983. *Telecommunications and Economic Development,* Baltimore Md.:The Johns Hopkins University Press.

(3) The World Bank. "The Welfare Consequences of Selling Public Enterprises" and "Experience and Case Studies". Synthesis of Cases and Policy Summary, June, 1992 by Ahmed Galal, Leroy Jones, Pankaj Tandon and Ingo Vogelsang.

(4) See in particular, William W. Abrose, Paul R. Hennemeyer and Jean-Paul Chapon, "Privatizing Telecommunications Systems: Business Opportunities in Developing Countries", Discussion paper 10, International Finance Corporation, 1990. Bjorn Wellenius, Peter A. Stern, Timothy E. Nulty, and Richard D. Stern, A World Bank Symposium, "Restructuring and Managing the Telecommunications Sector", 1989. Yoshiro Takano, Nippon Telegraph and Telephone Privatization Study: Experience of Japan and Lessons for Developing Countries, World Bank Discussion papers #179, 1992.

(5) George Stalk, Philip Evans and Lawrence E. Shulman "Competing on Capabilities: The New Rules of Corporate Strategy, *Harvard Business Review*, March-April 1992.

(6) Ambrose et. al. IFC Discussion paper #10, p. 12.

(7) See Wellenius et. al., Chapter 1 Timothy E. Nulty, "Emerging Issues in World Telecommunications", and Abrose et. al.

(8) See Abrose et. al., p. 16.

(9) Goldman Sachs, Investment Research, "Communacopia: A Digital Communication Bounty" July, 1992.

(10) Ralph Bradburd, "Privatization of Natural Monopoly Public Enterprises: The Regulation Issue", Policy Research Working Papers, Country Economic Department, The World Bank, April, 1992 WPS 864.

(11) See Nolty Introduction to Takano.

(12) See Bradburd, p. 6.

(13) See George R. Hall, "Regulatory Systems for Postal Rates" in Michael A. Crew and Paul R. Kleindorfer, *Regulation and the Nature of Postal and Delivery Services*, Kluwer Academic Publishers, Boston, 1993, p. 233 for a discussion of indexed regulation with "yardsticks" and "caps". See also, Director General of Telecommunications, 1992, *The Regulation of BT's Prices*. United Kingdom, Office of Telecommunications; London, England; January, 1992.

(14) See Hall Chapter in Crew and Kleindorfer.

MEDICAL APPLICATIONS THROUGH NUMERIS, THE FRENCH ISDN

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ISDN being the revolutionary service which enabled the development of specific applications as the ones we will talk about today in the medical field.

Let us first have a quick look on ISDN to remind the main advantages which will be particularly useful in the health field.

We will then consider what ISDN can offer to an hospital with some examples of practical applications.

ISDN, Integrated Services Digital Network was launched in Brittany on 21 December 1987.

FRANCE TELECOM is the world's first operator to have made the service commercially available. It was opened in PARIS one year later and the national coverage was available in 1990. It was developed in accordance with International standards and today subscribers have access to many foreign ISDN networks which have been interconnected to the French one as AT&T, MCI US Sprint networks in the United States, British TELECOM in UK, Deutsche Bundespost in Germany, RTT in Belgium, KDD in Japan, as well as the ISDNs of Denmark, Switzerland, Singapore, Spain, Sweden, Norway, Italy, Hong-Kong, Australia and the Netherlands.

We expect more than 100,000 people to be using this facility in France before the advent of the Single European Market in 1993.

ISDN: a reality and a major telecommunications innovation which enables voice, data and Image to be transmitted through a single standardized connection at a rate around 10 times faster than over the traditional telephone network.

Everybody knows the simplest installation using a telephone line to connect up to eight different terminals on a series of ISDN sockets.

More important ins the use of ISDN by big organizations. In large offices indeed, individual users are connected to the organisation's PABX which is linked to the PSTN and ISDN network through one or more primary rate interfaces.

In this example, the users are the different directorates using traditional terminals like telephone sets, fax, PCs or also connected to a local area network. It could also be a videoconference unit. For data applications, a direct connection to ISDN can also be configured rather than a switched access through the PABX to minimize the PABX congestion and reduce the points of possible equipment failure.

The big advantage of this configuration is that it can carry more traffic over existing facilities or reduce the number of facility leases required. Indeed, before ISDN, separate groups of trunks had to be dedicated to each required network service. It was not unusual to have separate trunk groups for access to the central office, to the packet switching network, to switched data services etc. With dedicated accesses to many network services, individual trunks are rarely utilized to full capacity. The ISDN approach permits trunks (B channels) to be assigned dynamically on a call by call basis. The capacity of the network automatically changes in real time to meet changes in user demand.

In this example, two hospitals and two offices in town are connected both to the packet switching network and ISDN network.

The doctor in town can call his colleagues in each hospital through ISDN. He can also have access with his PC to the data base of a hospital through the packet switching network, which can be a traditional configuration.

But, in this case, the big advantage is that any terminal, not even individually connected to the packet switching network, can have access to any other terminal, like a PC or a big computer. A PC to PC dialogue for example can take place through the LAN of hospital B then through the ISDN PABX, then ISDN network then PABX of hospital A and other PC. This same PC can also consult the data base in the big computer through the same way.

Without changing the initial configuration with LAN, PABX, connection to packed switching network, ISDN allows general communication through the whole organization.

France Telecom has built its developmental strategy of Numeris using partnerships with data processing service providers and equipment manufacturers in order to develop model applications.

Here are some typical applications available today, which have been used as a basement for the development of ISDN in the medical field.

1) Electronic conferencing, audio or video:

   Today face to face meetings are being replaced by a broad range of electronic alternatives, from three party conference call to full motion video links between two or more sites. Combining voice, video, fax and data access and transmission ISDN makes all these options possible.

2) Distance learning is an effective mean for expert teachers to see and interact with students in remote classrooms, using video facilities.

3) Group 4 Facsimile machines used on ISDN bring new levels of speed, reliability and quality.

4) File transfer applications are more efficient and cost effective. Typical applications are software up dates from a data center to remote locations in real time or image file transfer for photographs, diagrams or other graphics.

5) Document archiving and retrieval: remote users can retrieve actual images of documents from a central storage facility.

6) Image retrieval systems: As far as the health field is concerned, the need for communications between hospitals, doctors offices, pharmacies and laboratories is considerable. Medical files with X-ray, ultrasound and scanner views can be rapidly transferred through ISDN. Many other applications have been developed for the travel agencies, libraries, banks, audiovisual industry, press, advertising.

Call tariffs are the same as those of the ordinary telephone network or slightly more expensive for data or image transmission.

Access tariffs for basic access and primary access are given on the next slide.

Terminals (telephones, terminal adaptors, micro PABX and mini PABX) can be rented at the following rates

1) Let us talk first of the implementation of ISDN in a hospital.

ISDN represents a motorway for the circulation of information inside the hospital. The administration departments, data processing services and medical services are directly involved.

The first major advantage of ISDN in a hospital is its capability to transmit data files. The data processing services usually implement a local area network connecting the different users to the powerful central systems. But internal occasional users cannot be forgotten. ISDN will be a cost effective means to give them access to the medical information they need.

And this, with the simplicity of a telephone connection: during the time of the communication, the user is connected to the central services as any PC of the local area network. When he hangs up, the communication is over and the billing stops.

Moreover, if this user is connected to the PABX of the hospital, a few ISDN links can be enough for many users.

So, ISDN will represent an optimisation of the internal data processing network.

2) But the biggest advantage of ISDN is to open the hospital to the outside world in France and all over the world.

The different applications realized with the help of modems are available but with enhanced power and freedom. As far as data transmission is concerned, the PSTN is indeed the most used support through modems and communicating PC.

So, Data files can be transmitted to an outside user in another hospital or to a remote data processing center. Information can be sent for example to the doctor in town who is usually in charge of the patient.

The outside institutions (social security for example), consultation offices outside the hospital, doctors in town, laboratories, data banks, experts, other hospitals will have the same facilities to get or transmit information, from or to the numerous departments of the hospital, should it be the administration service or the treatment units, technical platforms, data banks, text and images services, consultation offices laboratories.

We could also add all the other actors involved in the health field, such as pharmacies, biologists, and research centers.

While exchanging information on a channel, the partners will also be able to establish a communication at the same time using the second channel of the ISDN access.

And the confidentiality of the transmitted information is always guaranteed through the caller's identification or also through the minimessage which can be used as a password.

As far as the health sector is concerned, the big innovation brought by ISDN is the possibility to transmit a picture, both moving and stationery with maximum reliability, to establish a diagnosis for example. This picture can also be modified by an expert.

Numerous applications have been developed in therapy like pathologic anatomy, emergency services, neurosurgery, radiology, pediatry but also in research and training.

Every picture which can be translated under a data processing protocol can be transmitted.

Today most pictures issued from modern technologies are digital and then can be used directly. If not, a scannerization process will digitize them and allow them to be transmitted through ISDN.

The different sources can be a scanner, a microscope, a video system, nuclear medicine, endoscopy, echography.

Compression can be also used and offers bigger possibilities.

Helping to the establishment of a diagnosis, a data base consultation allows a quasi instantaneous interpretation: 1 second is enough for a graphic picture, 5 seconds are requested for a microscopic view.

A picture with the definition of a scanner will need 40 to 50 seconds. But time is very subjective: the called party using ISDN second channel for the conversation can receive and stock many pictures while the calling party makes its comments.

About the cost, what we can say is that picture can be transmitted for less than one dollar.

The global configuration for image transmission is as follow:

- First: an ISDN connection
- Second: a communication card
- Third: a transfer software on a compatible PC
- Fourth: an application, using in this case a digitization module and a high definition color monitoring

Communication card, transfer software and application are available for about $40,000.

The use is very simple.

Traditional data processing orders are used. A software for the pictures treatment can be added if necessary.

The working position can be a multimedia: pictures coming from different sources can be collected and assembled on the same screen.

Real time remote diagnosis using point to point X ray image transmission is one of the numerous and major applications.

It is now in use in many hospitals in France. An emergency file made of digitalized scanner or X ray images is established and stocked. This file can be transmitted to a specialist of another hospital. The can be discussed by the different doctors, each of them having the whole file. The best decision will be taken: local treatment or transfer of the patient.

On real time or through weekly appointments, these medical cooperation is much on use in France especially in the diagnosis and treatment of cancers.

Another example is the anotomopathology application via ISDN.

The anatomopathology is the establishment of a diagnosis through the microscopic examination of tissues and cells. It requires high level specialists and the quality of the diagnosis is of the highest importance for the patient's future.

Then the confrontation of the different experiences and competence is necessary to reinforce the reliability of the diagnosis.

Till now, the French anatomopathologists (they are around 1000) were used to send daily glass blades by the post.

With ISDN, they can exchange their opinions instantly and feed the common data base. The doctor puts the blade under the microscope connected to a camera. The image is digitized and transmitted to the specialist of the considered organ. With the support a telephonic conversation at the same time, a reliable diagnosis can be established by the two colleagues. If the called party is not free. the image can meanwhile be stocked.

The doctors can also consult the reference base composed of pictures coming from specialists and validated by Scientific Council of the Profession.

This model of cooperation and consultation can be extended to other fields like dermatology, bacteriology, parasitology.

So, results of examinations can be available wherever they are requested; telediognosis can be established, and data banks filled.

In hematology, the equipments are more and more complex and expensive. The first French manufacturer has developed an analyser which allows a multi-dimensional study of the leucocyte population, analysing simultaneously each of them. This function brings a new capacity of leucocytes classification with very high sensibility.

The application developed on ISDN will bring the biologist the possibility of operating this analysis system with a graphic environment of professional and scientific high level.

This continuously updated information and its instant access reinforce the precision and speed of the interpretation.

But this is not the only advantage of this application. A telemaintenance development has been integrated, by linking the laboratories and central maintenance center.

Information coming from the equipments is automatically transmitted. In case of failure in the software for example, the ISDN link will allow a teleloading of a new version with the appropriate connections. In any case, the waiting period has been consequently reduced.

In epidemiology, the centralization of the distant teams works with the use of the high capacity data processing equipments guarantees the synergy of the different studies all over the world.

Should ISDN have been available and used earlier, the American and French teams would have cooperated rather than compete in AIDs research.

Videoconferencing will allow meetings among the staff of different hospitals without trips. It can also be possible to attend a conference without having to go there.

As far as training is concerned, the constant exchanges between practicians is the best mean to improve their competence. Trainees can also consult the available data bases and build their training themselves. The comparison between different cases will help him to interpret.

So distant work is facilitated. Data and pictures can be extracted to build a press article for example or a conference. The image data banks will be a very useful complement to text libraries.

CONCLUSION

The hospital technologies used by the medical profession are more and more performant. The medical structures try at the same time to improve their efficiency and "prestige".

Today data processing is not a management tool only but also offers updated and always available information.

Using the telecommunications, this information can go out of the hospital frame and reach the doctor in town, another hospital, an expert center in order to reach the synergy of competence.

The French ISDN network allows the flow of any information, voice, data, image - forgetting the distances - for a better efficiency of the medical services and at competitive prices.

Convergent Needs, Divergent Technology:
Nursing Education for Rural Practitioners

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1. ABSTRACT

The convergence of telecommunications technology toward integrated systems capable of interactive data, voice and video transmission is primarily an urban phenomenon. For the isolated rural communities of the northwest quadrant of North America, the 'converging technologies' of metropolitan society tend in fact to pose divergent choices among expensive and mutually exclusive technological alternatives of educational delivery systems. Using a technical strategy of the least common denominator, Gonzaga University has implemented a videotape-assisted distance learner program for rural nursing practitioners who frequently are the primary health care providers for remote areas. As digital telephony gradually is extended to rural communities, an infrastructure will emerge that permits upgrading the technological denominator to compressed video.

2. INTRODUCTION

The 'converging technologies' theme of this conference reflects a worldview that presupposes the technical, organizational and financial infrastructure of urban civilization. What usually is meant by converging telecommunications technology is broadband integrated services digital networks or B-ISDN. (Terry, 1992; Eigen, 1990) Nearly all of the professional literature on technical convergence takes for granted the availability of digital telephony and optical fiber networks. However, vast geographical areas are served only by analog systems which cannot support even narrowband ISDN, let alone B-ISDN.

Published articles on rural telecommunications are rare, and even these few sources tend to assume at least narrowband ISDN or satellite infrastructures. (Morris, 1991; Barnes, 1991; Hudson, 1989) The social reality is that even when digital telephony is available, end-users in rural areas lack both the knowledge and the fiscal resources to take advantage of telecommunications. (Irwin, 1990)

When the topic of rural telecommunications is narrowed to delivery of educational services, the dilemma of rural communities is further complicated by a bewildering array of media alternatives. Figure 1 below displays illustrative rather than complete examples of the various delivery approaches of some educational program providers in the Northwest. Access to all of these diverse technologies is well beyond the financial resources of any one rural community.

At the same time, telecommuncations is recognized as a crucial element in economic development and rural re-vitalization (Dillman, 1987) Likewise, extending educational access to rural citizens is well understood as one important dimension of rural development. (Zumeta, 1989) The choice of a delivery system for distance learners is not only a technical decision but also is necessarily a decision as to who will have access to education.

One inescapable consequence of this set of realities is that rural communities are not empowered to make the decisions which influence their destinies. (Burton, 1988) The availability of technical infrastructure is decided by telephone companies whose investment and service policies may or may not take rural needs into account. Further, access to educational opportunity in health fields or other areas is unilaterally decided by public and private institutions who pursue their own agendas and who seldom coordinate their activities with each other.

Though it has been national policy in the United States since the 1940's to extend basic telephone service to all rural areas, policy has not included the emerging ISDN standards of telecommunication. (Parker, 1989) State planning seeks to manage and allocate telecommunications access to tax-supported systems (State of Washington, 1992) but the divergence and proliferation of educational delivery systems continues unabated. It is in this context that strategies for nursing education are chosen.

3. CHOOSING A DELIVERY STRATEGY

There is no single decision rule or set of criteria for educational service providers. Most programs for rural

FIGURE 1
Educational Institutions Serving the Northwest

TECHNOLOGIES	INSTITUTIONS USING
telephone bridge	U. of Wyoming U. of Alaska
videotape	Gonzaga U. U. of Idaho Great Falls College
ITFS microwave	Washington State U. Gonzaga U. Spokane Community Colleges
point to point microwave	Washington State U. Boise State U.-U. of Idaho
CATV	Community Colleges District 81 (K-12)
satellite transmission	Educational Services District 101 U. of British Columbia U. of Victoria Chico State U. National Technical U.
compressed video	Oregon State system Washington State U. (in progress) U. of Washington

areas are designed by public institutions and internal decision processes vary considerably in their assumptions about priorities and institutional mission. It is realism rather than cynicism to suggest that political constituencies and budget competition are significant factors in decision-making by tax-supported institutions as to who will have what technological means of access to which rural education. Moreover, within institutions there can be distinctly different preferences between technicians and educational programmers.

Point to point microwave transmission is preferred by technicians for its superior full-motion video quality. Academic programmers like the two-way interactivity of this approach. Such systems, however, like the Washington Higher Education Telecommunications System (WHETS), are capital intensive. Satellite broadcasting maximizes geographical dispersion of signals, but requires both substantial investment in transmission equipment and high operational costs for satellite transponder time. Satellite technology also is not visually interactive.

The choice of technological strategy in public colleges and universities is complex, involving both internal faculty politics and legislative support. The situation for independent universities is quite different. Like any other private sector entity, the parameters for strategic choice are sharply limited by cost-effectiveness and market response.

Gonzaga University, an independent Jesuit-Catholic institution located in Spokane, Washington, is the only significant player in telecommunications among private higher education providers in the Northwest. Gonzaga's decision to enter the distance learner market was influenced by three factors; a value commitment to serving the under-served, the economic need to bolster revenue for a financially marginal nursing program, and a fortuitous gift of the Burlington-Northern Corporation to finance a television classroom.

This last factor, a benefactor who funded a link with the WHETS system operated by Washington State University to foster engineering education, may be regarded either as chance or as providence. The external funding of a sophisticated television classroom allowed the University the luxury of exploring applications beyond the donor's intent.

Barred from offering nursing courses over the WHETS system by academic turf politics, Gonzaga considered all the technological means for meeting the urgent need for educating rural nursing professionals. Satellite transmission was not cost-effective. CATV options simply could not reach rural communities. An independent point to point microwave system was too costly to be considered seriously. Though Gonzaga subsequently acquired a ITFS license, this means too could not reach rural areas. A telephone bridge was feasible but was rejected for reasons of educational philosophy.

The realities of rural infrastructure precluded ISDN applications. Video digital compression was quite attractive for its interactive capacity, but two factors precluded its use. First, the codec capital cost of establishing a number of regional centers was beyond the fiscal reach of a start-up distance learner program. Second, the reality of so many rural areas in the University's service area having only analog telephony posed what may be called the 'digital curtain.' Communities without digital infrastructure are behind the digital curtain and thus are excluded from ISDN-based delivery systems.

The technical strategy chosen by Gonzaga is best described as the least common denominator principle. Within the fiscal constraints of a private university, the only means of maximizing both rural access and cost-effectiveness was videotape-assisted instruction. The ubiquitous dispersion of VCR's in rural communities made videotape the logical choice for distance learner delivery. Given the digital curtain, VCR/videotape delivery was the only practical means of reaching rural nurse practitioners across the entire American Northwest and Western Canada. Sacrificing interactivity for market penetration potential, Gonzaga launched its distance learner baccalaureate nursing degree program in 1987.

4. CONVERGING NEEDS OF RURAL NURSES

Dramatic changes in nursing practice make more urgent the necessity for an increased number of nurses with advanced preparation in nursing for both urban and rural settings. In rural areas particularly, nurses are often the primary care providers, using consultation when needed. Nurses are responding to changes in client demographics, increasing levels of acuity and complexity of health care needs, changes in health care policy and payment structures, a knowledge explosion with an accompanying short half-life of this knowledge, technological advances, and an ever growing number of alternative delivery models and settings for practice (Chickadonz, 1990; Moccia, 1989; NLN, 1989).

Nurses need a strong theoretical base to deal with complex client needs, a growing number of ethical dilemmas, the legal ramifications of practice, changing professional accountability, changing consumer participation, and the increasing politicalization of health care. Changes in practice demand changes in educational patterns.

Colleges and universities offering baccalaureate and higher degrees in nursing tend to be located in larger urban and metropolitan areas. Yet nurses in rural and small communities are placebound; they cannot leave their family and job obligations for extended periods to attend school. However, those who are placebound must have opportunities to increase their levels of education in order to improve the care and services provided to individuals who live in rural or underserved areas. Distance education is essential.

Students enrolled in the nursing programs offered by Gonzaga University are typical of the nurses who are placebound. Most of students are Caucasian women in their 30s, married with children, and working full-time. Most of those enrolled in the BSN program have graduated from two year associate degree programs, are experienced in nursing (10 or more years), and have aspirations to obtain a graduate degree. The majority of those enrolled in the MSN program hold baccalaureate degrees in nursing but otherwise present a profile similar to the BSN students. All of the students from all programs fund their education through a variety of sources, primarily personal funds and tuition reimbursement provided by employers, with limited federal, state or provincial financial aid.

Nursing students range in age from mid-twenties to early-sixties and have from 1 month to 35 years of nursing experience. They hold positions in acute and extended care agencies, home health agencies, clinics, schools, industry, public health agencies, community colleges, residential treatment centers, developmental disability institutions, physician offices, and the military. Their positions include flight nurse, geriatric nurse practitioner, clinical nurse specialist, director of nursing, surveyor/consultant, patient and/or staff educator, faculty, utilization reviewer, supervisor/nurse manager, and staff nurse. Approximately 5% are men.

Although the percentage fluctuates by semester, currently 56% of the 160 students are distance learners. They reside in 39 communities located in 7 of the United States and 8 communities located in 2 Canadian provinces. Their communities of residence range from small rural to large metropolitan. Over half (58%) of the distance learners live in communities with a population of less than 25,000; 21% are from communities of less than 7500 and 37% from communities of 7500 to 25,000. Another 12% live in communities with a population of 25,000 to 50,000. Only 6% reside in a city with a population of 75,000 or more.

5. PROGRAM DESIGN AND DELIVERY

The Department of Nursing offers two degree programs for registered nurses, the Bachelor of Science in Nursing (BSN) and the Master of Science in Nursing (MSN), and a post-master's certificate program to prepare licensed Family Nurse Practitioners.

All programs are offered both through on-campus and distance learning formats. In some instances, students may complete the program through a combination of the formats or change formats during the course of study. Both formats are designed to minimize disruption in employment through use of nontraditional scheduling. All classes on campus are scheduled to meet once a week, and courses usually taken together are clustered on one or two days to accommodate work schedules and time off. Clinical experiences for many courses are arranged on an individual basis to meet the needs of students and facilities providing experiences.

The distance learning format is offered to nurses living more than 30 miles from Spokane. Distance learners complete the same requirements as on-campus students through a unique blend of distant and on-campus study and experiences. Each semester, the classes are videotaped in a special television classroom while they are in progress. This room is equipped with microphones at student desks as well as the instructor's, special cameras to capture visual aids and all class participants, and good acoustics. The equipment is state-of-the-art to provide high quality tapes.

The primary emphasis is on maintaining a normal classroom atmosphere rather than making a commercial production; broadcast quality video is less important than instructional effectiveness. Within one day of the classes students are sent, via United Parcel Service (UPS), videotapes of the courses in which they are enrolled. In a week to ten days, the tapes are collected by UPS for return to the Department. They are then recycled for subsequent use.

At least three times each semester, distance students spend two days on campus. During these days, they participate in classes with each other and on-campus learners, meet with faculty for advising, register for subsequent courses if needed, utilize the library, and enjoy some fun and relaxation with their colleagues. Dates are designated months in advance to facilitate individual scheduling. If a student is unable to attend at a designated time, arrangements may be made with faculty for an alternative date.

Tests for classes are sent to paid proctors within the students' communities. Faculty adjust deadlines for papers or tests to accommodate the lag-time for the tape system; however, students complete courses within a week of the on-campus students or simultaneously.

When students are not on campus, they call faculty to consult as needed for advising or discussing course or clinical issues. A toll-free telephone number is provided by the University. Students may also call faculty at home. Communiques are sent with each tape along with any handouts that have been distributed. Library services and other campus offices are also available through the toll-free number. In addition, students from mixed geographic areas often establish their own systems to communicate with and assist each other.

Nursing courses and most of the non-nursing courses required by the programs are provided through the distance format. The Chairperson of the Department of Nursing works with the Dean of the School of Professional Studies and other department chairpersons to identify and schedule non-nursing courses to be taught with a video section for distance learners. Undergraduate nursing students must fulfill liberal arts requirements, and the availability of these courses via video must be negotiated with a variety of academic departments. Generally, three or four courses are provided during the course of two successive summer sessions.

All of the Department's nursing courses incorporate seminar components in order to provide a forum for discussion and to assist students in considering the application of concepts in a variety of practice areas. In addition, many courses require group projects to build collaboration skills, increase awareness and use of group dynamics, and enhance communication skills. Special care is taken to ensure student-to-student as well as student-faculty contact and to encourage inquiry and the exchange of ideas.

Assignments are made without regard to geographic location and students are expected to make arrangements as needed. The university library employs two professional librarians to serve distance learners in nursing and other programs. Students are encouraged to establish study and discussion groups, but these are not required and sometimes they are not feasible for people in very isolated areas. Students have proved very resourceful in overcoming distance, however.

Clinical practice components of the courses are arranged by the Gonzaga faculty for both on-campus and distance learning students. Gonzaga faculty assume the responsibility for selecting appropriate sites for the learning experiences and appropriate individuals to serve as adjunct faculty or preceptors. Adjunct faculty and preceptors are closely linked to Gonzaga faculty and are oriented to the course, Department, and University prior to beginning their responsibilities. Gonzaga faculty visit clinical sites periodically to meet with students and agency personnel. A written agreement is signed with all facilities providing clinical experiences.

To the extent possible, students work with adjunct faculty or preceptors and obtain clinical experiences in their local areas or within a geographic area close to their communities (a one way commute within one hour is considered reasonable in the Northwest). However, if needed experiences are not available locally, students travel to other communities. For example, nurses in rural communities may come to Spokane for selected experiences available only in urban areas, while on-campus students may travel to more rural settings to take advantage of the unique experiences they offer.

The distance learning format strengthens the nursing programs and has many advantages, not only for distance learners but for on-campus students as well. The diverse perspectives brought from different regions and types of practice settings challenge all students and faculty to think more critically and globally about issues. The networks established by students in various locations increase the opportunities for clinical practice experiences for all students in the programs and have the potential to decrease isolation in current and future practice.

The videotape format requires a minimum of technical investment by students and the University. It eliminates the need for people in isolated areas to travel to a fixed location at a fixed time on a frequent basis thereby making the programs accessible and realistic for those in sparse population areas. Furthermore, the availability of classes/courses on tape increases the flexibility to meet special needs of students, whether they are enrolled on-campus or in distant locations.

Finally, because of the flexibility of the format, fixed extended campus sites do not need to be maintained. The distance sites are determined by the locations in which students reside. This feature makes the program more accessible, strengthens the mix of students, and enhances the potential to prepare more practitioners for isolated areas. It does, however, require greater effort by faculty to identify and develop clinical sites and adjunct faculty/preceptors as locations shift, higher costs for travel and lodging, complex and costly procedures for processing videotapes for distribution to students, additional faculty time for working with individual students via long distance, and creativity by faculty to blend the academic program needs with the student needs and the format needs.

In summary, registered nurse students, nursing faculty, and University administrators are enthusiastic and committed to the distance learning format even though it is complex and logistically challenging for all who are involved. The faculty and administrators believe the implementation of the distance learning format makes a definite contribution in serving the needs of nurses and consumers of rural health care by providing the opportunity for nurses to obtain a quality education without requiring learners to leave their homes or employment for extended periods.

6. ASSESSING EFFECTIVENESS

Effectiveness has two dimensions; achieving the desired learning outcomes and cost-effectiveness. The Gonzaga distance learner program performs well on each criterion.

The educational effectiveness of the distance video-assisted format is evaluated on two dimensions through comparisons between on-campus and distance learners: grade point averages and retention rates. In both measures, the two groups are comparable. Grade point averages earned in several non-nursing and nursing courses and compared at different time points reveal variations of only 1 to 5 hundredths of a grade point between the groups. The retention rates of the two groups are 79% for on-campus, 77% for distance learners while the overall University rate is 76%.

The cost-effectiveness of videotape-assisted distance instruction is evident. Over the five years since the first BSN program was launched, the department has doubled its number of faculty positions, increased its operating budget and recovered the capital cost of instructional equipment. In this time the ratio of direct costs to return on investment has averaged 1:1.6, a very attractive cost-benefit ratio. The high return to overhead has not only expanded the resources of the Nursing Department, but has financed technical and capital improvements on the University's instructional technology capability.

In fiscal terms, the choice of a low tech option to meet the lowest common denominator of end-users has yielded revenue which has expanded both technical and program delivery options. Other academic programs now use video instruction, including the University's four ITFS channels that were financed by nursing revenues. This points to another, less tangible, benefit; the academic and economic success of distance nursing education has legitimatized both video instruction and distance learning in the eyes of University players who were initially skeptical of the whole idea. As the program has grown, so has the potential for a new generation of programs and technologies.

7. EMERGING ALTERNATIVES

There are two keys to future expansions of video instruction to rural areas. On the the technology side, the 'digital curtain' remains the limit to use of ISDN alternatives. On the fiscal side, the key to both capital investment in ISDN-based equipment and program delivery is an expanded inventory of courses and services beyond nursing education.

Obviously, the capacity of service providers to use either narrowband or broadband ISDN depends on extension of digital telephony and optical fiber to small communities and rural areas. U.S. West, the primary carrier for most of the Northwest, is in the process of extending both throughout the region. Though it is highly doubtful that B-ISDN will be feasible for rural areas within the next two decades, the emerging digital infrastructure is sufficiently well dispersed to support a network of regional centers equipped with codec units for compressed digital video transmissions.

The concept under consideration by Gonzaga is similar to the 'telecottage' strategy now in use in parts of Scandanavia. There, community teleservice centers provide a variety of digital services for small rural communities. (Qvortrup, 1989) Adapted to the health care needs of the Northwest, such regional centers could be established at local hospitals and/or community colleges. Linked to urban-based medical centers and universities, this arrangement would permit multi-user systems to share costs, data, expertise and educational opportunities over a vast geographical area. The establishment of a rural health network is likely to depend on the total aggregrate demand for ISDN services from a wide variety of users beyond health and education. (Sawhney, 1992)

Rural hospitals in the Northwest are already forming interactive data networks. The addition of compressed video transmission is technically easy; the barriers are capital costs of codec equipment and formation of cooperative relationships among diverse health services providers. Clearly, the coalition-building is a necessary precondition for cost-sharing. No one provider has the resources to build a regional video interface system. Even so, the private sector of health care has sufficient resources to build a rural health network even if governments continue to assign low priority to rural health care needs. Initial conversations suggest that the converging health care needs of rural areas can be a viable base for regional cooperation.

If a small army of diverse and independent health service providers can overcome their isolation and develop a common agenda, rural health centers can become a reality. This will happen only if social and organizational convergence is encouraged that can take advantage of converging technologies.

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MULTIMEDIA BROADBAND COMMUNICATIONS
HEALTH CARE APPLICATIONS

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Abstract

This paper will describe Multimedia Broadband Communications (MBC) and its potential impact on the health care industry in the United States. It will address the technical/operational aspects of the system, the health care crisis, the market and a NYNEX trial implementation in Boston, Massachusetts, USA.

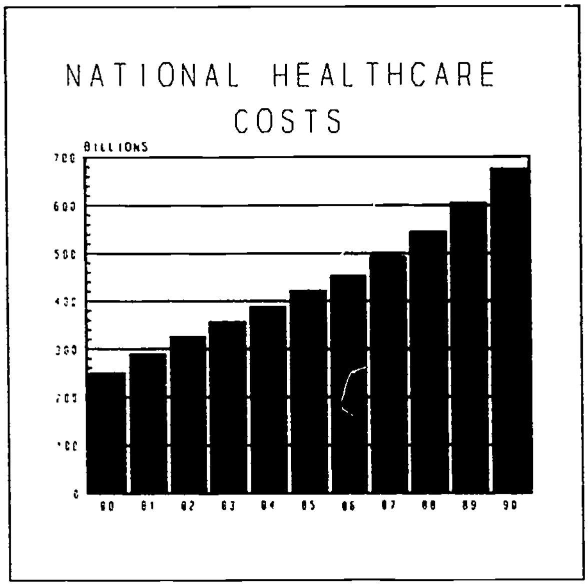
1.0 MultiMedia Broadband Communications

Multimedia Broadband Communications (MBC) is the generic term that we use to describe an emerging concept in multimedia communications. This concept envisions communications systems that are designed to provide an environment that supports multi-user, session-based exchange of high-resolution images, as well as graphics, audio, video, text and data. The sessions permit fully interactive communication between participants and information sources based at separate locations.

MBC provides the transport and networking capabilities to surmount the challenges now present in data transport and interactive collaboration. MBC enables session-based display and manipulation of images, graphics, text and data. MBC also supports resource servers that maximize utility of commonly used general services. The file server provides an efficient and centralized multimedia database available to users for data storage and retrieval at network speeds. The mail server provides a multimedia mail service capable of forwarding, storing, delivering and tracking multimedia messages. The directory service provides a text based or multimedia based catalogue of all users, resources, servers and facilities available throughout the network.

The use of images has increased dramatically as evidenced by the increasing use of CAD/CAM, fax machines, VCRs, desktop publishing, multimedia presentations, image viewing/manipulating, multimedia applications, computer-based instruction, and medical picture archive control systems (PACS). Many industries now heavily rely on the electronic exchange and manipulation of visual information, which most of the time is combined with other data types to form mixed-media data sets. There are two major problems that hinder the proliferation of such technology. One is the difficulty in transporting, in a timely manner, the massive amounts of data associated with high-quality images. The second problem is establishing an environment which allows interactive communications within which to review and manipulate the images and data being transported.

Media Broadband Services (MBS) is an example of Multimedia Broadband Communications (MBC). NYNEX Science and Technology Inc. is developing MBS as a network-based multimedia communications system. One of its applications is in the health care field is discussed later in the paper.



Graph 1

2.0 Health Care Crisis

The cost of health care in the U.S. is growing astronomically. The total health care cost for 1990 was $650 billion dollars as compared to $604 billion in 1989. As Graph #1 indicates, the increases in health care cost in recent years have been tremendous.

As a percentage of Gross National Product (GNP), health care continues to increase with no end in sight. Budget Director Richard Darman forecasts that health care costs will be 17% of GNP by the year 2000. Currently health care costs are 12.2 % of the GNP. [1] Graph #2 shows how this percentage has changed from 5.9% of GNP in 1965 to the current amount of 12.2%.

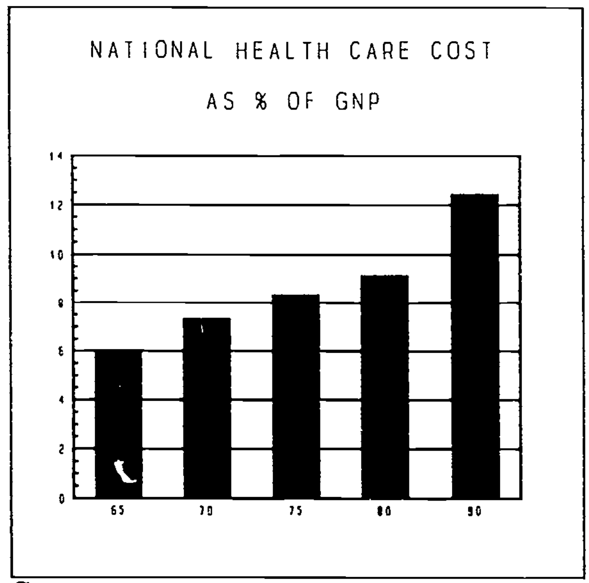
Health insurance costs per employee will have increased by more than five times by the year 2000. In a recent survey by Fortune magazine, 63% of the CEOs polled stated that skyrocketing medical costs was one of the biggest problems confronting them. Most expect annual increases in medical costs of 11% to 15% over the next 5 years. [2]

There are various factors that contribute to the current health care crisis. One of these factors is the growing number of malpractice suits. A recent survey by the American College of Surgeons indicates that 40% of its members had stopped accepting high risk cases in consultation. In addition, 28% of its members were not performing certain procedures because of the high risk of malpractice suits.

It is estimated that doctors pay over $5 billion per year for malpractice insurance. Further, there is the related cost of defensive medicine. This cost is estimated by the American Medical Association as being $15 billion a year. [3]

A recent study by A.D. Little, "Can Telecommunications Help Solve America's Health Care Problems", states that more than $36 billion can be saved annually by the wide spread use of telecommunications applications in the health care field. [4]

MBC services can be a tool to control and lower this liability. MBC would allow for faster access to records, tests, and other information. It would allow for faster consultation and diagnosis with various specialist. These features could help address this problem by making information readily available in a consistent and timely fashion.



Graph 2

3.0 Health Care Applications

This application segment exhibits a high degree of dependability on high quality images [X-rays, computed tomography (CT scans), magnetic resonance imaging (MRI), sonograms]. Currently most of this market segment's needs are being met through hard copies and utilization of Local Area Networks (LANs). Inefficiency can result from the great distances between locations where the images are taken, developed, stored and finally reviewed. One of the present constraints is the cost of reproduction and distribution of multiple copies of these records. As a result there usually is only one copy of the examination images. This sometimes means that a doctor may not be able to get a patient's record because it has been already taken out or it has been misfiled.

MBC offers the opportunity to move away from hardcopy to electronic images, thereby easing the current burden of archival and transport of physical images. Perhaps even more significant, MBC allows specialists to still work together even when physically at separate locations. Specialists can confer between workstations with full visual and audio communication. MBC enables the transport, storage, and viewing of patient information (images, audio, video, text) by multiple users, in multiple locations. The session feature lets different doctors and specialists, from different locations, share a patient's information, as well as exchange ideas, at the same time. Multimedia messages can be left with other people for future consultation. This will allow doctors and specialist to work together to a degree never before possible. MBC allows remote viewing of medical imaging studies from home or office rather than just the location at which the study originates. Doctors would no longer need to be on site to provide a diagnosis for an imaging examination. Physical distance will no longer be a constraint in the ability to fully utilize a specialist's expertise.

Better utilization of sophisticated imaging equipment and specialists can be obtained through use of MBC. For example, hospitals with sophisticated imaging equipment can not offer some specialized services because specialized personnel are not available to interpret studies produced on that equipment. Hospitals with specialists but without a particular piece of specialized equipment can make use of equipment at another location. MBC allows specialists at remote locations to review the studies and return diagnoses as if they were locally available.

MBC and other medical imaging systems will facilitate enormous costs savings. For example, there will be savings as a result of the reduction of real estate needed for storage of records. There will be savings in costs associated with film and chemicals that will no longer be needed. There will also be a savings as a result of the reduction in the high rate of displaced records. The time lost because of misplaced or lost files is currently a very significant problem.

The commercial benefits of MBC are potentially vast. The ability to access broadband transport without setting up private lines, and the use of sessioning as a means to conduct communication that had previously required the movement of people or hardcopy images, allows the development of new classes of multi-user, multi-site applications. Whole new classes of visually based information providers will have the opportunity to provide the multimedia equivalent of existing text-based on-line services. For example, the management of images is a new but rapidly growing market. Current technology allows a 12-inch optical disk to store up to 6.5 Gbytes of data. This is approximately 118,000 documents. These optical disks can be stored individually or in storage devices referred to as jukeboxes. These jukeboxes can store up to 190 Gbytes of data. Some projections for the imaging market indicate that this will be an area that will push the evolution of the telecommunications infrastructure toward fiber and broadband. In 1990, there were total imaging revenues of $3.58 billion, and it is projected that by 1995 this figure will be $8.14 billion. [5]

There is a large unmet customer demand for MBC. Health care providers need interactive sessioning, multimedia communications that can enable them to lower costs and improve the delivery of health care services.

4.0 Technical/Operational Feasibility

MBC design considerations are geared toward obtaining the maximum flexibility in terms of hardware platforms, software architecture and open interfaces. It is the goal of MBC to provide a real-time multimedia communication system capable of handling high-resolution images as well as graphics, video, audio, text and data records. The need for such a system is continually growing, as evidenced by a number of trends in industrial and commercial sectors.

In order to meet the demands of the marketplace, MBC is envisioned to achieve its goals by providing the following key features:

Broadband Transport: By making use of the existing telephone company fiber networks, MBC can deliver inter-node service at a rate of 45 Mb/s or greater.

Sessioning Environment: The network software provides a session-based communication environment in which users can share, display and manipulate data. Uses of such an environment can be as simple as a common window and pointer (allowing users at separate workstations to enter into a multimedia conference to simultaneously view, point at and modify objects within a common window). A more sophisticated transport environment within which data can be transmitted between end points without any special user setup or control of transport links is possible.

4.1 Hardware

MBC can utilize high speed broadband optical transport, with a minimum rate of transmission of 45 Mb/s and higher. Intelligent network software is utilized to manage the session environment. MBC can access resource servers that will enable users to effectively and efficiently utilize databases and applications that are commonly accessed.

4.2 Software

MBC software is divided into four functional layers. Each layer provides a service that is dependent on the layers below it. As such, the network services are at the lowest layers, and the user/application services are at the highest layers.

The **application layer** is entirely customer dependent. Functionality at this level depends on specific customer needs. Customer-designed applications, running on application-server workstations and application-client (i.e., user) workstations, provide the specialized functionality required by users at this level.

The **system layer** is the major point of interface between the application layer and the network. A system service interface (SSI) provides a bridge between commands received from the applications layer (to perform transactions for users) and commands executed on the network level. The SSI provides a library of function calls, or macros, that present application developers with an open interface to network services.

The **network layer** is responsible for the establishment of all sessions and for the maintenance of all on-going sessions. The functions at this level are varied, including: maintenance of all routing and user parameters; establishment and tear-down of session connections; coordination of transport of data to session participants; maintenance of network integrity; and tracking and reporting of usage.

The **transport layer** is not a software layer per se. but significant network resources are devoted to transport management to ensure timely and efficient network connections. The transport manager software is responsible for establishing broadband connections between local networks.

4.3 Software Facilities

MBC provides a variety of software facilities, each of which provides a unique capability to the network:

Network Server: this facility allows for the transport, delivery and presentation of multimedia information in a controlled environment known as a session.

File Server: this facility allows for maintenance of multimedia data, stored on various databases (i.e, separate databases for voice, images, text, etc.) under the control of a single server.

Mail Server: This facility provides a multimedia store and forward message system capable of receiving, storing, sending and tracking mail comprised of multimedia envelopes and associated multimedia contents.

Directory Server: This facility provides a local or network-wide listing of all accessible entities including users (both real and virtual), servers (network and local application), and other resources (e.g. available peripherals).

Application Servers: These servers, specialized by function, provide specific application capabilities for end users. Their functionality is entirely under the control of individual application developers, with the requirement that they interface to the MBC System Service Interface (SSI).

4.4 Open Interfaces

By providing an open and flexible interface to a networked sessioning capability, existing applications can be modified and new applications designed to run in a multi-user, multi-session environment. This scheme allows users to have access to applications that they would otherwise have to acquire independently. It also allows many users to interact with an application as a group, rather than accessing and using the application individually. Applications can be designed and developed as dictated by user needs, not by arbitrary criteria imposed by the network.

5.0 NYNEX Science & Technology Media Broadband Service (MBS) Health Care Applications Trial, Boston, Massachusetts

The trial implementation of MBS began in December, 1990 in Boston with five strategic customers: Brigham & Women's Hospital, Children's Hospital. Massachusetts

General Hospital, New England Medical Center, and Christian Science Publishing Society.

Each customer location is equipped with a processor, local transport and multiple CPE workstations. The following sections describe the configuration and applications deployed at the NYNEX Customer Development Center (CDC) and each customer location.

5.1 Customer Development Center (CDC)

The CDC is used as the communications hub for the various network nodes located at each customer's site. It is equipped with an processor, broadband switch, and fiber-optic links. The processor is responsible for coordinating inter-node traffic and for establishing and maintaining inter-node sessions. New England Telephone has supplied fiber-optic cable to link the various nodes with the CDC, and provides T1 and/or T3 capacity links to those nodes.

5.2 Brigham & Women's Hospital

Brigham & Women's Hospital (B&W) uses MBS primarily for teleradiology applications. With various SUN workstations located throughout the institution on an Ethernet LAN, radiologists, physicians and surgeons are able to simultaneously review magnetic resonance imaging (MRI) and computed tomography (CT) images. Additional workstations are located in the homes of specialists who are able to review images and consult with on-site personnel on an on-demand basis, greatly reducing the time involved in responding to emergency situations. The ability to conduct teleradiology through the MBS network benefits clinical diagnosis and treatment, it also enhances the research capabilities of the institution by facilitating the increased flow of information between departments.

5.3 Children's Hospital

The Children's Hospital of Boston (TCH) uses MBS in two ways. First, the service is used to enhance in-house operations by taking advantage of MBS's ability to transport multimedia objects and provide multi-user sessioning. Additionally, the service allows properly equipped professionals from remote locations to consult with TCH specialists. On site, TCH makes use of its existing FDDI LAN and integrates a local processor with various DEC workstations.

These MBS applications have enhanced patient care, streamlined routine procedures, provides easy and immediate access to on-line multimedia information, and saves valuable time by allowing for virtually immediate consultation on a patient's diagnosis and treatment.

5.4 Massachusetts General Hospital

Massachusetts General Hospital (MGH) has a variety of facilities spread out throughout the greater Boston area. MBS is used to link the existing fiber optic LANS and Macintosh workstations at the various locations into a cohesive MBS network. Applications take advantage of the broadband transport and sessioning capabilities of MBS, thereby integrating the individual sites into a more immediately accessible unified structure.

MBS applications allows MGH to improve the immediacy and quality of care that it provides; they also allow MGH to provide services to other health care institutions, maximizing efficiency and resources.

5.5 New England Medical Center

New England Medical Center (NEMC) has integrated MBS network service into its existing Fiber Distributed Data Interface (FDDI) LAN. DEC workstations are used for a telecardiology application allowing for both remote private viewing and multi-user collaborative viewing of full-motion video images of catheterization of a patient's heart or blood vessels. When conducted within a multi-user session, this application allows physicians at remote locations to simultaneously view a video loop while having access to a common pointer, useful in isolating or describing a particular part of the video.

This application allows technicians to present studies to specialists moments after they are generated, allowing those speciallists to determine diagnosis and treatment immediately. In emergency conditions, the time saved by

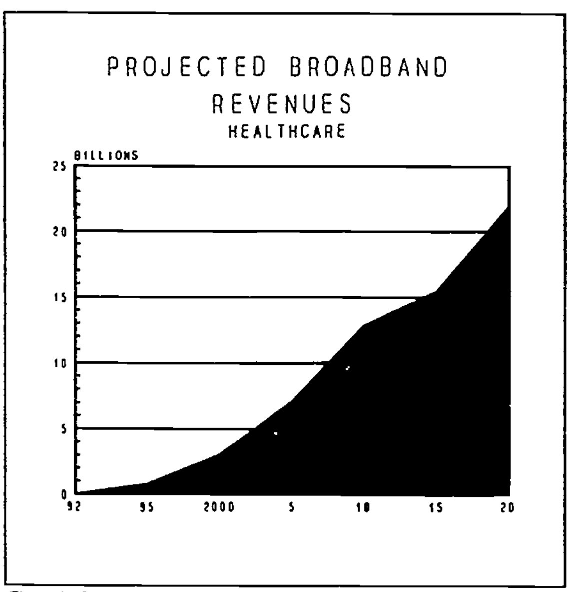
50.

this application can mean the difference between life and death; in non-emergency cases, this application can significantly reduce costs and time. For example, if a specialist has access to a study while a patient is still "on the table," the specialist can order additional studies to be conducted upon the patient immediately, rather than on a subsequent visit. MBS allows for both better quality health care and significant costs savings.

6.0 Conclusion

The health care crisis is one of the top concerns in the U.S. today. Current health care costs are $650 billion and are expected to continue to grow at a rate of 10% to 15% per year. Widespread use of MBC in the delivery and management of health care will result in significant costs savings and improve the delivery of health care.

Specific areas that can be targeted include costs caused by: defensive medicine ($15 billion), paperwork inefficiency ($75 billion), inappropriate treatment ($ 98 billion) and malpractice insurance ($ 5 billion). [6] Potential MBC revenues can be estimate to reach $2.97 billion by the year 2000. (See Graph #3)



Graph 3

Multimedia Broadband Communications envisions providing customers with the following service capabilities: establishment of multiple, multi-user sessions; addition of users to an existing session; removal of individual users from a session; ability to define, share, and update multimedia objects within a session; submission and receipt of multimedia objects to a file server; display of session status; and, control of dialogue (by voice and/or cursor).

MBC types of services will continue to grow and its deployment will accelerate. MBC will become a significant factor in helping the health care industry to reduce the cost of providing health care, as well as further raise the quality of this service.

Lastly, MBC services will be a significant force in creating the critical mass needed to accelerate the evolution toward the information/telecommunication infrastructure needed for the 21 Century.

January 19, 1993
White Plains, New York
U.S.A.

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NETWORK MANAGEMENT TECHNOLOGY

A PARADIGM FOR FUTURE ENTERPRISE CONTROL

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1. ABSTRACT

The new tools for integrated network management have the potential for radically altering the relationship between the lay manager and the specialists responsible for the maintenance of the organization's technical health. This paper addresses the new possibilities afforded by this technology which has been made far more user friendly than was heretofore possible. Detailed visibility into the inner workings of the most complex systems in a manner which greatly extends the control managers can exercise over the most complex of environments. The result facilitates the intelligent conduct of affairs across a variety of disciplines including transportation, information technologies, medicine and process control.

2. INTRODUCTION

The explosive growth in information technology and telecommunications is by now a familiar feature of the landscape.

As the size, variety, complexity and geographic scope of services grow, the networks needed to support them become increasingly intricate and diverse. Also, because of deregulation the user, whatever the degree of sophistication, is confronted with a plethora of dissimilar equipment and services. These must be assembled to provide the individualized array of services that are increasingly necessary to compete in the global marketplace. Such services have become crucial if business units are to maintain and enhance a competitive position (1).

To manage and control the networks made up of this grab-bag of technological wizardry, a sophisticated set of network management tools is required. These must be designed to provide the means of extending user and/or operator control to the furthest reaches of the network.

The network management environment has evolved with and reflected the telecommunications industry for the past 100 years. While these networks were the domain of either monopoly providers or PTT's the tools were designed for the network specialist. The major objective was to increase the productivity associated with repetitive processes needed to manage large networks providing a limited range of services in bulk.

As users started to break free from the confines of monopoly provided services, bulk leases of facilities were combined with procurement of arrays of elements to permit their more efficient and flexible use. Initial network management systems, some of great sophistication, have been and are provided by element manufacturers as adjuncts to their productsets. Numerous examples of these systems can be found. Many modem manufacturers, T-1 and other multiplexer manufacturers, transmission, computer and other equipment and software providers offer vertically integrated management systems designed primarily to control that part of the network they provide. Often these systems are advertised as the answer for integrated network management. Accommodation for other vendors is usually offered by either specialized software or, more recently, adherence to standards as these evolve, permitting interface to systems also designed to meet them.

The most effective integrated network management systems combine standards compliance with a set of tools facilitating the interface of a wide range of "legacy" systems. Both capabilities are combined into a composite whole that can then be managed. The ALLINK™ Operations Coordinator is an example of such a system (2). It combines many techniques for interface, decision making and display into a powerful system for controlling diverse networks. These play an increasingly important role in delivering the diversity of services necessary to running a modern business.

The premise of this paper is that these systems, resulting from the need to manage these complex diverse networks, have themselves provided a new paradigm for system operation and control across a wide range of disciplines. In answering the need for managing the diverse specialized systems used to assemble today's networks, the mechanism now exists by which the most complex of environments can be presented in a way permitting surveillance and operation by the non specialist.

Although the means of control are correspondingly easy to invoke, the desirability of allowing their use is much more in question. The example of armchair generals attempting to control the battlefield remotely comes to mind. Second guessing based on monitoring is one thing; active control of crucial situations is another.

Nevertheless, the translation of complex technical status details to decision makers in one of many (or many simultaneous) easily understood natural language formats, accompanied by well designed graphics interfaces may be considered revolutionary. With proper use of the tools provided, it now becomes possible to tailor the information derived from operations to meet the needs of a wide range of general management preferences.

3. THE INTEGRATED NETWORK MAN_.GEMENT TOOLSET

Recent technological innovations have introduced powerful set of technology to an ever wider range of applications. Display and computational power, once thought only applicable to large systems (such as those serving the military and largest corporations), is now available at a price range where sales for these systems number in the tens of thousands.

This same technology has made possible (and economically feasible) the development of a wide range of network (and by extension, enterprise) management systems. The building blocks of these systems are strung together in a distributed environment of unprecedented power allowing virtually unlimited expansion of function and capacity.

Figure 1 depicts the major components of an enterprise management system and their relationships. The ALLINK Operations Coordinator developed by NYNEX is assembled from major subsystems in exact correspondence to those shown.

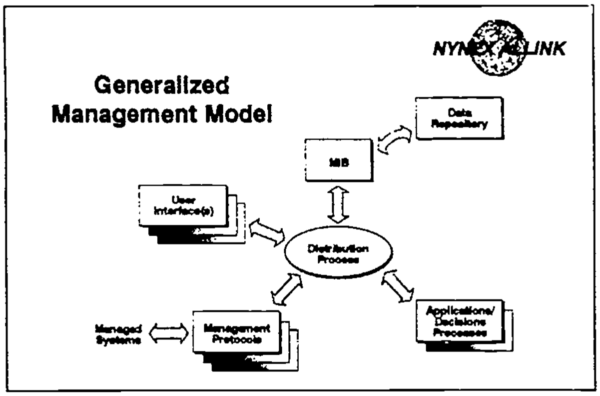

Figure 1: Components of an Enterprise Management System

3.1 THE MANAGEMENT INFORMATION BASE AND REPOSITORY

The effective assembly of data with efficient timely access is a precondition for the effective management and control of enterprise operation. By way of example, the ALLINK Management Information Base is constructed using a commercially available relational data base with a basic toolset built on a database 4GL forms package. In addition to providing the requisite data for operation, the schema is such as to permit the use of the management information base as a complete data repository. Provision is made for a wealth of data concerning network objects, to be determined at the discretion of the user. Vendor, contract and other data can all be stored in addition to the data elements requir l for real time operation.

Static data derived from the repository along with dynamic data uniquely associated with network object instantiations form the Management Information Base used in on line operation. The MIB static data derives from the object class and subclass as well as relationship data with respect to other network objects. Completion of the MIB requires the addition of status and alarm data derived through the surveillance capability of the AOC.

Constant interaction with the MIB is required to provide the ongoing basis for real time operation The function of the repository is as an accessible storehouse of more permanent data. These functions, combined within a single functional entity using suitable tools (eg. relational data base technology), add considerable power to enterprise operation. Proper use of these concepts and tools can provide system data, both static and real-time variable, in coherent tailored format. As a result, enterprise managers now have the means for unprecedented real time surveillance and control. These systems are just beginning to be procured and installed. The important work of deciding how to structure and use the capabilities now available has barely begun.

3.2 MANAGEMENT PROTOCOLS

The enterprise manager must use telecommunications facilities as the means of interacting with controlled entities and their agents. Recently much attention has been paid to accommodating a series of standard protocol stacks such as SNMP, CMIS/CMIP and the like. These ride on top of a plethora of standard transport protocols.

The wide diversity of interfaces necessary to accommodate the typical heterogeneous enterprise management environment make attention to this aspect of the process important. Within ALLINK we have found that the provision of a powerful set of tools for message translation and parsing accommodates both the standards and legacy based interfaces which must be handled for most applications.

The many types of incoming messages are converted into a common language used for interprocess communications using these tools. Although it may be modeled on OSI NMF message structures, the interprocess format generally requires an extensive superset of the message types defined by the standards community. Additional functions and data are required to support a more complete application set and handle internal system functions.

3.3 DISTRIBUTION PROCESS

The distribution process is the glue that holds the fabric of the AOC together. A client-server architecture allows the major system modules to exist over multiple platforms or within a single workstation depending on the needs of the network. Workstations and servers may be remotely connected using wide area facilities bridging the LAN's used within each site that support local connectivity. The result is complete flexibility to accommodate expanding function and volume.

The flexibility afforded by these modern networking tools allows information to be disseminated to anyone in the user organization. Secure domains of responsibility may be established in conjunction with a security structure which can define functions by individual, position or domain. It therefore becomes possible to tailor a profile of interaction to the level of management or operations personnel using the system.

3.4 APPLICATIONS & DECISION PROCESSES

To add value to the raw incoming data from the managed objects, their agents or element management systems, the enterprise manager invokes a series of applications. These can take the form of simple data interpretation or may be rather elaborate analyses of performance, multiple alarm correlation, automated actions and the like. Within the AOC, for example, processes are in the form of tailored rulesets which are implemented by the network administrator. These are implemented using artificial intelligence techniques provided as a part of the system (3). Within this framework are also available such applications as problem management and configuration management.

This processing region can also provide the ability to tailor data for a wide variety of interests. The same set of raw data can result in a number of individualized messages for different user requirements. By intelligent use of this capability, the network management platform and tools become the basis for true enterprise management serving any number of disparate entities within the organization.

Some examples of the potential general application of these platforms include inter alia

Generalized Status Monitoring: The basic functions of network status monitoring are easily accommodated to the more general case of status, maintenance and repair of plant and equipment serving an entire organization. There are no limitations on the definition of objects for inclusion within the MIB. Moreover, in addition to management protocol input, events may be generated against any defined object manually by the system operator. When configured using the sophisticated rule set available, the logical extension to any complex activity becomes apparent.

Incident Correlation: Data accumulated both through management protocol interfaces and through manual entry may be used to seek patterns of incidents not obviously correlated but which in fact may have related causality. The expert systems capability such as that provided within the AOC when coupled with the power of relational data base access to accumulated data provides the basis for sophisticated analysis in near real time.

Trend Analysis: Performance data accumulation along with input of relevant business data can be analyzed for significant trends. Again, while this has always been possible using the disparate systems of the past, the systems designed specifically for the enterprise network management environment have integrated these general capabilities to an extent not previously imagined. The tools thus having been brought into an integrated framework, take on the capability of serving the much larger and diverse objectives of major organizations.

Beyond the ability to provide a series of interesting applications, a major capability of sophisticated decision processing is the ability to synthesize natural language output as a result of intelligent operation on incoming data. Referring to Figure 2, the decision process accumulates the now standardized messages in conjunction with data from the MIB (relationships, object operational and property data and the rules for processing) to produce output tailored to varying specific needs of the organization.

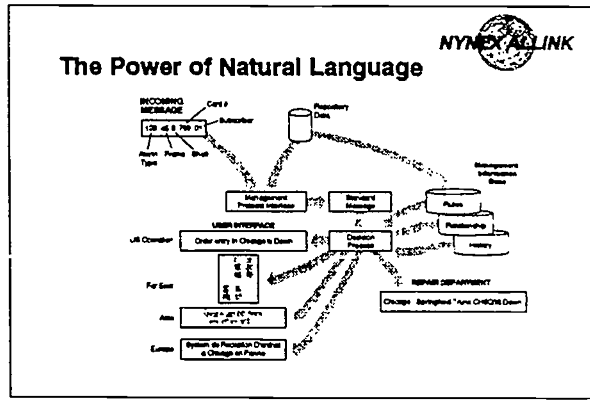

Figure 2: Intelligent Decision Processing

The example shown converts a specific equipment alarm received from a managed network into a series of messages for different users of the system. The alarm emanating from the element manager is processed based on the relationships between the specific equipment cited and other network objects. In the example shown the alarm signal is interpreted as having resulted from a trunk having failed despite the fact that the received message was actually an equipment failure indication. This deduced information is presented to the repair depot or network operator as the message shown, indicating a problem in the Chicago to Springfield trunk.

The impact of this failure on other managers is quite different. For the executive concerned with business operational status, the significant issue may be that order entry processing has stopped in Chicago as a result of the failure. The response of the business executive to this situation will generally be different than that of the network operator.

While the operator's emphasis is naturally directed toward bringing the Chicago facility back on line, the response of the business executive may be to reroute the business rather than rely on network repair. Capacity in other parts of the organization to handle the business function rather than any technological consideration may determine this.

To further emphasize some of the new flexibility we can soon anticipate, this same business message is shown appearing in several languages corresponding to the various divisions worldwide which may have need to view the data. Although still somewhat difficult to accomplish, the trend toward standard environments for graphic user interface encourages provision of more and more capability in this regard.

3.5 USER INTERFACE

The power of the new user interfaces cannot be over emphasized. In particular the addition of graphics to the user/system interface has irrevocably changed the way in which we interact with these systems. By properly tailoring views, navigation and presentation it is now possible to present the most complex data in a form usable by reasonably intelligent managers who are otherwise untrained in technology.

Some indication of the facilities available with which to accomplish this, are exemplified by those provided by the AOC. These include inter alia

Scanned or standard coded backgrounds

Scanned or drawn icons to represent network objects

Use of view objects as well as network objects to navigate and retrieve data. The icons representing both may be chosen at will or synthesized by the system administrator

The ability to represent an object or a view in multiple views

The ability to construct multiple view trees, parsing the enterprise simultaneously in accordance with different organizational needs

Multiple navigational capabilities including through views, previous reference, by view name, by object reference and by shortcut to the top of each view tree

These facilities and their future extensions provide a range of new possibilities for system administrators. Figure 3 shows an example of the methods used to display status and bring data and control capability to the network operator. The display indicates objects and their relationship to other objects through a connectivity diagram. A good deal of flexibility is provided in that objects may be depicted or not, labels may be affixed (either horizontal or vertical) or not and lines may or may not be shown. Choice of representation for an object is completely arbitrary as is the background for each view against which the objects and their relationships are shown.

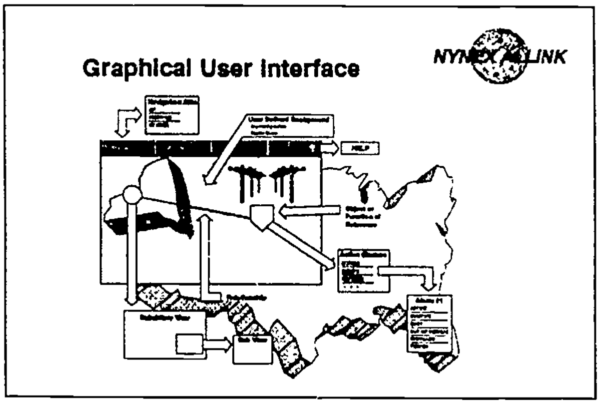

Figure 3: Operator Intersections for Enterprise Management

Menus of available data and actions are tied to objects defined within the MIB. It is thus possible to access any array of data for presentation this way. Virtually unlimited possibilities for active process control are thus afforded.

4. THE ALLINK OPERATIONS COORDINATOR EXAMPLE

The AOC incorporates many of these ideas. The aim is to make operation of the system as intuitive as possible. This will become evident in what follows.

A typical AOC configuration is as shown in Figure 4. The functions of analysis and decision making, management protocol handling and management information base processing are arranged in a client-server configuration serving a number of operator positions as clients. While a good deal could be said about the common server elements, of main interest for furthering the premise of this paper is the Network Operations Center that interfaces with the network operator user directly.

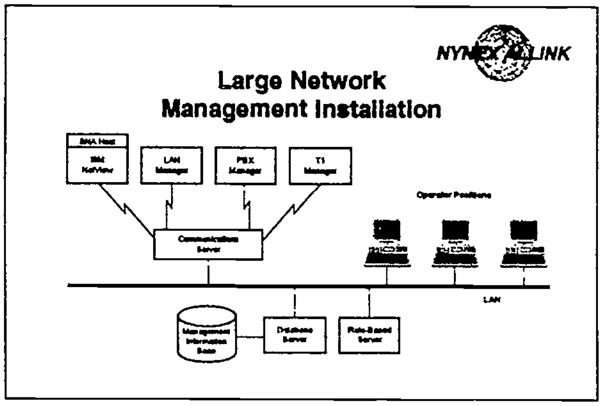

Figure 4: Large Network Management Installation

Figure 5 shows a typical display. Arrayed on the screen in quadrants are network views, a table of reported alarms, and a screen of object details. This was obtained via a pull down menu as shown. Each of the panels has stacking capability so that many layers of data can be rapidly recalled. The tiled approach shown as opposed to the more common "busy desk" overlapping arrangement has proved simpler for the operator.

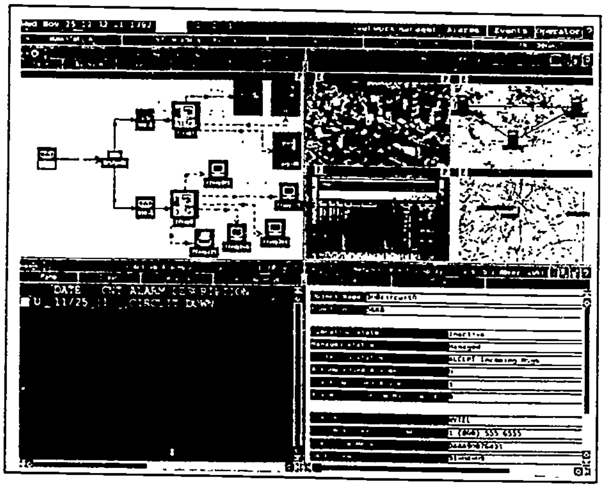

Figure 5: Typical Network Management Display

Figure 6 shows the same network view expanded to cover the full screen. This is useful for passive monitoring and often one user position is devoted to a full screen display for projection.

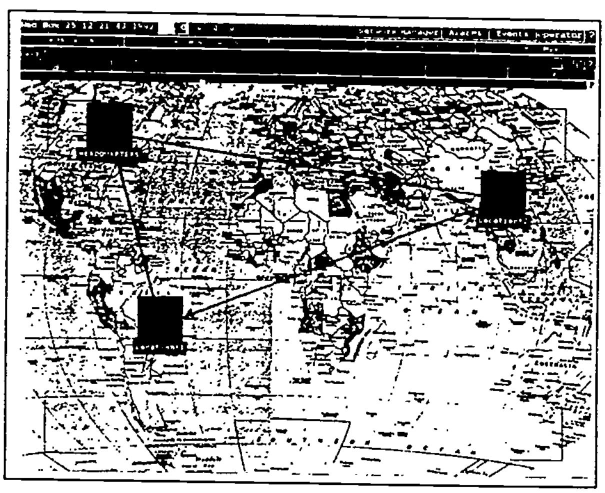

Figure 6: Full Screen World Network View

Figure 7 expands the alarm screen, showing a change in format and also displaying an example of the context sensitive help available in each pane. Additional information about network objects (text, graphic and audio) as well as specific suggestions to handle problems are also available. Figure 8 shows one of the typical problem management panes active.

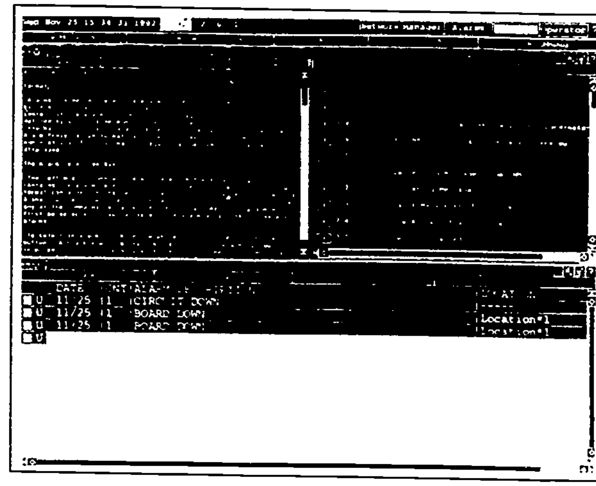

Figure 7: Alarm Screen and Contact Sensitive Help

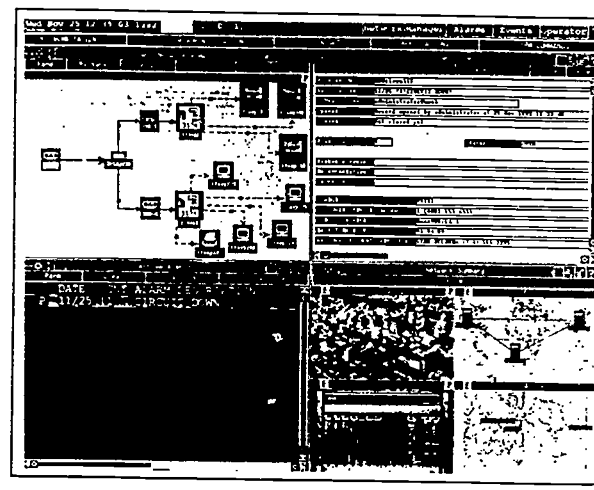

Figure 8: Problem Management Example

Figure 9 focuses on the navigation facilities provided. Shown is a schematic of the view trees available within this particular system. These are virtually an unlimited number of view trees which may be configured to correspond to the organization's needs. It thus becomes feasible to accommodate the simultaneous needs of disparate operations or departments within a diverse enterprise using a single system. By establishing domains it is further possible to isolate network objects from parties not interested in them or not authorized to act on them.

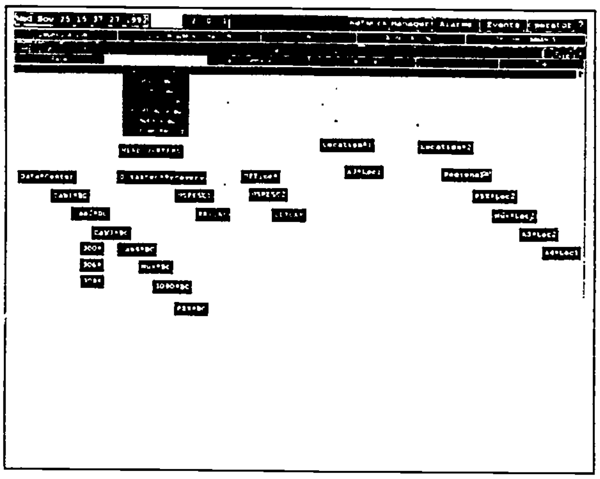

Figure 9: Navigation Illustrated

5. TOWARD A BROADER WORLD VIEW OF ENTERPRISE MANAGEMENT

The array of capabilities which have been brought to bear on the problem of enterprise management have much broader application. As the examples have shown, displays, navigation, language etc., can all be arranged at the user's discretion to suit a wide variety of needs. With point and shoot control and individualized choice of symbology, text and other aids to understanding, the need for the specialist operator diminishes. Also, the means of direct inquiry afforded by these new systems can bypass intermediate levels of interpretation in all but the most unusual cases.

The power of the well designed graphical user interface is illustrated by reference to figures 10 through 12. The first step is configuring the system with backgrounds corresponding to the reality or perception of the enterprise being managed. Figure 10 illustrates this principal by using an actual building artwork as the background. This could exemplify the case for security or physical plant monitoring.

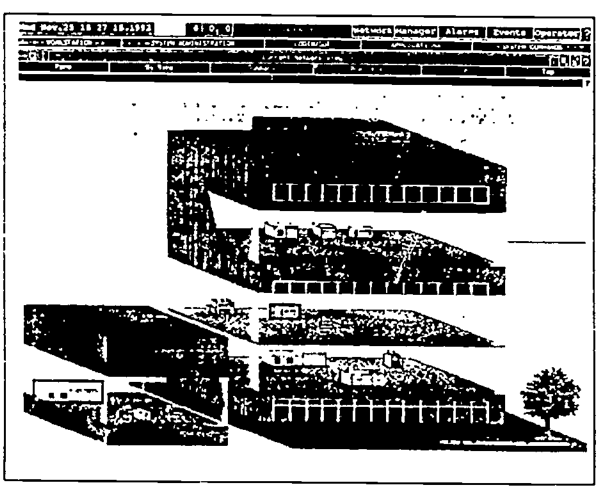

Figure 10: A Building with Object Icons

A computer is shown on one of the floors within the building. The part of this same picture representing the computer is then scanned into the system as an active icon able to respond to state changes and alarms. Artwork and language associated with menu choices are completely at the discretion of the system administrator. System usability for a given class of user is determined by this "software" rather than by the technology of the underlying platform and applications.

Another example as shown in figure 11 further demonstrates the power of the technique. Here an actual rack of digital cross connect equipment as the background against which one of the cards is placed as an active icon. The possibilities are virtually unlimited.

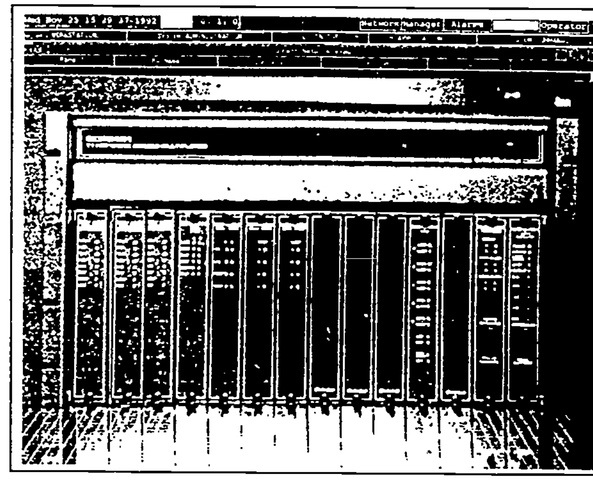

Figure 11: Equipment with Component Icons

Figure 12 shows a series of views showing a typical "drill down" sequence from global view to the underlying network branch served by the card in question.

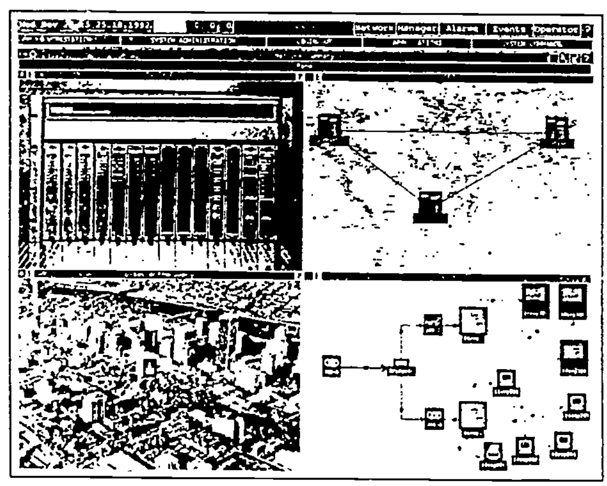

Figure 12: The Power of a "Drill Down" Sequence

To illustrate the general applicability of these techniques, Figures 13 and 14 show the same set of tools applied to hospital critical care monitoring. Here we have "drilled down to an individual bed from a city view. A sophisticated array of sensors are already available in the hospital environment with which to monitor patients, both locally and remotely. By using the tools now available, more complex and complete data can be accommodated and presented at a variety of levels, both for direct care providers and for supervision personnel.

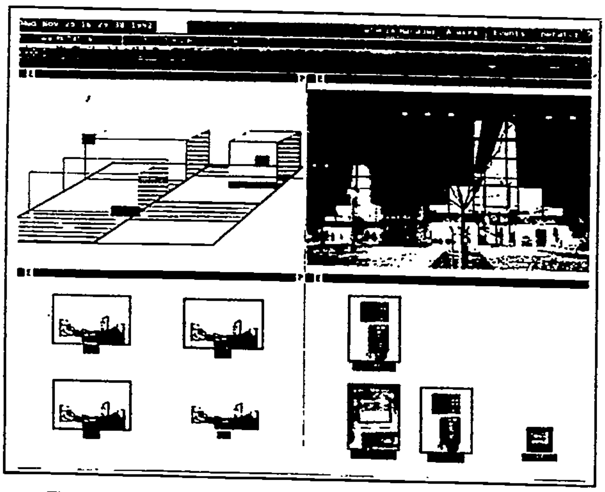

Figure 13: Managing the Hospital Environment

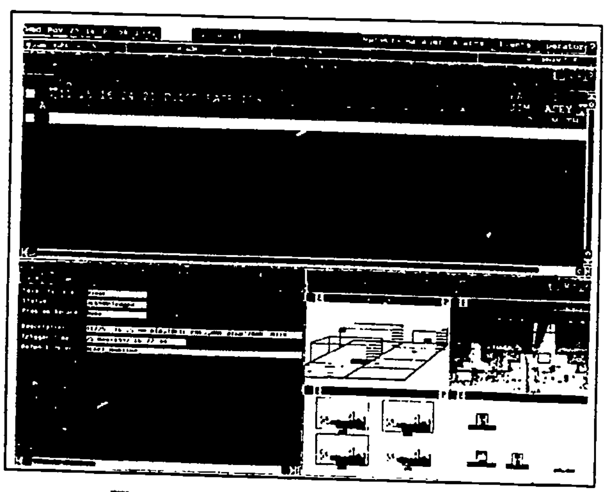

Figure 14: Medical Care Monitoring

Similar examples abound in a number of other fields. Transportation, utilities, manufacturing and security all require similar capabilities. Much work remains to define the requirements for these systems. However, the tools which already exist can meet a significant part of the need and can be used to prototype the systems of the future.

At this point in time the gadgetry is being developed at a rapid pace.

The equivalent effort in operational analysis and bringing these tools effectively into play remains to be accomplished.

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The Study of Telecommunication Network Configuration in The Greater Taipei Area

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Abstract

Owing to the vital role of telecommunication development plays in the Six-Year National Development Plan, a study group consists of engineers from NTTA and TL was set up to plan and evaluate the Greater Taipei telecommunication network. This study concentrated within the range of point-to-point traffic forecasting, trunk network planning, transmission network planning and the analysis of network reliability from 1991 to 1997. In this paper, we will describe the study we did and the result we obtained.

1. INTRODUCTION

Telecommunication Development plays an important part in the Six-Year National Development Plan of ROC(Republic of China) from 1990 to 1996. DGT(Directorate General of Telecommunication) of ROC will invest about over 10 billion US dollars to introduce new technology in this plan. In the next six years, most of analog exchanges will be digitalized and the majority of transmission equipment will be fiberized. It deserves to suspect whether the traditional network planning practices is still suitable to apply or not after construction. So, it is the significant time to evaluate and plan telecommunication network now.

A study group consists of engineers from NTTA(North Taiwan Telecommunication Administration) and TL(Telecommunication Laboratories) is responsible for planning and evaluating the Greater Taipei telecommunication network. This study concentrated within the range of point-to-point traffic forecasting, trunk network planning, transmission network planning and the analysis of network reliability from 1991 to 1997. We evaluated many alternative plans which we concerned about, and gained some network configuration guidelines and planning practices from this project. In this paper, we will describe the study we did and the result we obtained.

1.1 STUDY ENVIRONMENT

The major environment includes

- -Study Topic:The design of network configuration (trunk network and facility network), the evaluation of traditional design practices (routing rule, method of circuit calculation and design parameters), the evaluation of network reliability .
- -Study region : The Greater Taipei Area consists of Taipei City, Taipei County, and Keelung City, which are in the same local tariff area .
- -Planning tools: Four computerized tools which are designed by TL support engineers to plan the Greater Taipei Area. These tools include trunk network planning[1], transmission network planning[2], point-to-point traffic forecasting[3] and network reliability evaluation[4].
- -Study period: In responding to Six-Year National Development Plan, this study will be within the period from 1991 to 1997
- -Study method : Owing to physical environment constraints and take advantage of the experiment of planning engineers, our approach is not to optimize the network but to evaluate designated alternative plans.

1.2 THE GREATER TAIPEI

The Greater Taipei network serves approximately 2.6 million subscriber lines, and generate about 110,000 erlangs busy hour traffic. There are presently about 240 switching units, and about 60% switching units are digital. The yearly traffic growth rate is about 10% in this network. After the Six-Year National Development Plan, the ratio of digital exchange will be up to 90%. In this area, far-to-near rotation routing principle is applied to route traffic, and simple cost-ratio rule is used to dimension network. We use 1% blocking probability in final route to maintain 3% end-to-end blocking. The digitalization and fiberization of interoffice transmission facility are going actively and continuously. Due to the large system capacity of fiber optic transmission system, any failure in transmission facility will result in great damage in traffic throughput. The evaluations of network reliability become a new and important topic which engineer can not ignore in network planning.

1.3 STUDY PLAN

This Study went through several steps repeatedly to obtain some cost-effective and implementible plans. These steps include:

(1) The collection and verification of input data
(2) The forecasting of point-to-point traffic
(3) The design of alternative plans
(4) Trunk network planning
(5) Facility network planning
(6) Evaluation of network reliability of designed network

The evaluation of alternative plans are applied from step 4 to 6.

1.4 ALTERNATIVE PLANS

The goals of this study are to obtain an economic and suitable network configuration, moreover to evaluate traditional design practices. So, a suitable alternative design must imply the good practice experiments of engineers and the design parameters which engineers concerned. The alternatives in this study are designed by combining of important design parameters. These parameters include the number and location of tandem switches, the routing rule(the threshold to establish a connection between switches), the dimensioning method, and routing policy.

2. TRAFFIC FORECASTING

2.1 COLLECTION & VERIFICATION OF INPUT DATA

An ideal traffic forecasting is a basis of the whole network configuration planning. It will affect the performance of network dimensioning. Therefore, traffic forecasting operation should pay attention on data verification and forecasting model selection. These input data are listed as followis:

- -Collecting the base year traffic measuring data.
- -Collecting historical year traffic statistical data.
- -Collecting base year and forecasting year switch construction data.
- -Collecting subscriber data of historical years and forecasting years.
- -Collecting Gross National Production (GNP) statistical data.

2.2 FORECASTING MODEL

Owing to the source limitation of the collection of historical data and empirical characteristic of the traffic growth , we select the linear multiregression model (smoother one)as below:

$$Y = a + bN + cG$$

where	Y	denotes traffic
	N	denote subscriber no.
	G	denote GNP
	a, b, c	denote estimating parameters

2.3 TRAFFIC FORECASTING AND DISTRIBUTION

In order to get a suitable traffic forecasting result of the Greater Taipei network, we applied the forecasting procedure as below

(1) Verifying the input data.
(2) Distributing traffic by the tandem and routing rule to have the current point to point traffic.
(3) Dividing the Greater Taipei into seven separating total traffic forecasting areas.
(4) Forecasting the total traffic volume of each above area by using the linear multiregression model.
(5) Calaulating the forecast offered traffic matrix by using Kruithof's method based on exchange subscriber ratio.

2.4 OUTPUT SUMMARY AND ANALYSIS

We summaries the output of the traffic forecasting as the followings:

- -The Greater Taipei Area point to point offered traffic forecast matrix.
- -The Greater Taipei Area outgoing and incoming total traffic statistics.
- -The Greater Taipei Area per line traffic demand statistics.
- -The Greater Taipei Area nonresident and resident subscriber ratio statistics.

We divide the whole study period into two stages. The first stage (historical stage) is from 1985 to 1991, and the second stage (forecasting stage) is from 1992 to 1997. We summarized the results according to these two stages as followings.

Average year growth rate of subscriber is 8.54%, GNP growth rate is 8.6%, traffic growth rate is 8.6% during the historical stage. Average year growth rate of subscriber is 8.34%, GNP growth rate is 7%, and traffic growth rate is 9.84% during the forecasting stage separately.

3. TRUNK NETWORK PLANNING

The major problem in trunk network planning is to assign the circuits among exchanges economically under grade of service and physical environment constrains. In this situation, we do not have any software tool to solve this problem under so many constraints yet. So, our approach is to plan trunk network under fixing some design parameters that create various alternative plans. We will analyze these alternative trunk network plans and describe the results from planning and design practices view of point in the following sections.

3.1 TRUNK NETWORK DIMENSION

Traditionally, the cost ratio method is the most popular approach to calculate circuit demand among exchanges. This design bases on the concept of carrying traffic at the lowest cost. From the marginal cost points of view, circuit demand will satisfy the equation as followings

$$\frac{\text{DR circuit cost}}{\text{AR circuit cost}} = \frac{\text{DR efficiency}}{\text{AR efficiency}} \qquad (1)$$

DR : Direct Route
AR : Alternate Route

The efficiency will be reduced when we add circuit to trunk group at a fixed offered traffic. At a triangular routing pattern which consists of direct route and alternative route, the efficiency of direct route(DR) decreases but AR(Alternative Routs) increases when adding circuit to DR. In our traditional practice, circuit demand of one trunk group is calculated by equation (1) using the value of DR efficiency(LTC: Last trunk capacity) which is derived from given AR efficiency(ATC: Additional trunk capacity), DR circuit cost and AR circuit cost. The ratio of DR circuit cost to AR circuit cost is called cost ratio(ε) which implies the characteristics of network we plan. Then, equation (1) can be rewritten as

$$LTC = \varepsilon * ATC \qquad (2)$$

It's a hard problem to obtain an appropriate value of ATC when we try to derive suitable value of LTC. Dr. Rapp provided an equation to approximate the value of LTC as

$$LTC = \varepsilon(1-0.3\varepsilon^2) \qquad (3).$$

In practice, the value of LTC is usually derived from equation (2) when the value of ATC and cost ratio was provided by engineer. After getting the value of LTC, the circuit demand will be calculated from equation (3) as below.

$$LTC = A(E(A,N)-E(A,N-1)) \qquad (4)$$

N: number of circuit A:Offered traffic
E(A,N): the blocking when offered traffic is A and number of circuit is N

The evaluation of these three methods(given LTC, ε*ATCand Dr. Rapp) reveal that the last one is cheaper than former two and cost figures are more stable. But the cost difference is small compare to routing rule parameter variation. By cheaper and stable reasons, we choose Dr. Rapp's approximation method and equation (4) to dimension network.

3.2 TANDEM TRAFFIC CAPACITY

Generally speaking, trunk groups among local switches(LS) have lower offered traffic, and these equipments are hard to be cost justified. The lower the traffic threshold of routing rule we apply, the more the connections among LS have to build. The more the connections among LS are built, the lighter loads these tandem switches have to carry.

The selection of alternative plan depends on not only cost but also feasibility. One of the most critical feasibility problem is the traffic processing capacity of exchange. Take the Greater Taipei network as an example, the lowest cost alternatives are within the routing rules from 16HU (establish a connection when offered traffic equal to or greater than 16 erlangs) to 20 HU when there is no traffic capacity constraint on exchange, but the routing threshold is lower(below 16HU) when there is. The lowest cost feasible alternatives are 10HU under 17 tandem switches and 14 tandem switches separately when we take two different traffic capacity assumptions.

3.3 SENSITIVITY ANALYSIS

Network planning is to draw out the future network under some design parameter assumption. Owing to the time gap between the planning year and construction year, the difference between the expected parameter values of design and realized ones in the future could not be avoided. It is critical problem to evaluate the effect of design parameters such as equipment cost or forecasted traffic.
So, we investigate the impacts of the variation in cost parameters of several equipment and traffic load within 20% ranges in the study of Greater Taipei network. Despite the network costs are varied in some proportion to the variation of cost parameters, there are hardly any changes in the order sequence of network cost among alternatives. The increasing(deceasing) of traffic load make the most economic routing threshold getting highier(lower) within 20% variation ranges.

We have mentioned cost ratio has little effect on the calculation of circuit demand in section 3.1. The variations in switching cost or circuit cost cause the variation of cost ratio, but the circuit demand almost the same. It is another proof for this view of point.

3.4 ROUTING POLICY

Engineer may take some variant of routing policies that are different from compiete two-level routing hierarchies as Figure 3.1(a) to eliminate expensive route, reduce maintenance cost or prevent natural barriers. These variants are shown in Figure 3.1(b)-(g). Different routing policies have different constraints on routing between a pair of LS. In our opinions, every time we add new constraints on routing(delete routes from full two-level routing hierarchy), the problem domain is getting smaller and the total network cost might be going higher. These planning results prove this.

These network costs of 7 variant routing policies can be divided into 5 groups unambiguously. There are variant 0(full routing hierarchy) , variant 1 and variant 2, variant 3 and variant 4 and variant 5, finally variant 6 in ascending order separately. The cost differences among groups are clear, but are ambiguous within group. The cost penalty from variant 0 to variant 1 or variant 2 is small, but others are very large. As we could image, the largest penalty appears in the variant 6.

3.5MODULAR PROBLEM IN DIGITAL ENVIRONMENT

One of the most critical assumption in cost ratio approach to calculate circuit demand is linear per-circuit cost. In traditional analog network, linear per-circuit cost assumption is insensible to engineering result, in most situations, when terminate circuit to exchange in unit of one. But, the condition is changing when mass deployment of digital switching and transmission equipments. Linearized per-circuit cost is no more appropriate because the connections between switching systems(transmission links) are in unit of module size and they have high fixed cost corresponding to per-circuit cost. In this case, the dimensioning procedure is to determine the most economical number of circuits in unit of module size. We did not try to optimize the modular problem in this study, because the problem is too hard to solve. Our approach is to propose some modular guidelines that obtain from the evaluation of alternative plans. These guidelines will support engineer in design practices.

The modular strategy is based on the threshold to round-up or round-off a module size. We take some of these lowest cost alternative plans as examples to investigate what is the influence on the network cost when we modulize circuit demand. We choose 12 when the total circuit demand in both directions is the multiple of 24 and 24 as module size separately. The results about module size 24 reveal the most economical threshold is within the range from 12 to 14. Another phenomenon deserves to pay attention is the curve of network cost corresponding the threshold. The higher network total cost occurs at these lower threshold alternatives, and the cost decreases rapidly when raise the threshold. Then the network cost increases when the threshold is over these lowest cost ranges. But, the increasing trend is very smooth and ambiguous. The lowest cost threshold appears around 6 when the module size is 12, but the increasing cost trend over 6 very smooth. Summarizing these results of many other alternative plans we take, all the cases reveal

- -The lowest cost threshold is around half module
- -The cost variation more violent below half module threshold.

4.TRANSMISSION NETWORK PLANNING

The results of transmission network planning are significant for planners also. By these transmission strategy network plannings, the planners can catch the picture of the future physical network configuration. The analysis results of these alternative plans are departed into five parts, they are:

(1) transmission cost analysis,
(2) diverse routing,
(3) loading analysis of transmission system,
(4) network configuration selection,
(5) restoration network design

We will describe in the following sections separately.

4.1 TRANSMISSION COST ANALYSIS

There are two results provided by these transmission cost analyses. First, the percentage of transmission cost in total cost is supported by these analyses. It helps the planners to decide how to distribute the budget. In this study, the transmission cost is about 40% of the total network installation cost that indicates the telecommunication network cost system in the Greater Taipei is quite effective.

Second, the cost percentage of each part of the transmission network is provided by these cost analyses. All the transmission cost can be decomposed into four parts: multiplex cost, terminal equipment cost, cable cost and conduit cost. The multiplex cost takes the largest percentage 50.39% of the transmission cost; and the terminal cost equals 34.28%; the conduit cost equals 10.58% and the cable cost takes the lowest percentage 4.78%. On the basis of results, the efficient planning of the multiplexer arrangement and terminal deployment will reduce the transmission cost effectively.

Cost sensitive analysis is also important for the planners since different facility cost cannot keep the same level all the time. Figure 4.1 shows us the results of the cost sensitive analysis. The result of these four part cost analysis show that the influence on total network cost is very stable.

4.2 DIVERSE ROUTING

Diverse routing has been a basic and popular strategy to enhance the network survivability now. With the demands loaded into two or more edge disjoint paths, it always keeps some demands survivable for any single failure of the network. Since diverse routing is one of the most economical ways to enhance survivability, it has become a function of the loading tools used here.

The application of diverse routing strategy depends on network topology. If we cannot find two edge-disjoint paths for a demand, the diverse routing goal can not be reached. The computer program can help planners to check the connectivity of network topology also. Then, planning engineer can improve the network topology later.

Observing all considered alternative plans, we can find that some trunks of the new central office at suburban will become more important in the following six years, since the natural growth of the Greater Taipei metropolitan. So planners may adds edge-disjoint fiber systems in these new central offices to enhance network survivability. By this way the incremental cost is about 20% comparing with the MCR routing algorithm. The results show as Figure 4.2

4.3 LOADING ANALYSIS OF TRANSMISSION SYSTEM

To choose the suit capacity size of transmission systems is noticed in this study because selecting an inappropriate transmission system will imply the increment of transmission cost. Analyzing the almost 200 links of the Greater Taipei network, the loadings of all the links in these alternative plans are distributed as follows.

> 24 DS3	: 6% ~ 10%
12 ~ 24 DS3	: 11% ~ 18%
3 ~ 12 DS3	: 33% ~ 39%
1 ~ 3 DS3	: 25% ~ 27%
<= 1DS3	: 15% ~ 17%

Obviously, 3 ~ 12 DS3 takes the largest proportion that indicates the 565Mb/s(or 600Mb/s) transmission system will be the major and economical transmission system in the next 6 years. In addition, the proportion of greater than 12DS3 is over 20% so the introduction of higher speed transmission system should be considered.

4.4 NETWORK CONFIGURATION SELECTION

A fiber hubbing configuration is proposed as a cost-effective way of interconnecting local central offices using high capacity fiber optic transmission systems and DCS. We can achieve better fills of fiber links and better sharing of the costly multiplexing and transmission equipment by utilizing the configuration of aggregating the interoffice traffic from a local central office through digital multiplexing and optical transmission, onto a single route to a common facility hub.

This approach makes the maximized fiber utilization possible while maintaining flexibility for point to point transmission in an exchange network and allows fibers to be deployed even in small central offices.

Comparing the results between the hub network and tradition network configuration, we find that the high cost of DCS3/1 induces the introduction of DCS3/1 not so attractive. It defers evolving to hub network configuration.

4.5 RESTORATION NETWORK DESIGN

The problem of survivability and reliability enhancement becomes more and more important for migratation of fiber based networks. Since high capacity and broad bandwith properties of fiber transmission, the topology of network tends to be simpler, weaker structure and each fiber link provides more circuits. A link cut in the network will lose significant traffic and cannot meet the grade of service, even disconnect the network. So enhancing the network survivability effectively becomes a necessary consideration of transmission network planning. The probability of more than two links be cut at the same time is little, so we only consider restoration single link failure to meet the expect grade of service to design high survivability network.

For improving the survivability of the Greater Taipei transmission network, a restoration network among all the tandems is suggested to install. The spare capacity design of the restoration network follows the algorithm provided in [7]. Figure 4.3 shows the result of the restoration network design. In this proposed restoration network, For averge, each spare DS3 restores 2.48 DS3s while any single link failure occurs. Since the working DS3s and the spare DS3s share the same transmission system, the increment for the restoration network cost is quite cheap. And the generation of the restoration network makes all the circuits among the tandems can be 100% recovered for any singe link failure.

5. RELIABILITY EVALUATION

Zero network failure is most desirable from subscriber's point of view. Cost is not always the only consideration. A suitable quality measurement of survivability for the telephone network must consider both subscriber's need and network revenue simultaneously.

Quality of service to users is usually not affected directly by problems within relevant network facilities, but by traffic throughput degradation. Obviously, it would have no influence on users from a link failure if there is no throughput degradation.

There is traffic-oriented approach to network survivability proposed. Traffic-based measures can be used to estimate revenue loss and as an indication of customer's satisfaction of the services. We choose blocking probability as a reliability measurement that provides a criterion to compare different network configurations and quantify network performance under stress.

5.1 SURVIVABILITY MEASURES

A quantitative analysis method for network survivability is an essential part in network design. In this study of network configuration, we ignore equipment failure rates, down time and statistical variations of offerred traffic. We limit ourselves to the case of one link failure at a given time and using an iterative procedure to compute probabilities of end-to-end loss between node pairs. Traffic-weighted end-to-end blocking is then calculated to evaluate the network-wide impact of the failure. Finally, the following parameters are calculated for given physical link failures.

- Π : global blocking probability
  = total loss traffic / total offered traffic
- Π_x : the percentage of total traffic with end-to-end loss probability greater than a given value x%
- P_x: the percentage of total number of flows end-to-end loss probability greater than a given value x%

5.2 SURVIVABILITY ANALYSIS

In this section we present a procedure used in this study to analyze and quantify the survivability of a network. Figure 5.1 shows the block diagram of the procedure for network survivability analysis. Based on the results of end-to-end traffic forecasting, trunk network design and transmission network design, the algorithm identifies all the node pairs affected and the number of lost circuits along the path during a link failure. Then, the affected node pairs with their lost circuits are used in calculating network performance. The process is repeated for every physical link in the network. In the end, the results of single-link failures are analyzed and the parameters Π,Π_x and Px of network survivability are displayed against the axis of links.

5.3 SURVIVABLE NETWORK DESIGN

The improvement of network survivability can be obtained by strategically locating spare capacities in the network. In case of failures, the network will use spare capacities and DCS to reconfigure the network that alleviate the influence of the failure.

It is a new challenge how to design transmission network that achieves a suitable service survivability. In our point of view, a suitable survivability level must take the tradeoffs between cost and revenue into consideration. In this study, we do not recommend any particular service level, just shows the result number of links needing protection and total traffic loss at several given levels of plans (Table 5.1).

In this protection study, we also tried to find favorable capacity requirements, using 50% or 100% spare capacity for failed link, to satisfy the constraints of designated Π,Π_x and P_x. We were able to calculate the total cost of the protection network including the cost mentioned above. Two results are shown in Table 5.2 using Π<5% ,Π_3<10% and P_3< 10% .

5.4 CONFIGURATION COMPARISON

Any network configuration change produces different traffic serving characteristics and related cost. One still unquantified performance aspect of each network configuration is its degree of sensitivity to unexpected link failure. Using end-to-end service concepts, Figure 5.2 makes meaningful comparison between two different configuration designs. Where each point on the curve represents a single-link failure that makes an average end-to-end blocking greater than or equal to certain level.

ACKNOWLEDGEMENT

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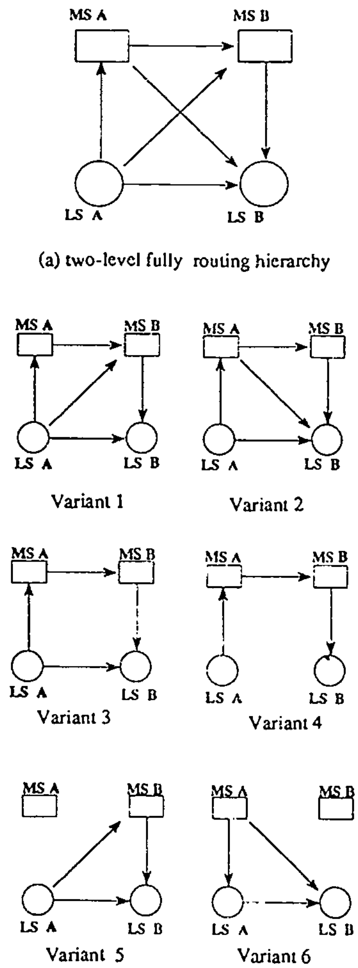

(b) Variants

LS: local switch MS:tandem switch

Figure 3.1 Two-level fully routing hierarchy and its variants

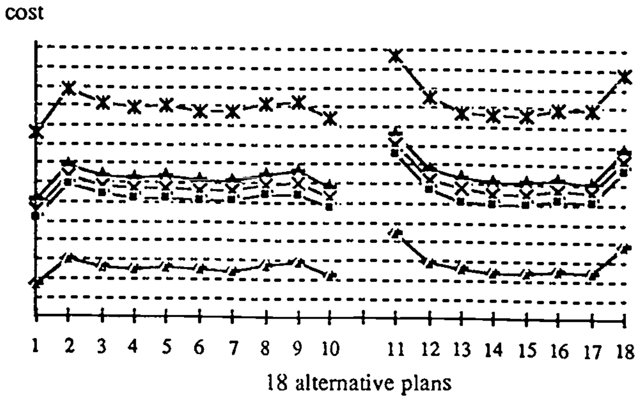

Figure 4.1 The cost sensitive of each equipment

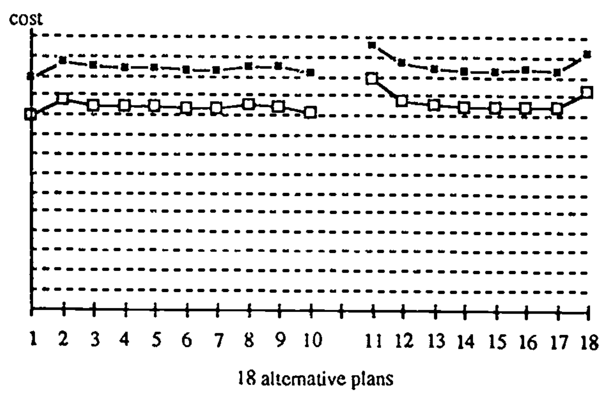

Figure 4.2 The increment of diverse route

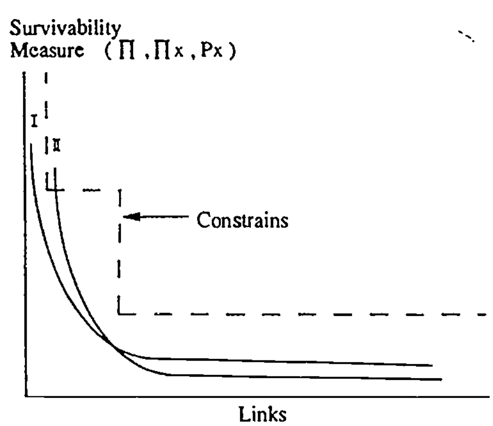

Figure 5.2 Characteristic functions and survivability constrains

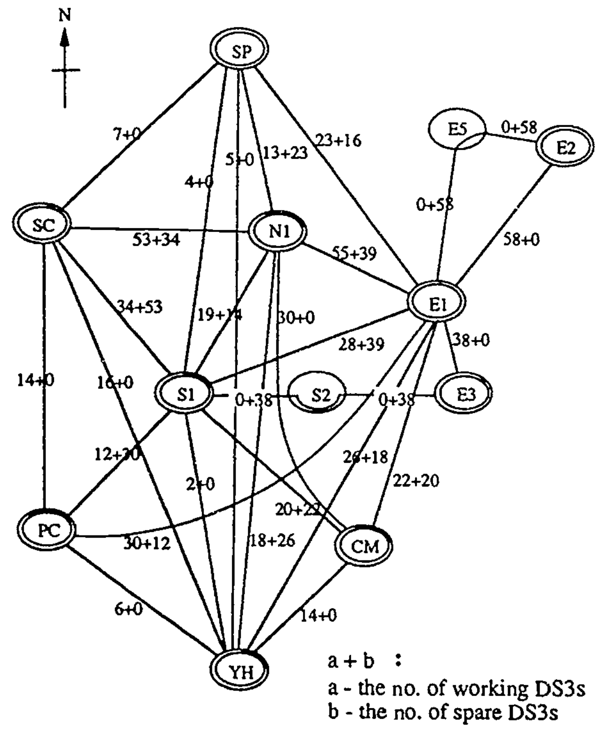

Figure 4.3 The restoration network design of Greater Taipei

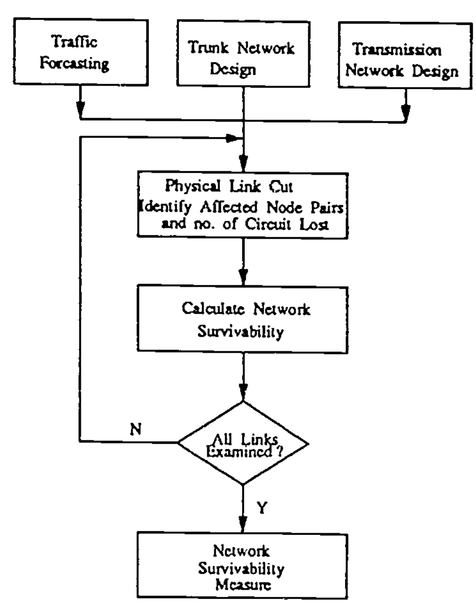

Figure 5.1 Network Survivability analysis

ENTERPRISE NETWORKING IN ASIA

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1.0 ABSTRACT

Multinational corporations are rapidly expanding the scope and complexity of regional communications solutions. This paper addresses the strategic and operational challenges faced by end-user communications managers in the context of regional regulatory and technological trends. The essay concludes with an examination of the options for regional "hubbing".

2.0 INTRODUCTION

Demand for corporate networks in Asia is soaring. As multinational firms continue to invest in commercial and manufacturing operations in the Pacific Rim, the need for corporate communications networking has grown acute. Telecommunications is redefining the concept of market proximity and business strategy, and the gap between regional business centers, international export destinations and corporate home offices shrinks with the installation of each new fiber optic line.

The Asia/Pacific region presents profound new challenges to telecommunications and IS managers. Regional GNP growth is forecast at about 5% for 1992, almost twice the world average. Some countries, notably Thailand, Malaysia and Indonesia, expect to grow 7%-8%, and south China's economic boom will push domestic production over 10% this year. International switched traffic in the region is expanding 20%-35%, while volume of some public data network (PDN) service carriers is surging at 100%-150% per year.

Market liberalization and telecommunications sector reform are redefining competitive trends in almost every major trading nation. The scope and range of liberalization varies from almost total deregulation (New Zealand, Australia) to extensive carrier competition (Japan), to gradual and selective introduction of alternative service providers (Korea, Malaysia, Thailand), to carefully controlled government management (Singapore, Hong Kong), to old-style monopolies (China, Taiwan, Indonesia). Unlike Europe, where economic planning and information networking developments are monitored by the European Commission, Asia has no common market, few similarities in industrial or political organization, and widely divergent values and expectations. Each country has vastly different rules and procedures regulating telecommunications policy, shaping both the scope and flexibility of end-user networking opportunities.

Communications managers designing networks for Asia need to be clever. While business in the Pacific is booming, multinational corporation's (MNC) regional investment strategies remain relatively immature compared to those in place for Europe and Latin America. Many companies' operations are based on scattered low cost manufacturing or sourcing opportunities, rather than seasoned campaigns to penetrate national markets. As Asian growth consistently outpaces the lackluster western economy many firms are recalibrating market strategies to tap the brisk activity. Localization is vital. New acquisitions, alliances and staff increases place extraordinary demands on network architectures engineered for simpler times. And if the boardroom plan for the region is not clearly defined, network managers may be required to do some creative second-guessing to anticipate the needs of the firm.

Two critical questions global communications managers must address while establishing regional networks in Asia are: Will the system be managed primarily as a private network? And, where is the optimal site -- or sites -- for regional network hubs?

3.0 USER NETWORKING OPTIONS

Because of the extraordinary characteristics associated with managing networks in Asia -- time zone differences, leased circuit break-even economies, geographic distances and cultural gaps as wide as the Pacific -- users must determine if they are prepared to commit to a regional private network strategy, or if they will rely on more traditional carrier solutions such as IDDD, switched 56/64, national PDNs, and international value-added networks (IVANs).

Composition and complexity of the Asian network naturally depends on the firm. Very large corporations typically have no choice but to build regional leased circuits networks. They may not, however, necessarily deploy staff to manage the equipment. Firms with modest networking requirements, unwilling or unable to justify investments in regional private backbones, may depend on the big international VANs for regional support. The IVANs are especially valuable in the fast-growing but difficult-to-manage developing countries, where delivery delays for expensive dedicated channels can reach two years.

Public (carrier-run) X.25 is used throughout the region, though it is clearly the "poor cousin" to international private leased circuits. Public data networks (PDN) are rarely a data transport option of first choice for inter-regional traffic, as they might be in Europe. Quality and prominence of domestic PDN services depends on the country. In Taiwan, for example, a new virtual data services (over existing X.25) is being introduced in effort to stem the anticipated migration of data traffic to private circuits, when market liberalization of the state carriers takes hold in 1993. In Thailand, a new carrier managed by Singapore Telecom, Datanet, has soaring demand for its circuit-switched "overlay" platform; 9.6 kbps services with error checking can be installed in days, cutting long lead times and gauranteeing data delivery through the rickety infrastructure. Indeed, in many countries the greatest difficulty with PDNs is gaining clean access to the local network node.

Users have an increasingly wide variety of carrier services in Asia from which to choose, but options are still dominated by traditional switched and dedicated services. Higher functionality services, such as VPN, X.400 and network-based frame relay, are still in the planning, pilot or very early implementation stages. Japan, Hong Kong, Singapore, Australia and New Zealand have far and away the most developed networking environments, with a high degree of network digitization. The middle-income and developing countries all have ambitious infrastructure expansion programs, and domestic line growth can reach 15% per year.

One of the great beacons of carrier marketing in Asia is one-stop shopping. Provisioning and network management agreements among carrier help smooth the logistics of procuring, testing and maintaining regional circuits. Most users agree, however, that managing physical connectivity is the dimension of network support that, while complex, ultimately presents the least difficulty.

The greater challenge is engineering the network above the physical layer. In the increasingly complex corporate data networking environment, the real challenge is finding solutions for dynamic bandwidth allocation for bursty traffic from LAN/WAN bridging, videoconferencing, and so on. One-stop shopping is an administrative and procedural matter that barely address user's real network management needs. Carriers can manage circuits well enough, but their ability to support higher OSI layers remains suspect. Even as carrier value-added services grow increasingly complex, emphasis is on connectivity and transport, not on interoperability and systems integration. U.S.- and Asian-based carriers fare equally in this weakness. Users seeking comprehensive facilities and network management solutions in Asia -- that is, control and surveillance equivalent to what they would provide themselves -- rightly question if carriers are up to the task. Firms must thus choose between embarking on capital-intensive private line network, or wait to see if and when carriers will live up to their promises to provide comprehensive solutions.

Enterprise network management strategies seem to run in cycles, and the prevailing wisdom is that users are willing to entertain carrier network management and outsourcing as a serious consideration -- to the carriers' delight, and often, to the users' nagging frustration. Many users would like to find a networking services company that could, as several Asia/Pacific network managers have said, "take the whole thing off our hands." None feel confident that any single firm has the wherewithal to accept that responsibility today.

With all the promises and media hype surrounding the carrier groupings -- whether or not NTT and Telekom joined Syncordia; if MCI gained a leg up on AT&T by creating the Financial Network Association (FNA); if Pacific Partners (AT&T plus all the Asian carriers less Cable & Wireless) will provide "magic bullet" solutions for regional users -- one has to wonder if users' most vexing concerns are even being addressed. None of the consortia begin to consider the notion of comprehensive outsourcing. Until alliances are formed between the transport carriers and systems integration firms like IBM, DEC, GEIS, or EDS, "managed data networking services" in Asia will amount to little more than carrier "babysitting" of communications equipment and circuits.

Facilities management -- babysitting -- is nonetheless growing popular. Users who cannot justify local staff (or have difficulty retaining them) like the idea of leaving network terminal equipment in reliable hands, while carriers think facilities management will provide a lever for better account control. It is usually sold like real estate -- by the square meter of equipment space required -- plus a mark-up for technical supervision. Hong Kong has the largest number of customers, with about 160, followed by 60 in Singapore, 20 in Japan, and a dozen in Australia, more or less reflecting the distribution of corporate regional hubs. None of the carriers have been successful at securing more complex "outsourcing" (equipment buy-back) arrangements, nor regional network and engineering design contracts. To date, multinational users have largely opted to retain control over their Asian networks.

Carriers hope to lure users to international virtual private network (VPN) offerings. Inter-regional and trans-Pacific VPN services are expected to post sharp growth, though there are also at least two significant impediments to user acceptability. First, voice and fax traffic is important for cost-justifying expensive international private circuits. Most (American) multinational traffic is *across* rather than *within* the Pacific Region, and by stripping voice and fax off the backbone and onto a VPN, critical financial economies are lost. (Today fax accounts for approximately 60% of all trans-Pacific carrier traffic). Second, some carriers require T1/E1 (1.544 - 2.048 mbps) network access to support VPNs, even though firms may be operating only DS0 (64 kbps) circuits -- or slower. The cost of local access may outweigh the efficiencies won with the virtual network. Despite these misgivings, VPN take-up in Asia will likely be strong.

4.0 REGIONAL ENTERPRISE NETWORKING TOPOLOGIES

Depending on regional presence, network applications, and business growth scenarios, companies are deploying a variety of topologies to serve their Asia Pacific communications needs. Some firms are content with simple star configuration networks, sending regional low-speed data into a simple hub with a single high bandwidth circuit across the Pacific, complemented by IDDD for voice and fax. Other companies, dependent on transaction processing, heavy file transfer, or financial data management, are more inclined to duplicate domestic information systems architectures with complex, redundant network topologies.

Many regional networks have grown up in piecemeal fashion: circuits are added when new offices or factories require direct communications with headquarters, with little consideration for a regional plan. The result may be an inefficient, hodgepodge network. As traffic to and within the region increases, weaknesses in design become apparent. Today a wave of companies are seeking to achieve better financial and technological economies and closer integration with U.S. and European systems through network redesign.

At the strategic level, firms need to determine what degree of support and compatibility is required for Asia Pacific network sites. Many companies are establishing global management systems with consistent hardware platforms comprised of muxes, modems and front end processors. This continuity comes at a cost. Creating a universal management environment may require significant upgrade of existing equipment, and a "highest common denominator" approach may not necessarily be the most appropriate solution for the firm's Asian business activity. Similarly, the high cost of trans-Pacific circuits can make replicating domestic network performance levels for redundancy or quick response brutally expensive.

For example, a company may be formalizing its domestic U.S. solutions for LAN/WAN integration, but in Asia, where PC and LAN penetration is limited, the bandwidth support and processing power may not be needed. With no overlap in time zones between regional offices and headquarters, voice traffic may still ride on the corporate backbone (rather than on a VPN). VPNs will become increasingly valuable options for inter-regional voice traffic in the future, as KDD, Singapore Telecom, C&W, AOTC and the US carriers broaden their service portfolios. Some firms use international 800 circuits to provide field employees dial-access to VPN nodes in the U.S., thereby achieving some VPN functionality without paying for stiff VPN access costs.

An MNC's fundamental data processing strategy, expectations for network management, and overall network flexibility also impact regional enterprise network planning options. Some companies, striving to achieve better MIS economies through consolidation of data centers, may attempt to harness "night MIPs" on home-office computers. A subsidiary in Thailand, for example, may poll a mainframe in Texas during the Pacific business day when the machine is underutilized -- consolidating control at headquarters and reducing regional support costs. Harnessing U.S. or European processing facilities generally implies bigger network transport capacity, which is costly, and which demands a high degree of resiliency and reliability from international circuits. Both factors tend to make communications managers nervous. In countries with spotty quality records, a top-down MIS strategy can produce considerable dread in the field.

Network management is another bogeyman in the planning process. Larger firms have begun to implement "follow-the-sun" network monitoring, where separate U.S., European and Asian control centers rotate responsibility for viewing the entire network during the local business day, and hand over control as the business day rises in the next hemisphere. American users accustomed to a high degree of visibility into carrier facilities -- such as real-time status monitoring, fault isolation, trouble ticket reporting, and so forth -- find little to work with from any of the major Asian carriers. Today users depend chiefly on existing mux and modem element management systems. With the introduction of DACS overlay networks, carriers are capable of a higher order of network management on PLCs, but this functionality and control is not shared directly with users; the big regional service providers are not inclined to grant users virtual access to the carrier network management platforms, as in AT&T's Accumaster or BT's Concert.

A further consideration for users is flexibility. If the regional business strategy is in flux, and for many companies it is, the network may need to accommodate unpredictable traffic from new manufacturing or production sites, or sudden changes in topology resulting from acquisitions. At the same time, future requirements may demand a full-mesh network, and the architecture may need to be engineered with future distributed processing and distributed support in mind.

As in domestic systems, carrier switched services play an important role in regional enterprise networks. Companies expecting to use ISDN -- as an architectural option, or for private leased circuit back-up -- will find interoperability problems between even the most advanced countries. Hong Kong and Singapore, the countries with the highest ISDN penetration (as a percentage of total lines), have different ISDN signalling environments, and neither sees it in its interest to ensure smooth compatibility with the other. In contrast to Europe, where carriers are working together to resolve variations in ISDN standards to achieve greater cohesiveness, Asian carriers with competitive pressures haunting are not acting quickly.

5.0 SAMPLE NETWORKS

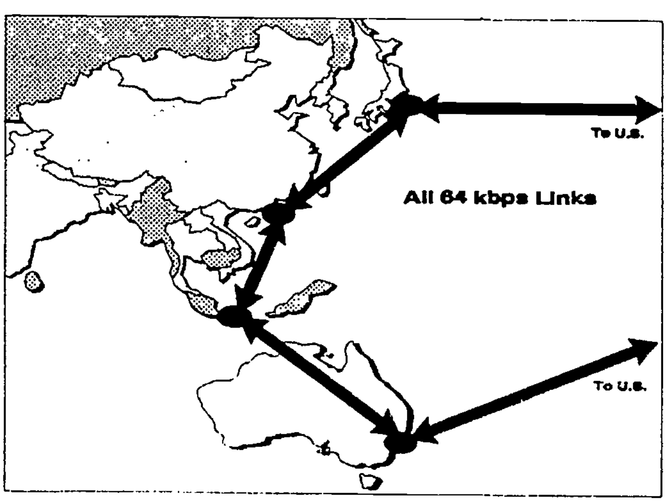
Companies develop unique topologies to support regional networks, and the following examples illustrate three basic designs.

A simple and reliable network topology, in this case supporting a major hotel chain, is engineered for both high redundancy and maximum flexibility. The architecture is a physical ring (see figure 1), linking the U.S. with Japan, Hong Kong, Singapore and Australian, and back again to the States.

Redundancy is high because traffic can be routed in either direction on the backbone circuits. Under normal operating conditions, primary traffic from Singapore to points south flows through Australia, and primary traffic from Hong Kong north flows through Japan; the circuit between Singapore and Hong Kong is largely quiescent. All sites on this network have the same relative importance, and the probability of failure on a link is the same at each node. As designed, the system can tolerate any single circuit fault.

Flexibility was a central consideration in the design for two reasons: the locations of the reservation offices are subject to change, and the company's plans for new hotels are dynamic, with many projects pending. By establishing a stable backbone, adding or deleting sites is straightforward. Companies that cannot be certain of the full scope of business operations need to devise an architecture that allows flexibility without significant penalty.

Figure 1



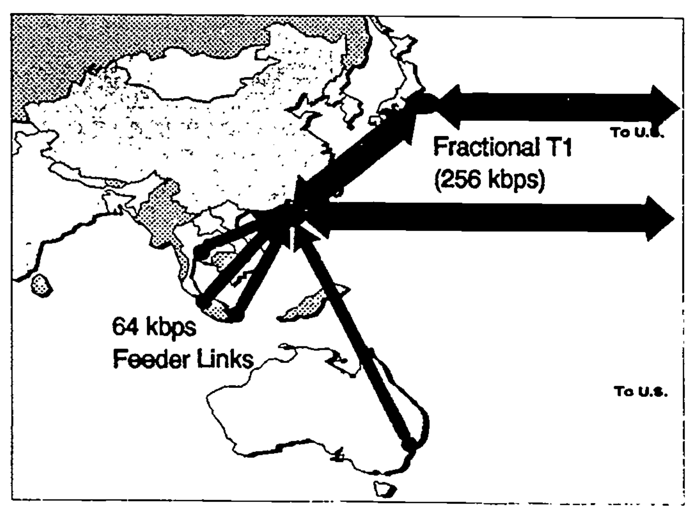
Another common network configuration is for firms to run dedicated circuits into Japan, which often has special traffic demands and applications support requirements, plus a separate star-hub network serving other areas in the Pacific.

Figure 2 below shows the network schematic for a large conglomerate. The Japan-U.S. traffic is routed over fractional T1 circuits (256 kbps) to a site near the U.S. headquarters data center, and redundant routing is available between Japan and the southeast Asia network node in the event of a serious network outage. The Hong Kong-U.S. route terminates at a second site near the headquarters for security. Hong Kong is the primary feeder site for central and south Asia, funnelling traffic from 13 countries on separate 64 kbps circuits.

Interestingly, because of the time zone differences between Asia and North America, peak daytime traffic within Asia -- for instance, between Japan and Hong Kong, which for this firm is a high volume corridor -- can be routed via the U.S. over the fast-packet (frame relay) mux network, more cheaply than though direct IDDD dialing. The reverse scenario from the U.S. to Asia applies as well, whereby routing domestic U.S. calls through the corporate network -- via Asia -- is in some instances less expensive than dialing over a domestic U.S. VPN.

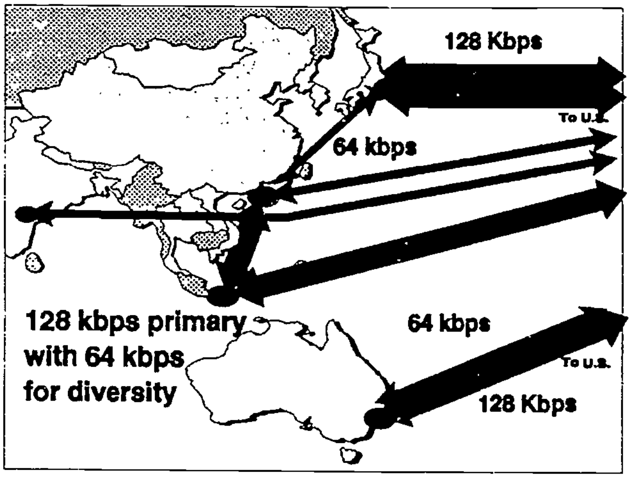
Some companies administer circuits to Japan as a discrete sub-network, with connectivity to a second, southeast Asian hub only for backup.

Figure 2



A third scenario, supporting extensive manufacturing, sales and component sourcing operations, is engineered for high volume data and video conference, with diverse routing throughout. Trans-pacific circuits from Japan are twin 128 kbps lines, terminating at separate domestic sites. Secondary circuits from Hong Kong and Australia use only 64 kbps. The company believes that the 64 kbps capacity will double by year-end 1993 (and that the 128 kbps channels will grow to 192 kbps or more), mainly because of increased traffic accelerated by the deployment of TCP/IP-based applications. The company has a number of data centers throughout the region, though Singapore acts as a client/ server hub

Figure 3



While each network has unique characteristics, some common themes are apparent. for terminal applications in four different countries: India, Indonesia, Malaysia and Thailand. Hong Kong is a hub for the Philippines and three locations in mainland China, which are triangulated with domestic leased lines -- a complex matter in the People's Republic. Most countries on the network have T1/E1 access domestically.

After analyzing the local competitive environment and internal traffic requirements, each firm identified the need for a physical ring, and the network topologies reflect their respective variations. The hotel's operations are distributed evenly throughout the region, the conglomerate has considerable traffic between its two primary hubs, and the manufacturer has immense requirements in Japan. The manufacturer added smaller backup circuits for key sites, while the hotel chain built in backup capability with a stable, reliable configuration.

6.0 HUBBING OPTIONS

Selecting an Asian hub site has become a dark science. The options used to be simple, if only because they were so limited. Firms had facilities in Japan and, separately, a hub for the rest of Asia in Hong Kong. With the profound, consistent growth in Asia's economies, the dynamics of regional trade are shifting, and with them, the need for more flexible networking arrangements. Singapore is now the gateway to the vibrant ASEAN region, Australia is claiming its place in the Pacific Rim, and even the stalwart PTTs in Korea and Taiwan have begun to recognize that the continued growth in national wealth depends on liberalization of telecoms solutions for large users. Competition among countries -- and not merely among carriers -- makes the choice tangled. Government tax concessions and R&D incentives are bandied about in the same breadth as leased circuit break-even economies and processable packet size.

Sorting through hubbing options is complicated, and no reliable rules apply. Likely hub sites may be management offices or large manufacturing facilities, though network hub technology sometimes resides at an entirely independent location. As the preceding section showed, companies will often use a hierarchical network of primary hubs (where multiple circuits or a regional data center resides), and secondary hubs (for redundancy, low volume traffic routing, or regions with new business development). Head office politics sometimes play a big role. The need to establish a local "showcase" office can outweigh traditional networking concerns such as traffic patterns, technical support, circuit costs, and so forth. Hong Kong is still the preferred hub location measured in terms of toal regional network hub sites, with Singapore nipping after its heels; Japan and Australia are scrambling to expand minority shares.

Assessing infrastructure fundamentals in each country is critical. Tables 1 and 2 identify a few general parameters that need to be taken into consideration; competitive access and flexible interconnection are especially important. Users learn quickly which regulations are "real", and which can be stretched or broken. Only Japan and Hong Kong have direct fiber links and diverse fiber routing with North America. Singapore has just recently gained fiber connectivity via Brunei, but Australia will not have optical links until late 1993. Additional considerations include terminal interconnection procedures and restrictions; direct access to satellite facilities, earth station ownership; and local definitions for "group VANs" and circuit reuse or resale.

Generally speaking, circuit pricing remains the weightiest concern in hub site selection. The cost of inter-regional circuits are characteristically equal to or only marginally less expensive than trans-Pacific Routes, and aggregate discounts have been a strong incentive for establishing a hub. Carriers in Hong Kong, Singapore, Japan and Australia all offer volume and aggregate circuit pricing schemes. Most are encouraging migration to digital circuits and considerable economies can be achieved at higher line speeds; 64 kbps DS0 channels have become the basic building blocks of regional enterprise backbone networks. Countervailing accepted logic (at least as it is espoused by the U.S. carriers), the U.S.-to-anywhere portion of an Asian network is not necessarily the cheapest leg of the journey. See Table 3.

7.0 HUB CHOICES

Hong Kong, still very much the Pearl of Asia, has long been the preferred regional networking center, and commands some 60% market share of Asian MNC hubs. Uncertainty

Table 1: Regulatory Matrix

8 Largest Asia/Pacific Market
(ranked by degree of liberalization)

	Private	Foreign Equity?	Competition in Int'l Voice	Competition in Domestic Voice	Private Network Intercon.	Private Satellite E.S.	Shared PLC
Australia	o	o	o	o	o	o	o
New Zealand	o	o	o	o	o	o	o
Japan	o	o	o	o	o	o	o
Hong Kong	o	o	●	●	o	o	●
Korea	●	●	o	o	●	●	o
Singapore	o	o	●	●	o	●	●
Taiwan	●	●	●	●	●	●	●
PRC	●	●	●	●	●	●	●

o= yes ● = no

Table 2: Key Factors

Main Hubbing Destinations
(Ranked by User Preference)

Country	Gov't Support	Corporate Tax Rate	Individual Tax Rate	Int'l Fiber	Fiber Route Diversity	IPLC Delivery	F.M. Users
Hong Kong	No	16.5%	15%	2Q90	3Q90	6 wks	>160
Singapore	High	10%, 31%	33%	1Q92 (Brunei)	2Q93	6 wks	> 50
Japan	No	51.4%	65%	2Q89	3Q91	16 wks	> 20
Australia	Medium	39%	48.25%	1Q93 (NZ)	4Q94	12 wks	< 20

over the Colony's political future after its June, 1997 reunification with the PRC leaves some communications managers wondering if their investments will be safe. Several firms have pulled hubs out of Hong Kong in the past year, notably Reuters and Federal Express, but they are clearly the exception to the rule. Most China watchers concur that the changes pending in Hong Kong are likely to be more cultural and political than economic: few believe that the transition of sovereignty will impact foreign business operations in a material way. Popular opinion actually maintains that because Hong Kong is the undisputed gateway to China, the importance of Hong Kong will actually *increase,* as the economy on the mainland continues to boom. It will retain this role, however, only if the political row between Britain and China over the interpretation of the Basic Law is resolved amicably.

Of more immediate concern to network managers in Hong Kong is soaring inflation (perhaps 13% in 1992), extremely high staff turnover, and escalating technical staff salaries and bonuses. At the same time, the advantages of Hong Kong remain: general business practices are highly efficient, and the local telephone company, Hong Kong Telephone, is highly responsive to MNC planning needs. Further, taxes are lowest in the region: 16.5% for corporations, 15% for individuals.

Whereas Hong Kong is the gateway to China, Singapore is the window on ASEAN (Singapore, Indonesia, Malaysia, Philippines, Thailand and Brunei). As such, many compa-

Table 3

64 kbps Half-Circuit Pricing
($US Dollars per month as October, 1992)

	HKTI	ST	KDD	AOTC	AT&T
HKTI	0	5125	4100	5125	5157
ST	5250	0	5250	5250	5500
KDD	4830	4830	0	4830	4830
AOTC	6408	6408	6408	0	6408
AT&T	7400	8400	7400	8050	0

Notes: All tariffs are for submarine cable circuits, and are subject to volume and negotiated discounts. New fiber optic cables connecting Hong Kong-Singapore-Australia, expected to be in service late in the first half of 1993, will reduce rates up to 20% next year. AT&T rates are to New York City.

nies are designing networks to leverage the advantages of each site.

Singapore is actively courting hubbing business, hoping to capitalize on the perceived political instability in China -- and the "dirty, disorderly and crime-ridden" qualities of Hong Kong life. Singapore seems intent on becoming the Switzerland of Asia, a manicured, tightly managed financial center with calculating government oversight. Of the four major hub sites, Singapore has by far the most aggressive government incentive programs for attracting business, coordinated by its Economic Development Board and National Computer Board. Firms can obtain generous tax holidays for committing to R&D and local investment.

While Singapore Telecom has long shouldered a reputation for inflexibility, the tide may be changing. The recent corporatization of the carrier suggests that it has the potential to become more sensitive to the market, both at home and abroad. Singapore has the most successful EDI network in Asia, managed by ST subsidiary Singapore Network Systems. Like Hong Kong, Singapore has high technical staff turnover and fast rising salaries.

As the most powerful economy in Asia, the largest financial center, and the country with the highest volume of inbound and outbound traffic, Japan is also a critical hub site for Asia. The difficulty of establishing facilities is cost. While international tariffs out of Japan have become competitive with regional counterparts, the general costs of doing business locally has not. High real estate, technical support and labor rates far exceed any other region in the world. On the up side, Japan has extensive competition in services provision, and technical standards are unparalleled. Companies bound to Japan have begun to move data centers and network control centers to suburban locations, south along Tokyo Bay and to Yokohama, to defray exorbitant overhead expenses in Tokyo.

Australia has intensified its bid to become a regional hubbing anchor, underscoring the national commitment to the economies of the Pacific; Australia's trade with Asia now exceeds that with North America and Europe. The government offers modest tax and investment concessions, incentives which help mitigate the high standard corporate tax rate of 39% (the maximum rate for individuals is over 48%). Extensive fiber facilities into Australia will not be available until 1994, but good satellite coverage is in place today. Some user questions how Australia, some 4,500 miles distant from both Hong Kong and Tokyo, could serve as a hub. In the reality of information networks, however, regional physical distances are arguably irrelevant. AOTC is clearly the dominant carrier in Australia, though Optus, the newcomer led by BellSouth, will be sure to concentrate on attracting MNC customers from its home territory in the U.S.

Both Malaysia and Taiwan hope to become popular corporate network hub sites. Malaysia is situated strategically in ASEAN's "growth triangle" and government planners believe that Kuala Lumpur can rival Singapore as the local of choice for regional headquarters. Market liberalization is encourgaing entrepreneurial access carrierss such as Information Networking Corporation (INC) and Time Engineering, and Telekom Malaysia is keen to capture international revenues it is losing to Singapore.

Taiwan is posied for fundemental market restructuring in 1993, beginning with corporatization of the national carrier, the Directorate General of Telecommunications (DGT), and redefinition of network access parameters and opportunities for value-added services. With foreign reserves topping $80 billion, the world's eigth largest stock exchange, and a government eager to earn political recognition to match its economic might, Taiwan will soon cultivate a broader regional presence in telecommunications.

8.0 CONCLUSION

Because competition for corporate traffic among countries is so intense, users designing networks in Asia are in an excellent position to negotiate tariff discounts and special treatment for local operations. In addition to pricing flexibility on published and group discount tariffs, users can bargain for circuit service level agreements, traffic engineering studies (which may sometimes be obtained for free), tax concessions, and favorable terms for facilities management.

By the mid-1990s, basic public networking facilities in Asia's largest information ports will be comparatively equal, and even variances in circuits pricing will cease to be a significant factor. Real differentiation will lie in network management and outsourcing capability, labor costs, and local lifestyle. Firms prepared to take advantage of Asia's ever-expanding riches can look forward to increasingly varied and robust regional networking solutions.

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WARC-92 AND THE IMPLICATIONS FOR DIGITAL AUDIO BROADCASTING

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1. ABSTRACT

The digital technology on which computers is based has been applied to audio broadcasting, making it possible for the first time to receive CD-like quality in the difficult portable and mobile environment. WARC-92 allocated frequency bands for providing digital audio broadcasting services from satellite and terrestrial transmitters, clearing the way for selecting an appropriate digital audio broadcasting system. The implications of the decisions reached at WARC-92 for digital audio broadcasting and its implementation are highlighted.

2. INTRODUCTION

The arrival of compact disks and digital audio tapes has given radio broadcasters sources of programme material having very high technical quality. Until recently broadcasters were resigned to the notion that they could not deliver the same technical quality to listeners due to the limitations of AM and FM technology and the characteristics of the transmission path. However, with the advent of digital broadcasting which utilizes similar technology to that employed by compact disks and digital tapes, the door was opened for AM and FM broadcasters to overcome the technical limitations and join the age of Digital Audio (or radio) Broadcasting (DAB).

DAB received a big boost at WARC-92. One item on the agenda of the WARC was to consider the allocation of a frequency band for the broadcasting-satellite service (sound) in the frequency range of 500-3000 MHz, including the accommodation of complementary terrestrial sound broadcasting uses within this allocation. After deliberations which extended over a month the Conference decided on an allocation.

3. WARC-92

The term 'WARC-92', refers to the World Administrative Radio Conference which was concluded in Málaga-Torremolinos, Spain on March 3, 1992. Such international conferences are held periodically to make major decisions regarding the use of the frequency spectrum and satellite orbits. It is only through the agreement of member administrations that there can be order in the use of radiocommunications. WARCs are administered by the International Telecommunications Union (ITU), based in Geneva, Switzerland.

In addition to WARCs, the ITU oversees other activities among which are the activities of an important committee, the CCIR (Comité Consultatif International des Radiocommunications). Member administrations develop Reports and Recommendations primarily on technical matters, with the objective of allowing radiocommunication services to be provided in an environment essentially free from interference. The CCIR played an essential role in preparing for WARC-92, producing an important Report which served as the technical basis for the Conference.

4. WARC-92 DECISIONS ON DAB

There was unanimous agreement at the WARC that digital audio broadcasting was needed, and there was general agreement on typical technical characteristics. But beyond this, agreement on a frequency band was very difficult. The major problem was that the frequency range in question, 500-3000 Mhz, is being utilized by various services in various countries, thus there was reluctance to a lesser or greater degree, to introduce a new service. In addition, there were several implementation concepts of DAB. Some countries considered satellite only services, others terrestrial only, others needed satellite and terrestrial in the same band while others found it more convenient to implement satellite and terrestrial services in different bands. In several of these combinations two grades of service were proposed; one having excellent grade equivalent to compact disks and the other having lower quality grade which would be more economical and faster to implement.

After numerous discussions and compromises, the following was agreed upon for **satellite and terrestrial** DAB:

a. The band 1452 - 1492 MHz (L-Band) was allocated on a world-wide basis except that,

b. the USA indicated by footnote that it would use the band 2310-2360 MHz (part of the S-Band) instead. India joined in this footnote in addition to the L-Band.

c. Some countries designated by footnote the band 2535-2655 MHz (another part of the S-Band) for DAB use in addition to the allocation at L-Band. Those countries are Belarus, China, India, Japan, Korea, Pakistan, Russia, Singapore, Sri Lanka, Thailand and the Ukraine.

d. A Resolution (COM4/W, now Resolution 528) was adopted which calls for a World Administrative Radio Conference to be held not later than 1998 to plan and rationalize the use of DAB in these bands.

Another Resolution was adopted in response to the desire by some countries to explore the VHF band for terrestrial DAB. This Resolution (COM 5/10, now Resolution 527) calls on the CCIR to undertake the relevant technical studies associated with terrestrial DAB, focusing primarily on the VHF broadcasting bands, and requests consideration of placing on the agenda of a future conference, the subject of terrestrial VHF digital sound broadcasting for Region 1 countries and interested countries in Region 3.

In addition, several countries suggested that future systems might not be limited to the geostationary satellite orbit, especially in high latitude areas. Since non-geostationary satellite orbits had not been studied in detail, Resolution (GT-PLEN/2, now Resolution 522) was adopted asking the CCIR to study, inter alia, the characteristics of the GSO and non-GSO for satellite DAB.

Finally, because of the impact that the broadcasting satellite service would have on existing services, a number of administrations have elected to limit the DAB services to a secondary status until the year 2007. This is one of several means available for allowing sufficient time for existing services to phase out their operations.

The administrations which chose an additional band at 2535-2655 MHz (c. above) have the option to also use the 1452-1492 MHz band. Indeed, the USA may also be able to obtain the option to use the 1452-1492 MHz band at some point in the future by seeking the agreement of neighbouring administrations.

Since all three frequency bands are currently used by most administrations for other services, there was the need to provide for an orderly transition to the broadcasting service. Resolution 528 therefore, calls for a competent conference, to be held preferably by 1998, to plan the broadcasting-satellite service, develop procedures for the coordinated use of complementary terrestrial broadcasting, and review criteria for sharing with other services. In the interim, terrestrial and broadcasting-satellite systems would have to be successfully coordinated with other administrations. Until the future conference has been convened, broadcasting-satellite systems are restricted to the upper 25 MHz of these bands, subject to successful coordination with administrations in accordance with the procedures described in Resolution 33 of the Radio Regulations.

5. IMPLICATIONS FOR DIGITAL AUDIO BROADCASTING

Now that WARC-92 has dealt with the frequency band issue, the next major challenge is the selection of a DAB system standard and the preparation for the 1998 WARC identified in Resolution 528. For much of what follows the discussion focuses on systems that might be introduced in the new L-Band and S-Band frequencies which are the subject of that conference. Systems providing excellent CD-like quality will be addressed, it being recognized that others with lower quality to meet specific applications could be derived from these systems or designed separately. During the preparations many common domestic issues will be considered by administrations and the results submitted to the CCIR for global harmonization and consensus. Some of these issues are described herein.

5.1 System Standardization

With the new broadcasting bands, we have the rare opportunity to select a new system rather than follow the usual practice of trying to modify and improve an existing system. It is also convenient and economical to choose one standard which could be used for terrestrial and satellite services. What characteristics should the system have, knowing that we will likely have to live with the selection for decades to come?

CCIR Recommendations 774 for terrestrial DAB and 789 for satellite DAB describe, among other things, the desirable technical and operational characteristics and capabilities of the high quality digital broadcasting system of the future. The aim is to have the same or very similar characteristics for both the satellite and terrestrial services. From these Recommendations it can be concluded that the essential characteristics and capabilities of the system should include at least the following:

- technical quality must rival that available from compact disks so that broadcasters will be able to meet the growing expectations of the listening public.

- the high quality service must be available in moving vehicles which means the system must be capable of dealing effectively with multi-path signals.

- the system must use the frequency spectrum in an efficient manner.

- it must be technically feasible to use a common receiver to obtain service from all means of programme delivery such as can be obtained by many configurations of satellite and terrestrial transmitters and cable distribution networks.

- it should provide the flexibility to transmit sound programmes with lower bit rates to allow an increased number of sound programmes at reduced quality and as well should permit a trade-off between extent of coverage for a given power. service quality, and number of sound programmes.

- it should have the flexibility to also provide supplementary information such as programme related data and value added services with the capability of interfacing to information technology equipment.

- the system must be affordable.

For the past several years the CCIR has been active in reporting on studies and tests on different methods of providing DAB services, leading towards the selection of a standard system. CCIR Reports 1203 for terrestrial DAB and 955 for satellite DAB describe several possible systems, including one that has already been developed, named 'Digital system A', otherwise known as 'Eureka-147'.

How close does this Digital System A come to meeting the requirements identified for the future broadcasting system? Briefly, consider the following:

- programme material is analyzed in real time, discarding those parts (over 80%) which the human ear cannot distinguish. This goes a long way towards improving spectrum efficiency while maintaining CD-like quality.

- 6-12 stereophonic pairs are grouped together and encoded in such a way that, within limits, received multipath signals reinforce rather than destroy the direct signal. This is a powerful feature which provides interference free reception in vehicles and which allows repeaters **using the same frequency** as the main transmitter to operate within the coverage area of the main transmitter. These repeaters are called 'gap-fillers' and 'coverage extenders'.

- for both the terrestrial and satellite cases, terrestrial gap-fillers can be used to fill in areas of difficult reception, allowing the use of much lower power for the main transmitter and making the system more affordable. In the terrestrial case it also improves frequency reuse which is good for spectrum efficiency.

- coverage extenders can be used to shape service areas of terrestrial systems and allow the use of less power for the main transmitter which is good for spectrum efficiency.

- For relatively small countries, the co-channel repeaters could be arranged to form a single frequency network which covers the entire country.

- By keeping overall power levels down an optional mode of operation becomes available which represents yet another improvement in spectrum efficiency in bands which are practical for both satellite and terrestrial use. With careful planning a mixed satellite/terrestrial service can be provided in which terrestrial stations use frequency blocks which are not used by the satellite service at a particular location, and vice versa.

Most of these features have already been demonstrated using the equipment of Digital System A which could be optimized for use at the chosen frequency bands.

While some other systems are on the drawing boards and perhaps even demonstrated in laboratories, they have not yet been proven in the field. No doubt this year and next will see more activity in this regard.

5.2 Optional Ways to Implement DAB Service

The worldwide allocation at L-Band and the allocation for specific countries at S-Band provide for DAB use by both the terrestrial broadcasting service and the broadcasting-satellite service. Prior to WARC-92, CCIR studies concluded that at a frequency near 1.5 GHz, the widest implementation flexibility would be preserved and a range of coverage options would be provided. Studies need to be carried out to determine the practical use of the S-Band for terrestrial and satellite DAB by those countries which have this allocation. In any one band however, administrations should have the flexibility to implement satellite and terrestrial DAB in one or more of the following ways:

- provide a terrestrial broadcasting service as a prelude to a future satellite service.

- provide a broadcasting-satellite service first and complement it later by a terrestrial service.

- provide both of the above services at the same time.

When terrestrial and satellite services are to be introduced at different times careful planning will be required in order to allow for the appropriate mix between satellite and terreatrial services. With the flexibility described above, administrations can meet the need for national, regional, and local services all within the same frequency band using the same receiver. The ability to use the same receiver for the reception of both satellite and terrestrial services is both convenient for the consumer and cost effective.

Generally, it would be difficult to have a broadcasting-satellite service put into operation in anticipation of listeners eventually buying receivers. It seems easier and more likely that regardless of the ultimate broadcasting use, terrestrial systems will be implemented first. This would allow a build up of receivers in the hands of the public to the point where it would become economically more feasible to introduce a broadcasting-satellite service.

5.3 Questions for Administrations

With all the various factors to consider, each administration needs to determine for itself what its needs are. Once the public becomes aware of the exciting possibilities digital radio has to offer the demand for such services can be expected to grow. Administrations need therefore to think seriously about what form of digital radio would best meet their needs so that the appropriate framework can be put in place to achieve their objectives. Even if an administration is not interested in early implementation, preparatory work is necessary to preserve future options.

In this regard there are some fundamental questions which need to be addressed including:

- Should digital radio be provided by satellite only, by terrestrial means only, or a mix of both?
- If the service is to be a mix of satellite and terrestrial what should the balance be?
- What are the relative merits of the available frequency bands for the desired operation?
- Would the digital service replace AM or FM, or be an add-on service?
- What is the appropriate mix of local, sub-national, and national services and how can this mix be met?
- How important is it to have freedom from multi-path degradation?
- Is high quality service required or will lesser quality do?
- Should a satellite service be provided from a geostationary or non-geostationary orbit?
- What is the best way to minimize the impact on existing services when digital radio is introduced?

5.4 New Planning Considerations

Planning terrestrial broadcasting stations is commonly done by establishing service and protection criteria and developing allotment plans through multi-lateral negotiations with neighbouring administrations. However, the fact that both the satellite and terrestrial services can be provided within the same band raises some planning situations which are not normally encountered. For example, suppose that neighbouring administrations want to implement DAB in the 1452-1492 MHz band as follows:

- Administration A wants to start with a satellite service.
- Administration B wants to start with only a terrestrial service.
- Administration C wants both a satellite and terrestrial service at the same time.

For the sake of this discussion, let us assume that the DAB system selected provides 6 stereophonic services in frequency blocks 1.5 MHz wide. A 40 MHz allocation would therefore provide 26 frequency blocks, each 1.5 MHz in width.

At some point in time it will be necessary to determine how many of the 26 frequency blocks are to be used for the satellite service since provision should be made for the terrestrial services of administration B in this exercise. Should administration B decide to use more frequency blocks for terrestrial service than administrations A or C it should be free to do so provided such use would also allow the other administrations to have their appropriate mix of satellite and terrestrial blocks.

Any of the 26 frequency blocks which are not identified for the satellite service in an area would be used in the development of a terrestrial allotment plan. Since such terrestrial allotments would not have to cope with the interference from the spill-over signals from the satellite service their power levels could be quite modest.

The frequency blocks identified for use in the satellite service would be associated with particular geographic areas. To re-use the same frequency block in the satellite service may require a large geographical separation. In a mixed service concept, these same frequency blocks would be re-used by the terrestrial service at locations between the satellite service areas. This mixed satellite/terrestrial concept represents a significant improvement in spectrum efficiency. Since these terrestrial stations would be operating in the presence of spill-over signals from satellites, careful planning would be required to attain usable sizes of service area for the terrestrial service.

5.5 Further Preparatory Work

Traditionally, terrestrial broadcasting services have been provided over a given area by a single high-powered transmitter. This requires that co-channel stations be separated by large distances, resulting in low frequency re-use. A second disadvantage is that there are high levels of field strength in the vicinity of the transmitter and this can invite interference and other problems. The ability to use gap-fillers and coverage extenders in the DAB terrestrial service however, gives the opportunity to depart from the conventional way of providing coverage. By using a lower powered main transmitter and relying on gap-fillers to fill in areas of low signal strength, and on coverage extenders to shape the periphery of the coverage area, frequency re-use can be significantly improved and interference potential reduced. Combining the results of the propagation and DAB system tests that have been carried out so far has led to the conclusion that at 1500 MHz, reliable DAB coverage in dense urban, urban, suburban, and rural areas can be achieved by using relatively low power. No doubt S-Band will be similarly investigated in the near future.

In the area of satellite DAB, once the system standard has been selected and optimized for the appropriate band it will be possible to determine appropriate operating parameters and constraints to achieve the desired coverage. Studies so far have focused on the use of broadcasting satellites operating from the geostationary orbit, which is the simplest case. As the latitude increases however, it becomes increasingly difficult to provide coverage because shadowing increases as the arrival angle decreases. Coverage at high latitudes can be achieved by placing several satellites into highly inclined elliptical (i.e. non-geostationary) orbits and arranging to have them pass over the desired coverage area sequentially. The use of non-geostationary orbits need not be limited to providing satellite service at high latitudes. Resolution 522 of WARC-92, proposed that both the geostationary and non-geostationary satellite orbits be studied. The choice of the type of satellite orbit has a direct impact on the required operating parameters.

One of the tasks identified in Resolution 528 was to determine criteria for sharing between DAB and other services. Such criteria will give administrations the necessary tools to assess the impact that the introduction of DAB would have on the existing services and how to best plan to make the most efficient use of the spectrum in both the short and long term. If sharing proves to be very difficult, an alternative rationalization for introducing DAB and minimizing the impact on existing services would have to be determined. Time-phased introduction is one approach which should allow sufficient time for existing services to be phased out only whenever and wherever necessary.

6. SOME DOMESTIC CONSIDERATIONS

In implementing WARC-92 decisions, there are a number of domestic considerations which can come into play, depending on the actual broadcasting use envisaged, the nature and extent of existing services, and the protection they are to be afforded domestically. For example, Canada is proceeding to implement DAB at an early date by taking the existing fixed service into account when DAB is planned. All efforts will be made to implement DAB in a way that delays the impact on the existing services so that at many locations they won't have to vacate the band for a long time. While the exact details on just how this can be accomplished have yet to be worked out, something along the following lines could be envisioned:

- The criteria for the operation of DAB services and the continued operation of existing services for as long as possible would be set.
- When the operating parameters for terrestrial DAB are known and the size of service areas fixed, the required geographical separations between various DAB systems and existing fixed systems may be determined.
- Once the geographical separations are known an allotment plan for terrestrial DAB could be drawn up.
- During the implementation stage, the first frequencies to be used for broadcasting in any area will be those which would have the least impact on existing services.
- The satellite service will be introduced when there is a sufficient receiver penetration in the hands of the public.

In several cases, it may be that existing services could remain in place for many years. In other cases it may be that some DAB allotments would have an associated implementation schedule which would allow existing services lead time to make alternative arrangements or vacate the channel if there is no alternative. But these kinds of details have yet to be worked out and they are unique to the prevailing situation in each country.

7. OTHER STUDIES

Aside from the studies requested by Resolution 528 for the future WARC, the CCIR has also been asked to study the feasibility of providing terrestrial digital radio broadcasting in the VHF band, focusing primarily on the broadcasting bands. Work has been undertaken in some countries in Europe aimed at using the FM band or part of the TV band for DAB. The concept is to use vacant allotments or to introduce temporary measures for digital use until the FM band is vacated for DAB.

In the USA, work is being undertaken to determine the feasibility of allowing FM and AM broadcasters the opportunity to also provide a digital service without requiring the use of new frequency spectrum. Several new concepts have been advanced for consideration including in-channel digital signals operating at lower power levels than the FM or AM signal, and digital signals occupying adjacent channels. Testing of several proposed systems will be undertaken by the EIA throughout 1993. The practicality of these systems and the extent to which they can meet the characteristics and capabilities for digital radio given in CCIR Recommendation 774 should be known before the end of the year.

8. CONCLUSIONS

Although the decisions of WARC-92 have cleared the way for the introduction of digital audio broadcasting by both terrestrial and satellite means there is clearly much more work to be done to progress from the concept stage to the implementation stage. Additional developmental work such as the establishment of DAB stations in various countries as soon as possible would help to provide the required broad base of information and experience essential to other administrations and the CCIR.

Of particular importance is the selection of a world-wide system standard for DAB. If the appropriate system is selected, all administrations would benefit from the economies of scale and the convenience of having one common receiver. This has been traditional in radio broadcasting.

Reaching agreement on a worldwide system standard at the October 1993 meetings of CCIR Working parties 10-11S and 10B, would provide a good boost to the start of preparations for the 1998 WARC.

References

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DAB SYSTEMS FOR THE WESTERN HEMISPHERE:
SATELLITE SYSTEM DESIGNS

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ABSTRACT

The purpose of this paper is to describe the designs of several satellite digital sound broadcasting systems intended either for domestic service to the United States or for regional or global service involving the United States. The systems are categorized according to their service requirements, including service area, receiver size, mobility and cost constraints, and the number, type and fidelity of audio programs to be provided. The nature of the relationship between service requirements and the regulatory, environmental and technological aspects of system design are described both in general and for each of the specific systems considered.

1. INTRODUCTION

As with any satellite radiocommunication system, the factors that control the design of a satellite sound broadcasting system can be divided into four categories:

- Service requirements
  - broadcast service area and intended audience
  - receiver size, mobility, use, and cost constraints
  - number of audio programs and number of channels per program (mono, stereo, surround sound)
  - signal quality and availability objectives
  - constraints on the use of complementary terrestrial transmitters
- Regulatory constraints
  - available frequency allocations
  - applicable coordination procedures and/or assignment or allotment plans
  - existing services and frequency sharing criteria
- Environmental phenomena in the available frequency bands
  - propagation impairments
  - noise environment
- Technological alternatives and cost tradeoffs
  - system architecture
  - source coding techniques
  - channel coding and modulation methods
  - satellite transponder and antenna technology
  - ground antenna and receiver technology.

For satellite sound broadcasting systems, the factors in the first category have the greatest impact on system design. Thus, if the requirement is to serve only fixed or mobile receivers with well-sited directional antennas, there are comparatively few regulatory, environmental or technological constraints on system design. The system can be implemented in any one of several frequency bands allocated to either the fixed-satellite service (FSS) or broadcasting-satellite service (BSS). The sharing criteria, inter-system coordination procedures (or plans) for using these bands are well established, and transponders on existing spacecraft are often available for purchase or lease to initiate the sound broadcasting transmissions. Propagation and noise impairments are not serious and do not require the use of sophisticated signal processing and modulation techniques.

At the other extreme, if the requirement is to reach receivers in land-mobile vehicles with near-perfect sound quality and very high signal availability, the satellite system design is highly constrained. The combination of a small, non-directional receiving antenna and serious propagation impairments such as foliage attenuation, path blockage, and multiple echoes restrict the choice of frequency bands to those newly allocated for this type of service at WARC-92. There are many regulatory constraints on the use of these bands for satellite broadcasting that make their availability for early system implementation uncertain.

To begin with, only one band, 1452-1492 MHz, is allocated on a nearly worldwide basis. But it cannot be used at all in the United States, and can be used only on a secondary basis (must accept interference from, but cannot cause interference to, other services in the band) until the year 2007 in 15 European countries, 10 African countries, 4 Latin American countries and 2 Asian countries. Two other bands are allocated in certain countries: 2310-2360 MHz in the USA and India, and 2535-2655 MHz in 9 Asian countries and in Belarus, Ukraine, and the Russian Federation.

This paper is essentially the same as the author's presentation to the Technical Forum at Europa Telecom 92, Budapest, Hungary, 12-17 October 1992.

The foregoing constraints on the geographic availability of a primary allocation to the BSS for sound broadcasting make the design of satellite systems for either regional or global coverage very difficult. Moreover, all three bands are subject to planning at a future World Radio Conference to be held by 1998. Until then, only the upper 25 MHz of each band can be used and such use is subject to coordination with existing primary services. Except possibly for the 2535-2655 MHz band in the Middle East or India, use of the new bands would also require the design, construction and launch of a new satellite to provide a sound broadcasting service.

In addition to the severe regulatory constraints just described, the propagation problems associated with land-mobile reception force the system designer to use complex channel coding techniques and to consider the use of terrestrial gap-filler transmitters to reduce the satellite power that the desired coverage might also require.

Between the service requirement extremes corresponding to receivers with highly directional antennas and line-of-sight paths to the satellite on the one hand, and land-mobile receivers on the other, is a service to small portable receivers that will be used primarily at fixed indoor locations. Such a service would still use the new WARC-92 allocations, but would not need the channel coding required for land-mobile reception.

Regardless of the required service area (domestic, regional, or global), or the constraints imposed by the receiving installation (fixed, mobile, portable), the receiving antenna (directional, omni), and the propagation path (line-of-sight, obstructed), service requirements can differ in the number of channels per program channel (mono, stereo, surround sound), and the fidelity per channel. Fidelity will be identified as AM-quality, FM-quality and CD-quality corresponding respectively to audio bandwidths of about 7.5, 15 and 20 KHz and digital bit rates of 16, 32 and 64 kb/s per monophonic channel. The number and fidelity of the required audio channels will of course also impact the design of the satellite sound broadcasting system.

With this introduction to the relationship between service requirements and system design as background, the design of five different types of existing and proposed satellite sound broadcasting systems will be described. All of the systems are intended either for service to the United States or for regional or global service involving the United States. The systems differ in their service requirements as shown below in Table 1; the descriptions are given in Sections 2 through 6.

2. DOMESTIC SATELLITE SOUND BROADCASTING SYSTEMS FOR HOMES WITH SATELLITE TV RECEIVERS

Satellite system for broadcasting radio programs directly to homes throughout the United States have been in operation for several years using analog techniques. Such systems are an adjunct to the satellite broadcasting and distribution of television programs in the fixed-satellite service (FSS) at C band (3.7-4.2 GHz). They can be received in any of the nearly 4 million US homes now equipped for satellite TV reception in this band. Using several different satellites, well over 100 programs of FM quality are available either in monophonic or discrete stereo channels using special FM subcarriers in the video baseband of the TV transmission. Many unaugmented satellite receivers can tune to these auxiliary audio subcarriers. In addition, a few C-band transponders are devoted exclusively to stereo radio programming on a single-channel-per-carrier (SCPC) basis, but these carriers require an auxiliary FM receiver for demodulation.

Until recently, digital satellite transmission of radio programs was limited to systems for distributing network programs

Table 1. Various Digital Satellite Broadcasting System Requirements and Corresponding System Examples

	SYSTEM				
REQUIREMENT	1	2	3	4	5
Service Area	Domestic	Domestic	Domestic	Regional	Global
Receiver type	Fixed indoor	Aircraft	Automobile and portable	Portable	Portable
Antenna	Highly directional	Highly directional	Omnidirectional	Omnidirectional	Omnidirectional
Propagation Data	LOS	LOS	Variable loss strong multipath	Fixed loss little multipath	Fixed loss little multipath
Signal quality	FM, CD	FM	CD	AM, FM	AM, FM
Channels/program	Stereo	Stereo	Stereo	Mono *	Monovoice & stereomusic
No. of programs/ beam	30	2	30	3*	**
System example(s)	DMX & DCR	Sky Radio	Satellite CD Radio	Afrispace & Caribspace	Radiosat International
Band	C	Ku	2.3	1.5	1.5 or 2.5
Service	FSS	FSS	BSS (Sound)	BSS (Sound)	BSS (Sound)
Status	Operational	Operational	Application Filed	Expl License	Being planned

* Initially

** 200 monovoice and 20 stereomusic distributed among 50 beams to AM and FM radio stations for over-the-air broadcast. This program distribution service used transponders on domestic satellites in the FSS bands and was begun about ten years ago using Scientific Atlanta's DATS (digital audio transmission system). During the past year, many of network affiliates converted to a new Scientific Atlanta technology called SEDAT (spectrum efficient digital audio technology), which now offers the option of compressing the audio signal to triple the number of programs that occupy a given bandwidth.

Although this satellite distribution system for digital sound programs can be considered a broadcasting-satellite service for "community reception", the high cost of the DATS and SEDAT receiving equipment (about $9000 and $3000 respectively) precluded any widespread use for direct-to-home service ("individual reception" in ITU parlance).

However, direct-to-home digital sound broadcasting was recently inaugurated as a 30-channel subscription service called Digital Music Express (DMX) on transponder 19 of the C-band domestic satellite Satcom F4 at 82° W.L. Reception of the DMX programming requires a special set-top converter.

3. DOMESTIC SATELLITE SOUND BROADCASTING SYSTEM FOR IN-FLIGHT AIRLINE PASSENGERS

A satellite radio broadcasting service to airline passengers aboard commercial airliners while in flight could also be described as a broadcasting-satellite service for community reception. A single receiving installation on the aircraft feeds a local distribution system that provides a stereo audio connection to headphones at each passenger seat. The receiving installation can use a highly-directional steerable antenna mounted so as to have a line-of-sight path to the satellite. Apart from the need for automatic tracking of the satellite, the antenna size and gain can be essentially the same as those used for TV reception in homes. And, at cruising altitude, the propagation path will have significantly lower rain and atmospheric attenuation than the path to a home receiver. As with satellite sound broadcasting to the home, a number of existing domestic satellites can be used. However, to keep antenna size compatible with installation on commercial aircraft, K_u-band satellites are clearly preferable to C-band satellites.

Just such a digital satellite sound broadcasting system was inaugurated in the summer of 1992 by the newspaper "USA Today", in partnership with Flite Communications Systems, Inc. Called "USA Today Sky Radio", the service began with one stereo audio channel providing live news, sports and weather on a 24-hour-a-day basis. The advertiser-supported programming is tailored to the interests of business travelers and will eventually be available on the domestic flights of nearly every major aircraft in the fleets of Delta Air Lines and United Airlines, two of the three largest US carriers. Sky Radio plans to introduce a second audio channel in the fall of 1992. This will be a 24-hour all-sports channel including sports news, interviews with players and live play-by-play coverage of sporting events.

The service originates in the Sky Radio broadcasting studio at USA Today's headquarters in Arlington, Virginia. Two feeder link antennas operating in the FSS uplink band at 14.0-14.5 GHz are used with the GSTAR 3 satellite at 93° W.L. to provide downlink coverage in a single beam of the coterminous United States (CONUS) plus most of southeastern Canada at en eirp level of about 54 dBW in the FSS K_u band (11.7-12.2 GHz). The satellite tracking receiving antenna is mounted in a low-profile radome on the top of the aircraft. The output of the associated digital receiver/audio processor is then routed to passengers through the aircraft's existing entertainment center. The Sky Radio service requires no flight-crew operation or monitoring and is available as soon as the cabin audio system is turned on.

As the necessary technology becomes available, USA Today Sky Radio may offer live audio programming on international flights. It may also expand its service to include in-flight live TV using the existing satellite antenna with compressed digital video receivers and seatback video displays.

4. DOMESTIC SATELLITE SOUND BROADCASTING SYSTEMS FOR PORTABLE AND AUTOMOBILE RECEIVERS

As explained in the introductory section, satellite sound broadcasting to portable and land mobile receivers poses a much more serious system design problem than does reception by properly-sited highly directional antennas at homes or aboard commercial airliners. The combination of small, nearly omni-directional antennas and the sometimes rapidly-varying propagation path to the receiver make it necessary to use one of the three new bands allocated to the BSS and the terrestrial broadcasting service for digital audio broadcasting at WARC-92.

For a domestic system serving the United States, the only band available is the allocation at 2310-2360 MHz. To protect its extensive flight test telemetry operations, the US excluded itself from the band 1452-1492 MHz where the BSS and the terrestrial broadcasting service have primary allocations in Canada, Mexico and all other Western Hemispheric countries except Colombia, Cuba, Ecuador and Panama. In these countries the allocation is secondary until the year 2007.

Consistent with the US position at WARC-92, the Federal Communication Commission (FCC) proposed on 8 October 1992 to allocate the band 2310-2360 MHz for what it calls "satellite digital audio radio services (satellite-DARS)". To alleviate the frequency sharing problem that satellite DARS would encounter with the existing US Government and non-government terrestrial mobile and radiolocation systems that now occupy the band, the FCC made the following additional proposals. The existing systems would be permitted to continue operation until 1 January 1997, or until satellite DARS begins operations and affects, or is affected by, those services. Affected existing terrestrial services would be reaccommodated in the band 2360-2390 MHz which is already allocated to these services.

The FCC's proposal for a national allocation to satellite-DARS is part of its response to a petition for rulemaking and license applications filed in 1990 by a company called Satellite CD Radio, Inc. (SCDR). As revised on 14 September 1992, the SCDR filing includes a petition for an allocation similar to the one the FCC has now proposed but with associated allocations for feeder links and, after five years, for complementary terrestrial gap fillers. The new SCDR filing also includes a revised application to construct, launch and operate two satellites in a mobile point-to-multipoint satellite service (MPSS) for the United States plus an unlimited number of terrestrial gap fillers after five years. SCDR further requests a conditional construction permit to begin first year's construction of its MPSS satellites pending the FCC's development of the rules and regulations for using the new allocation.

As proposed by SCDR, the system operates as a private carrier on a subscription basis (monthly fee about USD 5) in a competitive environment including up to four digital sound broadcasting systems serving CONUS. It provides 30 channels of high-data rate (128 kb/s) digital signals (stereo CD-quality audio or a multiplex of lower data rate signals) to low-cost (USD 200-300) mobile, portable, and fixed receivers equipped with a small (4 x 6.4 cm) nearly omnidirectional antenna (3dBi gain).

Each of the 30 program channels is digitally compressed using a audio source coding algorithm such as MUSICAM, Dolby AC-2, or the US standard to be developed for digital audio radio by the US Electronic Industries Association. The 30 data streams plus a 128 kb/s service channel are multiplexed into a 3.97 Mb/s composite data stream which includes framing and data interleaving. The composite data stream is then channel coded using a rate one-quarter convolutional code, and the resultant 15.88 Mb/s signal modulates the carrier using offset quadrature phase shift keying (OQPSK). The resultant rf signal occupies one of four frequency-interleaved, cross-polarized, 8 MHz bandwidth channels in the proposed feeder link band, 7035-7055 MHz.

The same rf signal is fed to two SCDR satellites each providing full-CONUS coverage from a 3.2 m shaped-beam antenna mounted on a spin-stabilized bus such as the Hughes HS 376 series. The satellites provide simple frequency-translating transponders but are separated in geostationary orbit by 30° (e.g., at orbital positions of 80° and 110° W.L.). They also use different frequency translations such that their 8 MHz bandwidth downlink transmissions are separated by 20 MHz in frequency (e.g., with center frequencies at 2325 and 2345 MHz). Left-hand circular polarization is proposed for both SCDR downlink rf channels. With 20 MHz of frequency separation and 30° of orbital separation, the resultant frequency and angular diversity is expected to provide from 9 to 15 dB of mitigation against multipath fading at the SCDR receiver.

In order to be receivable on 3 dBi gain receivers, SCDR plans to use 1 kW transponders. With an edge-of-coverage satellite transmitting antenna gain of 29.5 dBi, the corresponding satellite eirp is 59.5 dBW. This leads to a maximum downlink pfd at edge of coverage of about -139 $dBW/m^2/4kHz$ over the 8 MHz rf channel. This is believed to be sufficiently low to protect terrestrial services in neighboring countries.

With the uplink and downlink frequency bands divided into overlapping, cross-polarized 8 MHz rf channels as envisioned by SCDR, three other digital satellite sound broadcasting system operators could implement 30-program-channel, two-satellite systems similar to the SCDR system. For example, with SCDR downlink channels using left-hand circular polarization at 2325 and 2345 MHz, the other operators could use left-hand circularly polarized channels at 2335 and 2355 MHz, and right-hand circularly polarized channel pairs at 2320/2340 MHz and 2330/2350 MHz.

The receiver for automobile installation would employ a small planar array (6.4 x 4 x 0.3 cm) mounted flat to the roof of the car. This provides a gain of 3 dBi at worst orientation and, with a noise temperature of 158 K, provides a G/T of about -19 dB/K at 2320 MHz. It will be able to tune to the pair of copolarized 8 MHz SCDR downlink channels and appropriately select or combine them to realize the advantages of diversity reception.

As previously noted, SCDR expects that such receivers can be supplied for USD 200-300. Portable receivers for indoor use, outdoor use, and marine applications will have similar technical capabilities. Based on its market research, SCDR expects the total number of subscribers for its service to grow from about 130,000 during the first year of service to as many as 14 million after seven years.

5. REGIONAL SATELLITE SOUND BROADCASTING SYSTEMS FOR PORTABLE RECEIVERS

With its ability to provide a reliable broadcasting service in a single frequency band to receivers within wide geographic areas (ranging from several adjacent countries to entire continents), satellite sound broadcasting can offer many advantages over HF shortwave broadcasting for regional and international coverage. Indeed, it can also form an attractive alternative to terrestrial AM and FM broadcasting in areas where such facilities do not already provide good coverage. In addition to stable constant geographic coverage and freedom from propagation anomalies, digital satellite broadcasting systems can offer data services and audio fidelity ranging from good AM quality, through FM quality, to true compact disk quality. By sacrificing audio fidelity, the satellite power and rf bandwidth for a given number of program channels can be reduced significantly, enabling smaller and less expensive satellites to be used.

When the broadcasting service area includes countries in the developing world, low cost for the satellite receiver become a dominant requirement. In contrast to the market in developed countries, the primary demand for receivers in developing countries is likely to be for hand-held portable units rather than for sets capable of reception in moving automobiles. The simpler channel coding permitted by the more stable propagation path to a portable receiver used at a fixed (or only slowly moving) location combines with the lower channel bit ratio for AM or FM-quality reception to simplify the receiver and reduce its cost.

For regional and global international broadcasting to service areas outside Asia and India, the only available frequency band is the WARC-92 allocation at 1452-1492 MHz. For service to many Asian countries, the band 2535-2655 MHz is also available as explained in the Section 1 above.

Taking into account all of the foregoing considerations, a US company called Afrispace in 1990 proposed the "Afristar" system. This system would be able to provide service to all African and Middle Eastern countries except possibly for those who do not choose to change their WARC-92 decision to keep the 1452-1492 MHz allocation secondary until the year 2007. This coverage would be provided from a single geostationary satellite with separate beams for the Middle East plus the northeast part of Africa, the northwest part of Africa, and the south central part.

The initial Afristar satellite, a so-called "lightsat", planned for launch in 1994 would provide twelve monaural voice channels in each beam using about 75 kHz of rf spectrum per channel for a total spectrum occupancy of 2.7 MHz. Future system augmentations would offer larger numbers of channels and rf channel bandwidths up to 300 kHz. Afrispace envisions the use of lightweight inexpensive, solar-powered receivers fed by 5 dBi gain "patch" antennas and selling for about USD 50. The FCC has granted Afrispace an experimental license to uplink its system from the US.

More recently, an affiliate of Afrispace called Caribspace received an official license from the Government of Trinidad and Tobago to cover the Caribbean Basin with a system technically similar to that proposed by Afrispace.

6. GLOBAL SATELLITE BROADCASTING SYSTEM FOR PORTABLE RECEIVERS

The only truly global digital satellite broadcasting system is still in the planning stages. The system concept has been developed by the International Radio Satellite Corp. (Radiosat-International). Its system is intended to provide a complete alternative to broadcasters who now use shortwave (HF) radio transmitters in the conduct of international public diplomacy. It would employ three cross-linked geostationary satellites, each with 50 steerable, switchable 1° spot beams, to provide service as needed anywhere in the world. Beams would normally be directed towards populated areas and in particular centered on major cities. Coverage of an area larger than that illuminated by a single 1° beam would, of course, be obtained by switching the same program into two or more adjacent beams.

The rf power of each satellite would be sufficient to support a combination of 200 monaural voice channels of better than AM radio quality, 20 FM-quality stereo music channels, and 300 kbps of data in a total of about 20 MHz of spectrum, to be divided as desired among some or all of the 50 beams. These channels would be available to all countries of the world on an equitable basis permitting them to broadcast to one another on a reciprocal basis as with shortwave. Initial system planning was based on the valid assumption that WARC-92 would provide an appropriate allocation near 1500 MHz, but Radiosat International continues to explore system designs optimized for the WARC-92 allocation near 2600 MHz.

Acknowledgment

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Biography

Edward E. Reinhart is a consultant to several corporate clients on the technical and regulatory aspects of satellite systems designed for such applications as broadcasting, mobile, and point-to-point telecommunications. He was Director of Spectrum Engineering for various divisions at COMSAT in Washington, DC, from 1977 to 1988; Manager of NASA broadcasting satellite studies at the Jet Propulsion Laboratory in Pasadena from 1974 to 1977; and a member of the technical staff in the Engineering Division of the RAND Corporation from 1954 to 1974. He has been active in CCIR Study Groups and ITU Radio Conferences since 1968 and participates in current US studies on broadcasting-satellite issues.

SATELLITE CD RADIO SYSTEM TRADES

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1. ABSTRACT

The search for an economical solution for nationwide satellite digital audio broadcasting (DAB) of 30 digitized compact disk (CD) quality music channels to mobile users has led to a dual satellite, single carrier time division multiplex (TDM) transmission system. The satellite transponder consists of a parallel path distributed amplifier, which requires a minimum of satellite power and circuit complexity. The dual satellite path in connection with receiver diversity combining provides robust mobile communication.

2. INTRODUCTION

This paper discusses several methods of transmitting 30 digitized CD quality music channels to the contiguous United States (CONUS) via satellite for reception by mobile users. Various multiple access and multiplexing methods are analyzed, including frequency division multiple access (FDMA), time division multiple access (TDMA), TDM, and code division multiple access (CDMA) taking into account link fades due to attenuation and multipath. It is shown that, with frequency division multiple access (FDMA) transmission and a bit rate of 256 kbps per CD music channel, the satellite dc-power requirements are enormous, whereas using a 128 kbps CD music channel in connection with TDM and path diversity combining, the dc-power requirements are moderate and can be handled by a medium class satellite.

The system trades derived such optimum system features as dual satellite path and single carrier TDM transmission. Single carrier TDM does not suffer from multipaction problems, intermodulation noise, or power loss due to amplifier backoff; it uses satellite dc-power most efficiently. The satellite payload, which is extremely simple, is a single distributed transponder, with a small X-band receive antenna and a single feed shaped beam S-band reflector that fits on a wide-body spinning satellite.

The modest payload EIRP and power requirements are in part due to the diversity method proposed by Satellite CD Radio, Inc, which doubles the channel requirement but takes several decibels of fade margin from the link, resulting in an overall system power reduction.

A considerable number of system tradeoff studies were conducted to arrive at an optimum CD radio satellite configuration. These tradeoffs included modulation, multiple access and configuration analysis, link and spectrum efficiency analysis, and fade and diversity path investigations.

As it is well known, the mobile link suffers from multipath and shadowing. Using diversity, the link fading can partly be mitigated with a dual satellite path, i.e., the mobile receiver receives identical information from two satellites via two separate frequencies. Depending on the type of diversity combining, whether selection or signal combining, the overall fade margin can be increased. The amount by which the fade can be mitigated depends on the fading model, whether multipath, shadowing, or both.

The appendix shows that, by use of path diversity, a considerable fade margin of the dual link can be achieved for only a moderate fade margin of the individual link.

2.1 Original Concept

The original Satellite CD Radio, Inc Federal Communications Commission (FCC) filing considered 60 channel satellites, where each CD radio channel was transmitted through a separate transponder. The satellite would receive 15 independent or 60 dependent CD radio channels through a Ka-band antenna/receiver and transmit those 15 (60) channels into four to six time zones, resulting in 60 channel RF power transmission (Figure 1). Figure 2 shows the associated transponder diagram (configuration 1). By time division multiplexing five CD radio channels, the number of carriers could be reduced from 60 to 12 (configuration 2, Figure 3) with each carrier requiring five times as much bandwidth and transmitter power as those carriers in configuration 1. Total transmitter power and bandwidth would remain the same.

2.2 Diversity System

Satellite CD Radio, Inc conceived a diversity system that required that 120 channels be transmitted from each satellite. Each satellite would receive the full complement of 30 channels and output 120 channels (Figure 4). On the ground, the mobile receiver would select the stronger of two carriers received from two satellites or diversity combine the two carriers to reduce the required link margin of 9 dB to 4 dB. A 120 channel transponder system (configuration 3) would have the same make up as configuration 1. Again, by time division multiplexing five channels, the number of transponders can be reduced to 120/5 = 24 (configuration 4). It should be noted that the reduction in single path link margin must be bought by a more complex mobile receiver system. This receiver must be able to diversity-combine two satellite transmissions into a single data stream.

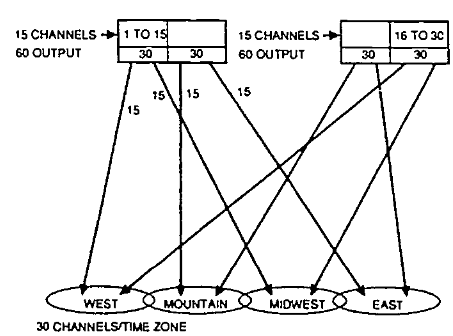

Figure 1. Original Satellite CD Radio Concept

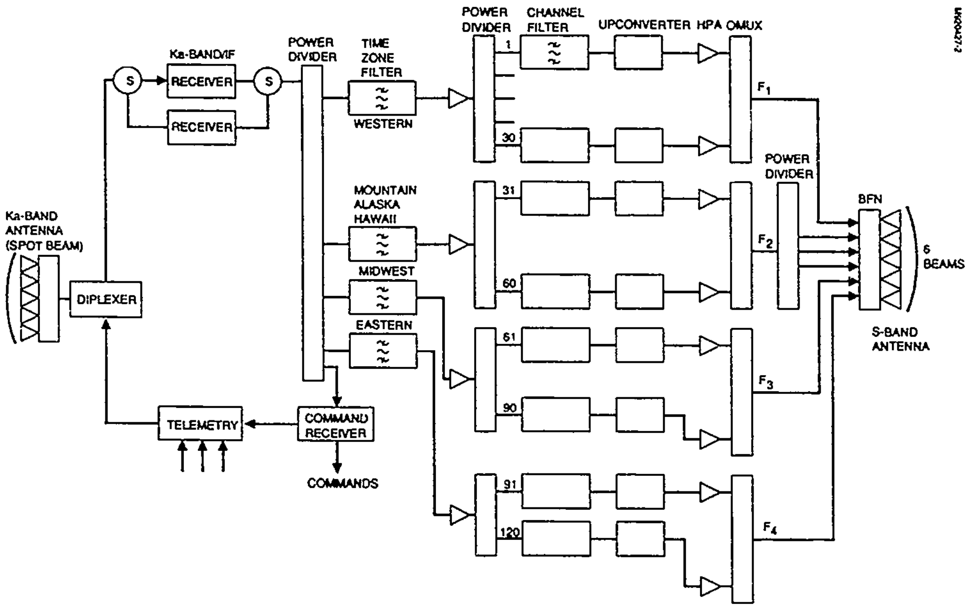

Figure 2. Transponder Configuration 1, 60 Channels FDM

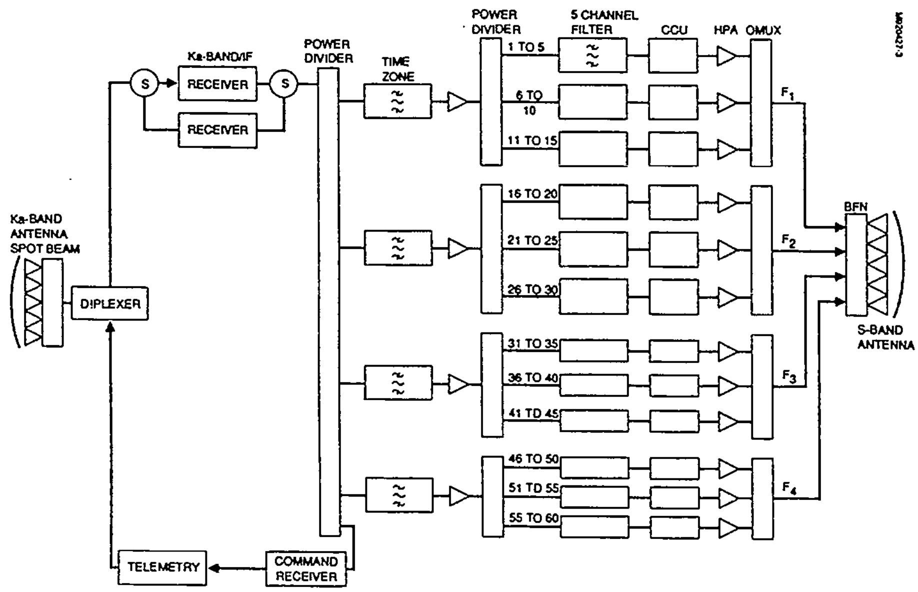

Figure 3. Transponder Configuration 2, 60 Channels TDM/FDM

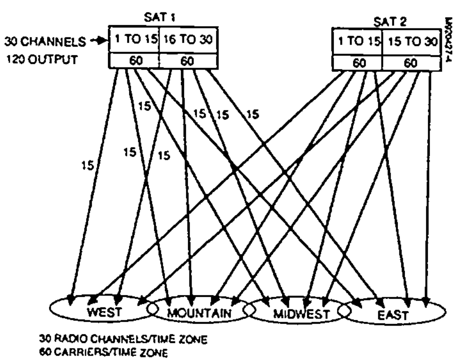

Figure 4. Modified Concept

2.3 Reduced Channel Bit Rates

The CD channel transmission rate of 256 kbps can be reduced to 128 kbps by applying an improved redundancy removal algorithm. Such algorithms for two dependent stereo channels (being developed by Scientific Atlanta Company, AT&T, Sony, and others) should be available in early 1993 (Table 1). Using the same configurations as before means that the bandwidth and RF power can be reduced in half while the

Table 1. CD Bit Rates of Scientific Atlanta Spectrum Efficient Audio Technology (SEDAT)

Bit Rates, kbps	*Requirement*
256	For 2 independent stereo channels
192	For stereo dependent algorithm
128	In development, will be marketed early 1993

number of CD channels per satellite is maintained. The resulting configurations are called 1a, 2a, 3a, and 4a.

2.4 Comparison Among Multibeam Systems

The resulting eight multibeam configurations 1, 2, 3, 4 and 1a, 2a, 3a, and 4a are compared in Tables 2 and 3. The total dc power requirement (derived from Table 4) ranges from 7000 watts for nondiversity to 2200 watts for diversity and bit rate reduction. However, all these system implementations require a large amount of transponders in addition to a large antenna (6 meters).

2.5 Comparison Between Multibeam and Single Beam Systems

Link power budgets for four spot beams and a single CONUS beam (Figure 5) are shown in Table 4 for FDM multiplexed channels. The table shows that the CONUS beam carrier requires four times the power of the spot beam carriers, but the total RF power requirement is identical (Table 5). The 6 meter spot beam antenna is twice the size of the CONUS beam antenna (3 meters). Also, because there are 30 carriers to be multiplexed for FDM, there may be multipaction problems. Multipaction happens when the signal peaks of independent signals add up in amplitude and cause voltage, i.e., field strength breakdown. For the CONUS beam, the FDM multicarrier CD radio satellite transponder (configuration 5) is shown in Figure 6, and the TDM-FDM CD radio satellite transponder (configuration 6) is presented in Figure 7. The CONUS beam antenna is of modest size (3 meters) and fits on a modestly sized satellite with spin stabilization.

Table 2. SCDR Configurations 256 KBPS Per Channel

Parameter	1	2	3	4
Frequency band	Ka to S	Ka to S	Ka to S	Ka to S
NR of CDR channels/satellite	60	60	120	120
Access method	FDMA	TDM/FDMA	FDMA	TDM/FDMA
RF channels/satellite	60	12	120	24
NR of beams	4/6	4/6	4/6	4/6
Antenna gain, dBi	34.0	34.0	34.0	34.0
Beam width, deg	2 X 3	2 X 3	2 X 3	2 X 3
Ratio/path combining	No	No	Yes	Yes
Fade margin, dB	9.0	9.0	4.0	4.0
Power per amplifier, W	64	320	20.0	10.0
EIRP, dBW	50.0	57.0	45.0	52.0
S-band total RF power, W	3840	3840	2400	2400
Estimated spacecraft power EOL, W	6981	6981	·363	4363
Frequencies satellite 1	F1, F2, F3, F4	F1, F2, F3, F4	F1, F2, F3, F4, F5, F6, F7, F8	F1, F2, F3, F4, F5, F6, F7, F8
Frequencies satellite 2	F5, F6, F7, F8	F5, F6, F7, F8	F1, F2, F3, F4, F5, F6, F7, F8	F1, F2, F3, F4, F5, F6, F7, F8
Polarization	RHCP	RHCP	RHCP	RHCP

Table 3. SCDR Configurations 128 KBPS Per Channel

Parameter	1a	2a	3a	4a
Frequency band	Ka to S	Ka to S	Ka to S	Ka to S
NR of CDR channels/satellite	60	60	120	120
Access method	FDMA	TDM/DMA	FDMA	TDM/FDMA
RF channels/satellite	60	12	120	24
NR of beams	6	6	6	6
Antenna gain, dBi	34.0	34.0	34.0	34.0
Beam width, deg	2 X 3	2 X 3	2 X 3	2 X 3
Ratio/path combining	No	No	Yes	Yes
Fade margin, dB	9.0	9.0	4.0	4.0
Power per amplifier, W	32	160	10	5.0
EIRP, dBW	47.0	54.0	42.0	49.0
S-band total RF power, W	1920	1920	1200	1200
Estimated spacecraft power EOL, W	3490	3490	2181	2181
Frequencies satellite 1	F1, F2, F3, F4	F1, F2, F3, F4	F1, F2, F3, F4, F5, F6, F7, F8	F1, F2, F3, F4, F5, F6, F7, F8
Frequencies satellite 2	F5, F6, F7, F8	F5, F6, F7, F8	F1, F2, F3, F4, F5, F6, F7, F8	F1, F2, F3, F4, F5, F6, F7, F8
Polarization	RHCP	RHCP	RHCP	RHCP

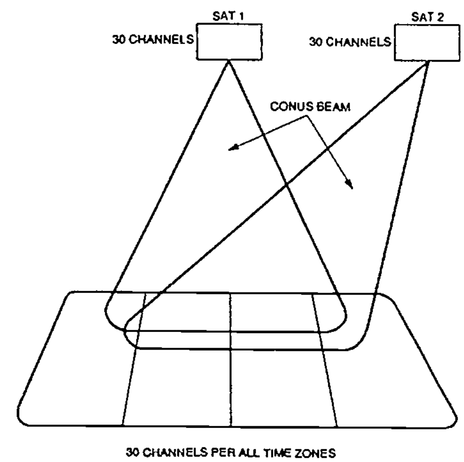

Figure 5. CONUS Beam

Table 4. Link Budgets for Spot Beams and CONUS, FDM

	Without Diversity, kbits		With Diversity, kbits	
Downlink (2.3 GHz)	256	128	256	128
4 spot beams				
Power amplifier, W	64.0	32.0	20.0	10.0
Transmitter power, dBW	18.0	15.0	13.0	10.0
Output losses, dB	-2.0	-2.0	-2.0	-2.0
Transmit antenna gain at edge of coverage, dBi	34.0	34.0	34.0	34.0
EIRP, dBW	50.0	47.0	45.0	42.0
Path loss, dB	-192.0	-192.0	-192.0	-192.0
Fading loss, dB	-9.0	-9.0	-4.0	-4.0
Earth antenna gain, dB	3.0	3.0	3.0	3.0
Received carrier, dBW	-148.0	-151.0	-148.0	-151.0
K, dBW/Hzk	-228.6	-228.6	-228.6	-228.6
B, dBHz	54.0	51.0	54.0	51.0
T, dBk	22.0	22.0	22.0	22.0
kTB, dBW	-152.6	-155.6	-152.6	-155.6
E/N_0, dB	4.6	4.6	4.6	4.6
E/N_0 required for 10^{-5} BER, dB	4.5	4.5	4.5	4.5
Margin, dB	0.1	0.1	0.1	0.1
CONUS beam				
Power amplifier, W	256.0	128.0	80.0	40.0
Transmitter power, dBW	24.0	21.0	19.0	16.0
Output losses, dB	-2.0	-2.0	-2.0	-2.0
Transmit antenna gain at edge of coverage, dBi	28.0	28.0	28.0	28.0
EIRP, dBW	50.0	47.0	45.0	42.0
Path loss, dB	-192.0	-192.0	-192.0	-192.0
Fading loss, dB	-9.0	-9.0	-4.0	-4.0
Earth antenna gain, dB	3.0	3.0	3.0	3.0
Received carrier, dBW	-148.0	-151.0	-148.0	-151.0
K, dBW/Hzk	-228.6	-228.6	-228.6	-228.6
B, dBHz	54.0	51.0	54.0	51.0
T, dBk	22.0	22.0	22.0	22.0
kTB, dBW	-152.6	-155.6	-152.6	-155.6
E/N_0, dB	4.6	4.6	4.6	4.6
E/N_0 required for 10^{-5} BER, dB	4.5	4.5	4.5	4.5
Margin, dB	0.1	0.1	0.1	0.1

Table 5. System Comparison Between CONUS and Spot Beams, FDM

Characteristic	CONUS Beam		4 Spot Beams	
	Diversity	No Diversity	Diversity	No Diversity
CD radio satellite, 30 channels, 256 kbps				
Transmitter power, W	80.0	256.0	20.0	63.0
Transmitter power, dBW	19.0	24.0	13.0	18.0
Output losses, dB	-2.0	-2.0	-2.0	-2.0
Antenna gain, dBi	28.0	28.0	34.0	34.0
Antenna size, m	3.0	3.0	6.0	6.0
EIRP/channel, dBW	45.0	50.0	45.0	50.0
NR of amplifiers	30	15	120	60
Total RF power, W	2400	3890	2400	3780
Fade margin, dB	0	9	0	9
Required dc power, dB	4363	6980	4363	6872
CD radio satellite. 30 channels, 128 kbps				
Transmitter power, W	40.0	128.0	10.0	32.0
Transmitter power, dBW	16.0	21.0	10.0	15.0
Output losses, dB	−2.0	-2.0	-2.0	-2.0
Antenna gain, dBi	28.0	28.0	34.0	34.0
Antenna size, m	3.0	3.0	6.0	6.0
EIRP/channel, dBW	42.0	47.0	42.0	47.0
NR of amplifiers	30	15	120	60
Total RF power, W	1200	1920	1200	1920
Required dc power, dB	2181	3490	2181	3490

2.6 Single Beam, Single Carrier System

To reduce system complexity of an FDM or TDM/FDM multicarrier system, Hughes has investigated a single CONUS beam single TDM carrier diversity system using a single transponder. The link power budgets, with and without diversity, are shown in Table 6 and the power requirements are given in Table 7. Total RF power requirements for a 128 kbps diversity system are 1000 watts, which compare to 1200 watts for an equivalent FDM system (Tables 4 and 5). The satellite transmits a single carrier, upon which 30 CD radio channels are offset quadraplane shift key (QPSK) modulated, requiring a total bandwidth of 7.2 MHz.

2.7 TDM VERSUS CDMA

In CDMA, the data stream of a single carrier is pseudo-noise (PN) modulated onto a higher rate carrier, thereby acquiring some multipath fading immunity. If 128 kbps are onlv spread over a bandwidth of 8 MHz, little is gained relative to single carrier TDM. On the contrary, according to Table 8, the CDMA, on a signal power basis, falls short of required E/N_0 by 4.7 dB, which would have to be made up by higher RF power or lower number of accessing carriers or a wider spread bandwidth.

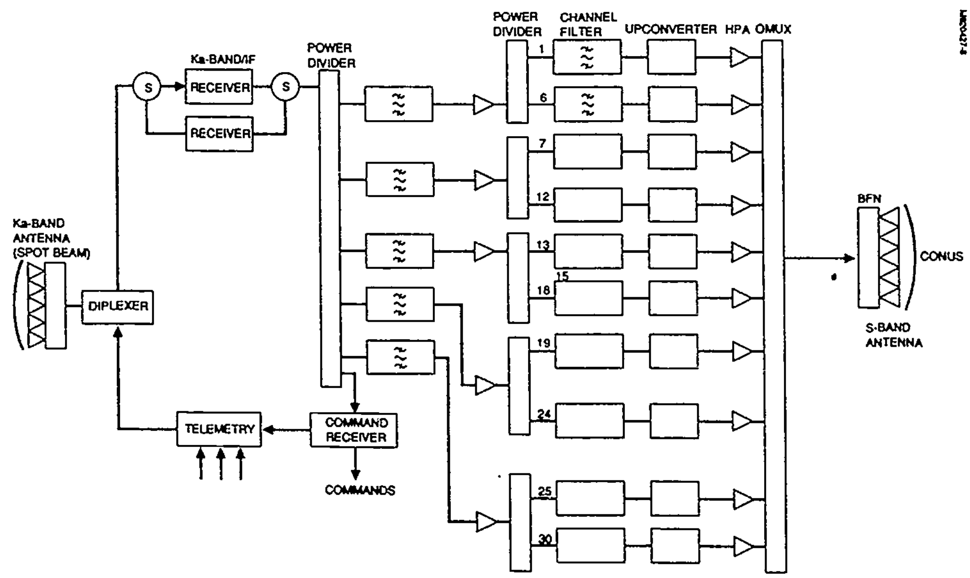

Figure 6. Transponder Configuration 5, CONUS Beam, 30 Channels, FDM

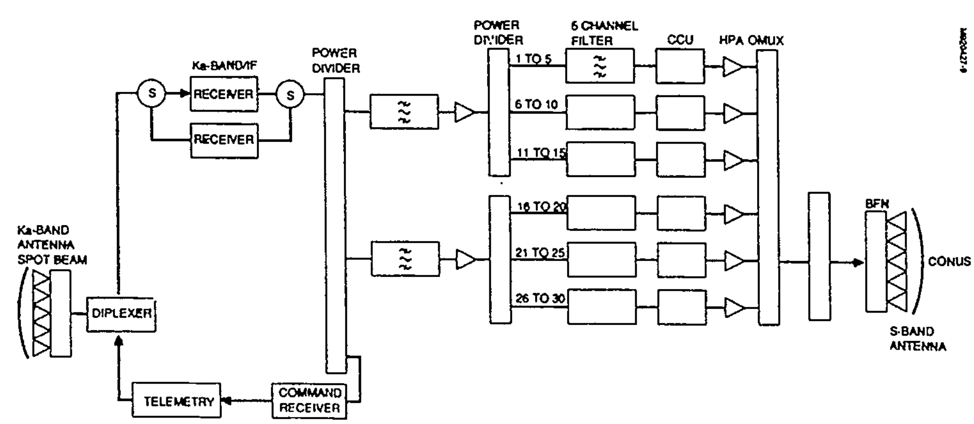

Figure 7. Transponder Configuration 6, CONUS Beam, 30 Channels, TDM/FDM

Table 6. Link Budget for TDM CONUS Beam

Downlink (2.3 GHz)	Without Diversity, kbps 256	128	With Diversity, kbps 256	128
Power amplifier, W	6,400	3,200	2,000	1,000
Transmit power, dBW	38.5	35.0	33.0	30.0
Output losses, dB	-1.0	-1.0	-1.0	-1.0
Transmit antenna gain, dBi	28.0	28.0	28.0	28.0
EIRP, dBW	65.0	62.0	60.0	57.0
Path loss, dB	-192.0	-192.0	-192.0	-192.0
Fading loss, dB	–9.0	–9.0	–4.0	–4.0
Earth antenna gain, dB	3.0	3.0	3.0	3.0
Received carrier, dBW	-133.0	-136.0	-133.0	-136.0
k, dBW/Kz K	228.6	228.6	-228.6	-228.6
B, dB Hz	69.0	66.0	69.0	66.0
T, dBk	22.0	22.0	22.0	22.0
kTB, dBW	-137.6	-140.6	-137.6	-140.6
E/N_0, dB	4.6	4.6	4.6	4.6
E/N_0 required for 10^{-5} BER, dB	4.5	4.5	4.5	4.5
Margin, dB	0.1	0.1	0.1	0.1

Table 7. Power Requirements, for TDM CONUS Beam

Characteristic	256 kbps Diversity	No Diversity	128 kbps Diversity	No Diversity
Transmitter power, W	2,000	6,400	1,000	3,200
Transmitter power, dBW	29	38	30	35
Output losses, dB	-1.0	-1.0	-1.0	-1.0
Antenna gain, dB	28.0	28.0	28.0	28.0
Antenna size, m	3.0	3.0	3.0	3.0
EIRP, dBW	60.0	65.0	57.0	62.0
Total RF power, W	2,000	6,400	1,000	3,200
Required dc power, W	3,636	11,836	1,818	5,818

Table 8. TDM and CDMA Downlink Comparison

Characteristic	TDM	CDMA
Power amplifier, dBW	30.0	30.0
Output losses, dB	-1.0	-1.0
Backoff, dB	0.0	-2.0
No. of carriers, dB	0.0	-14.8 (30)
Transmit antenna gain, dBi	28.0	28.0
EIRP/carrier	57.0	40.2
Path loss, dB	-192.0	-192.0
Fading loss, dB	-4.0	-4.0
Earth antenna gain, dBi	3.0	3.0
Received carrier power, dBW	-136.0	-152.8
k, dBW/Hz K	-228.6	-228.6
B, dB Hz	69.0	69.0
T, dB k	22	22
N, dBW	-137.6	-137.6
(C/N)d, dB	1.6	-15.2
$\frac{C}{IM}$, dB		-4.8
$\frac{C}{n-1}$ dB		-14.8
(C/N)total, dB	1.6	-18.2
WT, dB	3.0	18.0
E/N_0, dB	4.6	–0.2
E/N_0, required dB	4.5	4.5
Margin, dB	0.1	-4.7

2.8 Dual Satellite Split Capacity Versus Dual Satellite Diversity

Reverting to a two satellite system in which each satellite carries one half of the total capacity (15 channels), increases the fading margin from 4 to 7 dB. This is a possible fallback in case the diversity system has trouble in the ground receiving instrumentation. In the split capacity system, the single path link margin is doubled and the bandwidth is halved, but in the diversity system the dual path margin is higher than the single path margin.

3. Preferred System

A simple satellite configuration emerged after the advantages and disadvantages of single versus multiple beam, single versus multiple carrier, FDMA versus TDM versus CDMA, single path versus dual path were weighed. A single carrier TDM configuration was chosen because intermodulation noise and transmitter amplifier power backoff loss was virtually eliminated.

The preferred system consists of two satellites that simultaneously broadcast identical information. Each satellite transmits a single digital high power carrier of 3.97 Mbps, which is offset QPSK modulated by 31 × 128 kbps CD radio music channels. It is assumed that the mobile radio receiver is able to receive two identical 3.97 Mbps carriers, one from each satellite, diversity combine those carriers, bit and frame synchronize itself to one or the other or both incoming data streams, and provide forward error correction and TDM demultiplexing and selection of one of 30 CD radio channels.

The CD radio feeder link stations transmit a single digital carrier of 3.97 Mbps at 7.041 to 7.049 MHz to satellite 1 and to satellite 2. At the satellite, the X-band carrier is received through a CONUS beam X-band antenna, from where it is routed to an X-band receiver, which provides low noise amplification and frequency translation. In satellite 1, the incoming carrier is translated to 2325.0 MHz. After signal amplification, the carrier is power divided into eight parallel paths. Each partitioned signal passes through an input redundancy network, a commandable phase shifter, a power amplifier of 135 watts each, and an output redundancy network. All eight paths at the output of the redundancy switches are combined in a three-layer hybrid matrix network to form a high power carrier of 1000 watts. After power combining, the signal is fed to the shaped beam antenna, from where it will be transmitted to all the CONUS, providing an EIRP of 57 dBW (Figure 8). The link power budget of Table 6 (last column) shows a single link margin of 4 dB, which is equivalent to a diversity link margin of over 9 dB for path diversity combining (see Appendix). Because most users will get more than 57 dBW EIRP, the diversity link margin for a typical user would be over 12 dB for path diversity combining. The CONUS beam S-band antenna patterns from two satellite positions are shown in Figure 9.

3.1 Frequency Plans

A comparison of frequency plans for the multibeam and CONUS beam systems is presented in Figures 10 and 11. It shows that the single CONUS beam system is more bandwidth efficient than the multibeam configurations. Figure 12 shows the presently envisioned CD Radio Inc frequency plan, where the two satellite system occupies 2 × 10 MHz slots at 2.325 and 2.345 GHz, which is about 25% of the total available DAB frequency band, when using dual polarization.

4. REFERENCES

(1) *Mobile Point to Multipoint Satellite Service*, Compendium of Applications and Restatement of Petition filed with Federal Communications Commission by Satellite CD Radio, Inc;December 1991, September 1992.

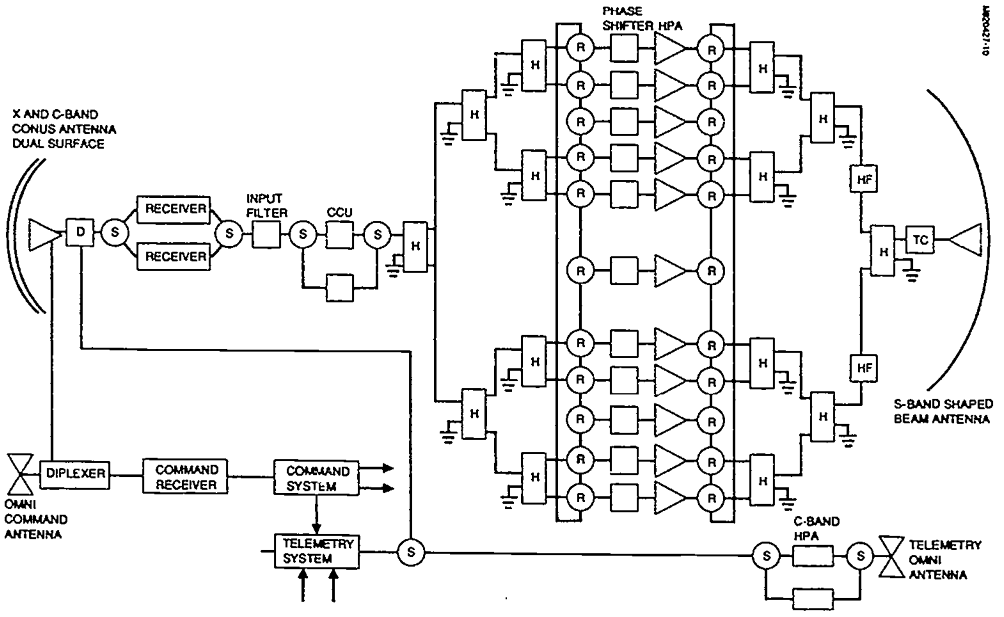

Figure 8. Preferred CD Radio Satellite Transponder, Single Carrier TDM

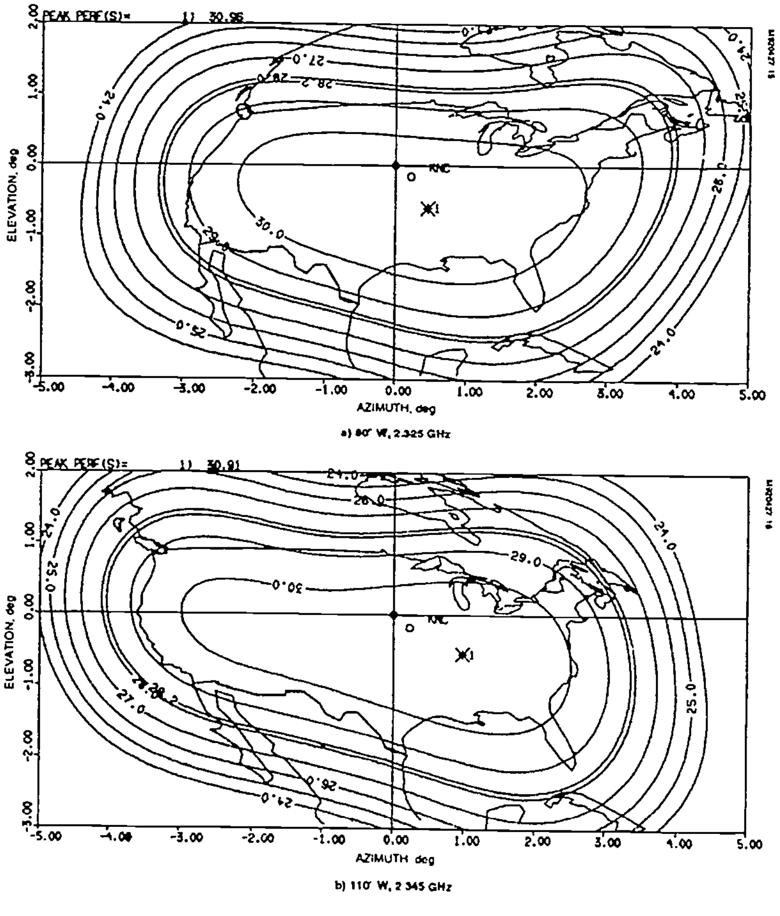

Figure 9. Antenna Directivity Contours for Two Orbit Locations

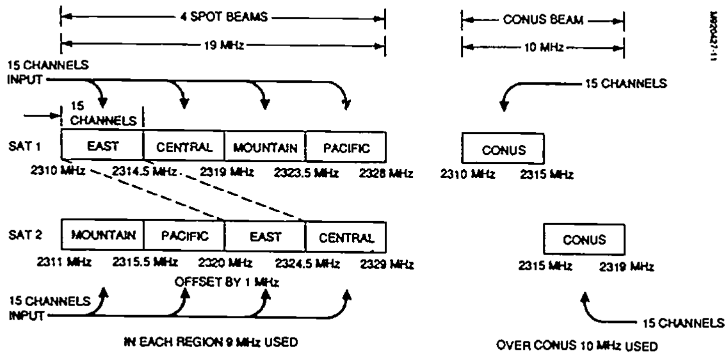

Figure 10. Frequency Plans (No Diversity)

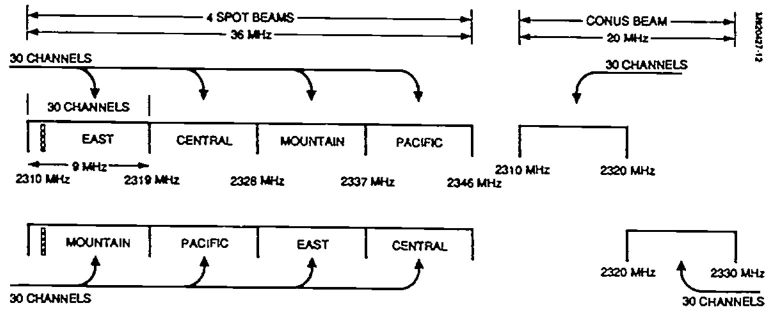

Figure 11. Frequency Plans (Diversity)

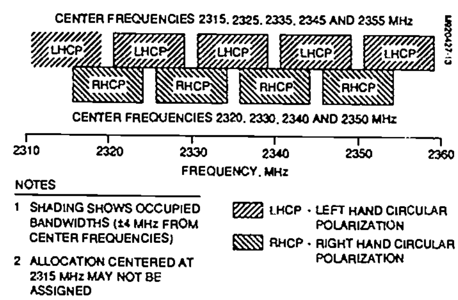

Figure 12. DAB Frequency Plan (2310 TO 2360 MHz))

(2) "Modulation and Coding for the Aeronautical Satellite Channel," Andreas Neul, *Space Communications*, November 1990.

(3) *Communication Systems and Techniques*, M. Schwartz, W. Bennett and, S. Stein, McGraw Hill, 1966.

APPENDIX

A. DIVERSITY PATH COMBINING

The effect of fading channels is to require substantially increased transmitter power for reliable communication. To compensate for the deterioration due to fading, various forms of diversity communication are used to detect the same data stream picked up over two fading channels. The expectation here is that one channel has a signal fading substantially below the median, and the other may have a signal considerable larger in amplitude. Various types of diversity systems exist like space diversity, frequency diversity, and time diversity. In addition to the different methods, there are different ways of combining the independently fluctuating signals. One may select the largest signals and simply add all output or add them after weighting each according to the average signal-to-noise ratio (SNR) measured. This last technique is called maximal ratio combining, which can be shown to be optimum in the sense that it provides the largest output SNR. The difference in link availability between a diversity link and a standalone mobile link is significant, whereas the difference between the various combining techniques is relatively small. One distinguishes between Rayleigh fading, where all signal paths are equally likely, and the Ricean fading, where there is a strong direct path. Note that the satellite system proposed operates in the 2310 to 2360 MHz frequency band using both spatial and frequency diversity on two individual transmission paths, each having elevation angles of at least 20° from the horizon.

A.1 RICEAN FADING

The mobile link suffers from shadowing, multipath and a combination of both. In case of multipath, the probability $p(y > \bar{y})$ that the signal level is larger than or equal to the normalized averaged signal envelope $\bar{y}$ is shown in Figure A-1 for a carrier to multipath ratio of 7.5 dB. For a 90% single link availability, there should be a link margin of 4.0 dB (see figure).

With path diversity, this link margin can be improved. Assuming p_1 is the link availability of path 1, p_2 is the link availability of path 2, and the link outage of path 1 and 2 is $(1-p_1)$ and $(1-p_2)$ respectively, the link availability after diversity combining with $p_1 = p_2 = 0.9$ is

$$p = 1 - (1\ p_1)(1 - p_2)$$

$$= p_1 + p_2 - p_1 p_2 = 0.99$$

By path combining the link availability has improved from 0.9 for the single link to 0.99 for the diversity link. The question as to how much is the additional fade margin that has been gained can be answered by going back to Figure A-1, which shows that a 99.0% link availability would require a 9 dB link margin. So, by path diversity, an additional (9–4) = 5.0 dB link margin has been obtained.

The link fade mitigation can be improved by increasing the single link fade margin.

A.2 RAYLEIGH FADING

For Rayleigh fading and 99.0% single link availability the required fade margin is 20 dB, and the required fade margin for dual diversity is 10 dB (see Figure A-1). Thus, for Rayleigh fading, the fade mitigation would be 10 dB, provided that the system has 10 dB of fade margin available in a single path.

A similar diversity improvement factor an be arrived at by error rate calculations.

For FEC coded coherent PSK the error rate is approximately

$$P_e = \frac{1}{2} erf_c \sqrt{\alpha \frac{E}{N_0}}$$

The error rate of a channel after it undergoes Rayleigh fading is with $E/N_0 = \gamma$ from reference (3)

$$P_{e_1} = \frac{1}{2}\left(1 - \frac{1}{\sqrt{1 + \frac{1}{\alpha\gamma_1}}}\right)$$

The error rate of a dual diversity system is approximately

$$P_{e_2} = 2P_{e_1}^{\,2} = 2\left(1 - \frac{1}{\sqrt{1 + \frac{1}{\alpha\gamma_2}}}\right)^2$$

The relative SNR ratio is

$$\frac{\gamma_1}{\gamma_2} = \frac{(1 - 2Pe)^2\left(1 - \left(1 - \left(\frac{Pe}{2}\right)^{\frac{1}{2}}\right)^2\right)}{\left(1 - \left(\frac{Pe}{2}\right)^{\frac{1}{2}}\right)^2\left(1 - (1 - 2Pe)^2\right)}$$

For an error rate of 10^{-5}

$$\frac{\gamma_1}{\gamma_2} \geq 13.0\ dB,$$

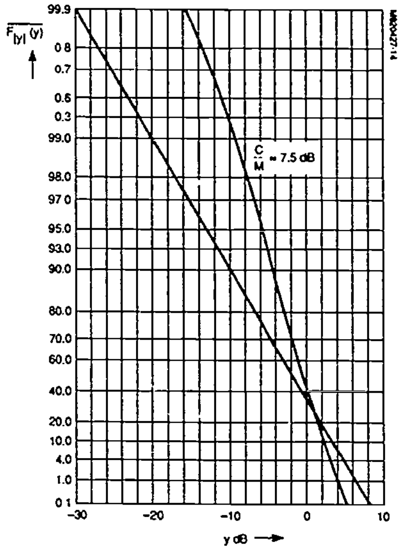

Figure A-1. Complementary Probability Distribution Function of Normalized Received Signal Envelope in Rayleigh and Ricean Fading

i.e., the received SNR in a single branch system must be 13 dB higher than the SNR in a dual branch diversity system, if both systems are subjected to Rayleigh fading. This result of fade mitigation is similar to that obtained from Rayleigh fading link outage considerations as outlined above. The improvement will not be as high for Ricean fading, probably closer to 5 dB as was estimated before.

A.3 SHADOWING

In terms of shadowing, attenuation by buildings, or other obstacles on one side of the vehicle, one can postulate that the signal from one satellite may fade more than 4 dB, while the received signal level of the other satellite is maintained. If one signal path was attenuated by 10 dB and the other signal path was not attenuated at all, fading has been mitigated by 10 dB. This argument leads one to believe that the two satellite system is more robust than the single satellite system and is therefore preferable.

A.4 CROSSPOLARIZATION

Crosspolarization isolation, which in mobile communication is usually of low value, will be increased by satellite path diversity. Therefore crosspolarization interference which is already reduced by offset transponder frequencies will further be mitigated by dual satellite path diversity.

United States Satellite Digital Audio Radio Service

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1. ABSTRACT

A description is presented of a digital audio radio (DAR) service to be provided by satellites to automobiles and other mobile and transportable terminals throughout the United States. The service is by user subscription, and the subscribers can select from among thirty types of music programming, each of Compact Disk (CD) audio quality. No commercials or other interruptions to the music occur. The system configuration, technical innovations and major engineering parameters are presented. Details of the satellites are given in a companion paper.

2. INTRODUCTION

A satellite system has been designed which provides many channels of high fidelity music to vehicles in the continental United States. (1) Since the transmissions from the satellites are digital and will be primarily CD quality music, the service is called DAR (Digital Audio Radio). Satellite DAR service is considered complementary with terrestrial radio broadcast. There are currently about 5000 AM and 4700 FM terrestrial radio broadcast stations in the United States. The stations all broadcast analog signals of modest quality in the local geographical areas in which they operate and generally are supported by revenue from advertisers. The satellite DAR service provides digital transmissions of Compact Disk (CD) quality throughout the continental United States and is subscriber supported so there are no commercial or other interruptions to the music programming.

3. SYSTEM REQUIREMENTS

3.1 NUMBER OF CHANNELS

There are 30 CD quality stereo music channels and a service channel. The number of channels is set by the requirement to have enough programming diversity that at least one of the channels will appeal to all subscribers (i.e., often referred to as "narrowcasting"). Figure 1 shows the currently proposed channel programming.

3.2 CHANNEL COMPRESSION

It is necessary to compress the stereo CD quality music before digital transmission as is currently done in most radio frequency communications systems. The compression will result in a stereo CD quality music program being transmitted at a 128 kb/s rate. The algorithm which will be used performs composite (or joint) processing of the stereo pair in contrast to algorithms which perform independent processing. Composite processing removes redundancy between the left and right stereo channels. Such compression has been demonstrated by AT&T, Sony, Scientific Atlanta and others.

3.3 VEHICLE RECEIVER

The vehicle receiver must meet the subsequently discussed economic requirements and must have an antenna which is omnidirectional in azimuth and with coverage of approximately 20°-60° elevation angle (for the continental United States and for geosynchronous satellite locations between 70°-120° W. Longitude). Such an antenna will have a 3 dBi gain at the elevation angle limits and , with an appropriate preamplifier, a G/T of -19 dB/ K. A receiver block diagram is shown in Figure 2, and a typical antenna is a planar array approximately 5 cm square by 0.5 cm thick recessed into an automobile roof with paintover for invisibility. The receiver utilizes at least two radio channels for diversity and possibly a third for reception from complementary terrestrial facilities.

3.4 CAPACITY/SPECTRUM AND ORBITAL USAGE

The satellite DAR system is configured for four operators serving the United States in the 2310-2360 MHz band using both satellite space and frequency diversity (2). Each operator would utilize two satellites, and a proposed frequency plan is shown in Figure 3. Frequency re-use of the band is accomplished by circular cross polarization (i.e., four satellites radiate right hand circular polarization and four left hand; 20 dB or more intersystem cross polarization isolation is anticipated). The total capacity of the frequency band is 120 stereo CD channels for the four operators. This capacity could be increased if required. Although all eight satellites could theoretically be co-located at one geosynchronous orbital position, the requirement for space diversity from the satellites would place pairs of satellites approximately 30° apart in the geosynchronous orbital arc at orbital locations where the minimum elevation angle throughout the coverage area is greater than 20° (e.g., 80° and 110° W. Longitude).

3.5 SATELLITES

The significant system requirement for the satellites is the relatively high EIRP which is necessitated by the previously discussed low vehicle G/T and the large number of high fidelity channels radiated per satellite. As later shown by the detailed system implementation and link budget margin requirements, an EIRP of 57 dBW would be typical at edge of coverage for a space/frequency diversity satellite DAR system covering the continental United States. The details of the satellite are described in a companion paper.

3.6 MODULATION

The 30 stereo CD music channels and a 128 kb/s service channel are digitally multiplexed together (4 Mb/s), convolutionally encoded and transmitted by quadraphase shift keying. The occupied bandwidth is somewhat less than 8 MHz. Another requirement of the digital multiplex is to perform time interleaving which reduces the probability of bit errors and multipath effects. A typical transmission link budget at 2335 MHz is provided in Table 1. Since the dual satellites provide both space and frequency diverse paths at elevation angles above 20°, multipath fading will be extremely infrequent and blockage events will be significantly decreased.

3.7 UPLINK FACILITIES

The program origination and up-link facilities required are modest, since a centralized facility is used. With geographical redundancy, the satellite DAR service requires two up-link facilities in the United States. These facilities use relatively large transmit antennas (i.e., 5-7 meters diameter) to reduce transmitter power output level and consequent cost. Radio frequency clearance on a local basis of a 10 MHz wide radio frequency band above 7 GHz is required and easily accomplished.

3.8 OPERATIONS

A satellite DAB subscriber service necessitates several requirements. It is necessary for potential users to subscribe to the service including the acquisition, installation and activation of the vehicle receiver as well as payment for the receiver and for subsequent service. The only significant technical requirement is that each vehicle receiver be individually addressable through the service channel by the control center at the up-link facility. This addressability must include the capability to turn the receiver on and off and to send messages for display such as the title and performer of the music being heard. Security of this service channel is also required to prevent the acquisition of unpaid service.

3.9 COMPLEMENTARY TERRESTRIAL FACILITIES

Blockage of both satellite paths occurs in tunnels, in a few very densely populated urban locations and in certain other infrequent circumstances. Depending on the requirement for service continuity, such blockage outages can be almost eliminated by use of sufficient numbers of satellite terrestrial repeaters. In one mechanization, such terrestrial repeaters would receive the satellite S-band signal, translate it to an unused S-band channel and radiate it at low transmitter power with a directive antenna into the local geographical area where blockage has prevented service. It is unknown presently if such repeater facilities will ever be required and, if so, when in the system development. The vehicle receiver could employ a third channel for receiving signals from complementary terrestrial facilities, although it is believed possible to mechanize one of the diversity channels in the receiver for this additional function.

3.10 INTERNATIONAL INTERFERENCE

The significant requirement is to ensure that no unacceptable interference occurs from the satellite transmissions into 2310-2360 MHz receivers in Canada, Mexico and the northern Caribbean. The satellite antenna pattern has a roll-off in gain such that other countries are not affected. However, the satellite antenna's edge of coverage for the United States corresponds to the southern border of Canada and the northern border of Mexico. This results in a -139 dBW/4 kHz/m^2 flux density at these borders. Table 2 shows the flux density calculation. Detailed coordination is necessary with both countries. It is noted that none of the approximately 172 receivers currently used by Canada in the 2310-2360 MHz frequency band with high gain antennas (i.e., greater than 30 dBi) have their main beam pointing at the geosynchronous orbital arc of interest (i.e., 70-120° W. Longitude).

4. IMPLEMENTATION

The DAR satellite system is shown in Figure 4. The Figure also roughly illustrates how the use of the two satellites reduces blockage in the overall system configuration. It is noted that the automobile receiver block diagram shown previously in Figure 2 is capable of normal analog AM and FM reception and digital audio reception from terrestrial broadcast stations as well as the subject DAR service from satellite. Less than one quarter of the receiver electronics is involved with the satellite signal. Figure 5 is a block diagram of the uplink facilities including the programming center and the satellite TT&C (Tracking, Telemetry and Control) center.

5. ECONOMIC REQUIREMENTS

Satellite DAB systems operating on a subscription basis must be affordably priced. There are two major requirements, the previously mentioned low cost vehicle receiver and the monthly service price. Vehicle receiver prototypes have been built for DAR terrestrial reception at microwave frequencies with price estimates in quantity of $150-200 US (3). Similar DAR service is currently provided to homes through cable television systems. Such subscribers currently pay between $5-10 US per month. The major capital requirement for implementation of a satellite DAR system is the satellites and launch vehicles. Estimates have been made that two satellites and launch vehicles would cost approximately $200-300 Million US.

6. SUMMARY

A domestic satellite system providing United States DAR service operating in the 2310-2360 MHz frequency band has been presented. Implementation of this system will soon be started and will provide by 1996 new radio services to mobile users such as freedom from commercials, better fidelity music, much larger selection of programming and nationwide coverage.

(1) Satellite CD Radio, Inc; FCC Application For Authority To Construct, Launch And Operate A Digital Audio Radio Service Satellite System; File No. 44/45-DSS-AMEND-92; Washington, DC; Filed September 14, 1992.

(2) U.S. Patent Application No. 07/886,910 (Pending); "Radio Frequency Broadcasting Systems and Methods Using Two Low-Cost Geosynchronous Satellites"; Robert D. Briskman; Filed April 1992

(3) "Manufacturing DAB Automobile Receivers"; John I. McComas, Mark A. Kady, Brian J. Warren; Delco Electronics Corp; First International Symposium On Digital Audio Broadcasting Proceedings; Montreaux; June 1992; pp 235-244.

SATELLITE-TO-AUTOMOBILE LINK BUDGET

Satellite EIRP (1)	57	dBW
Path Loss (2)	-192	dB
Vehicle Antenna Gain (3)	3	dBi
Received Power at Vehicle	-132	dBW
Receiver Noise Power (4)	-141	dBW
Resultant E/No	9	dB
Required E/No (5)	5	dB
Power Margin	4	dB
Diversity Gain (6)	12	dB
Effective Multipath Margin	16	dB

(1) At edge of coverage area
(2) Geosynchronous orbit/2335 MHz
(3) Worst orientation; includes polarization loss
(4) Effective G/T = -19 dB/ K; includes uplink contribution and losses; B_N=3.9 MHz
(5) B.E.R. of 10^{-5}
(6) Satellite spatial and frequency diversity provides 9-15 dB multipath mitigation

TABLE 1

POWER FLUX DENSITY AT CANADIAN - U.S. BORDER

Satellite EIRP	+ 57	dBW
Spreading Factor	-163	dB/m^2
	-106	dBW/m^2
Bandwidth Factor (8 MHz to 4 KHz)	- 33	dB
POWER FLUX DENSITY	-139	dBW/m^2/4kHz

(Note that above numbers are rounded to the nearest whole decibel)

TABLE 2

CHANNEL LISTING

1. **Symphonic**
Music from the masters Bach Mozart Handel The world s greatest classical comoosers orcadcast in onliiant CD fidelity

2. **Chamber Music**
Elegant music performed by small ensembles of solo instruments sucn as the cello violin and woodwind

3. **Opera**
Expenence Carmen Madame Butterfly and Faust The drama and soectacle is all yours

4. **Today's Country**
The sexy down home sounds of today s country stars. Like Garth Brooks. Wynonna Judd. Billy Ray Cyrus and Alan Jackson

Traditional Country
All of your favorite country • western legends are here. Stars like George Strait Loretta Lynn Hank Williams, Jr and Patsy Cline

6. **Contemporary Jazz**
The syncopated rhythms of today s jazz musicians The cool sounds of Kenny G Wynton Marsalis Al Jarreau and Diane Schuur

7. **Classic Jazz**
The mood is magic when the music is improvised Listen as musicians like Duke Ellington Dizzy Gillespie and Miles Davis experiment and create that sound we know as jazz

8. **Blues**
Lonely Soulful We ve all been there Lament to the sounds of Anson Funderburgh and The Rockets B B King and John Lee Hooker

9. **Big Band/Swing**
A time of war And peace Remember the sounds of Tommy Dorsey Glenn Miller and Artie Shaw Now you're "In the Mood"!

10. **Top of the Charts**
Today s hot hits from recording artists such as Phil Collins, Michael Bolton and Paula Abdul are here Day or night And always without interruptions or repeats

11. **Classic Rock**
The giant hits from the 60 s through the 80 s an entire generation of music Led Zeppelin Simon and Garfunkel. The Rolling Stones

12. **50's Oldies**
It was a simpler time We went to sock hops We went steady And Elvis was king Tune in and experience the energy of America s halcyon years

13. **40's Oldies**
Put the top down and cruise to the sounds of the sixties The Beach Boys The Beatles and The Supremes

14. **Folk Rock**
Thoughtful. inspired melodies from performers like Peter Paul and Mary Joni Mitchell and James Taylor

15. **Latin Ballads**
The enduring romantic sounds of Latino vocalists Julio Iglesias Nino Bravo and Roberto Carlos

16. **Latin Rhythms**
Move to the beat of a latin drum and cha cha with stars such as Tito Puente Sergio Mendes and Seis Del Solar

17. **Reggae**
When you can t get to the Islands man here is the next best thing Bob Marley Maxi Priest UB40

18. **Hip-Hop & Rap**
Music that s "in-your-face" Hear the messages of the downtrodden Hammer Queen Latifah Boyz II Men Kriss Kross.

19. **Dance**
Music that keeps on keepin on Cece Peniston Janet Jackson and C+C Music Factory Gotta move!

20. **Songs of Love**
Remember the song the two of you first danced to? Here s the music that helped make your pulse quicken and heart beat faster

21. **Singers + Strings**
Pure magic Legends like Sinatra Streisand and Nat King Cole The lush sounds of Percy Faith Andre Kostelanetz and Mantovani

22. **Heavy Metal**
Driving, explosive, hard chargin rock-and roll The sound of bands like Guns N Roses Metallica and Ozzy Osbourne

23. **Album Rock**
The best cuts from today s top rock albums Mariah Carey George Michael and Madonna

24. **Alternative Rock**
Turn right here for the sounds of tomorrow s music sensations Not yet discovered talent like Arc Angels. Techmaster P E B and K Solo

25. **New Age**
Soft and soothing acoustics often mirroring sounds found in nature Enya Tangerine Dream and Yanni

26. **Broadway's Best**
You have the best seat in the house for music of The Great White Way All of your favorites from The Fantasticks to Guys and Dolls

27. **Gospel**
Music to keep you going in the right direction Mahalia Jackson The Winans and The Mighty Clouds of Joy

28. **Children's Entertainment**
Storytelling at its most magical Complete with lifelike sound effects Disney classics and Sesame Street

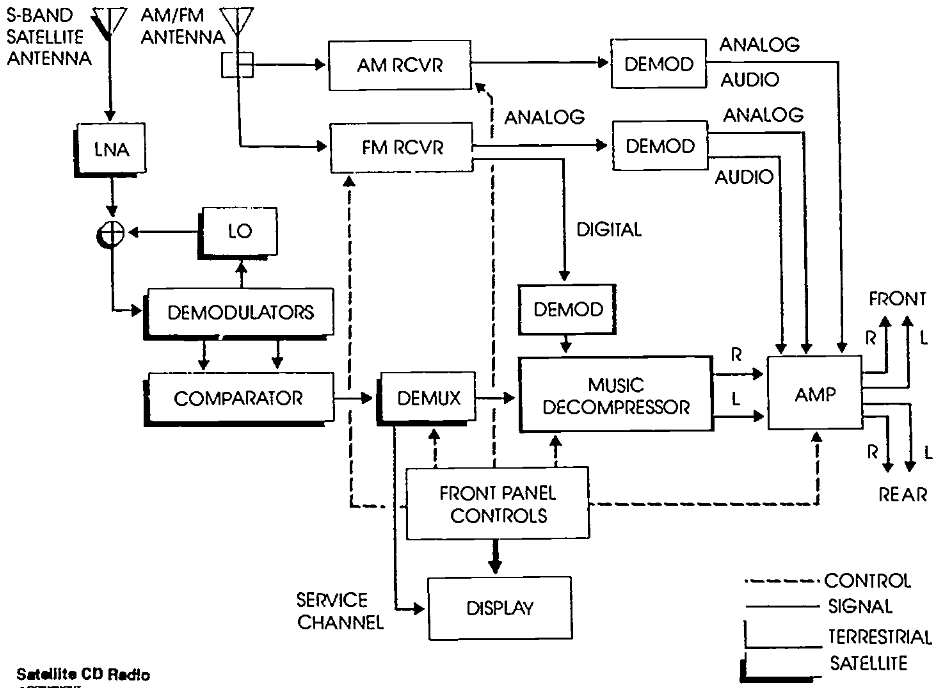
29. **World Beat**
The beat goes on all around the planet Follow the sun musically with cuts from Angelique Kidjo Kronos Quartet and Outback

30. **New World**
Asian cultural programming oriented toward new Americans Bridging the old world and the new

FIGURE 1

VEHICLE RECEIVER

Analog AM & FM/Digital Satellite & Terrestrial



Satellite CD Radio

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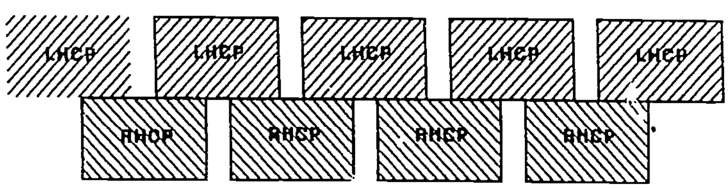
FIGURE 2

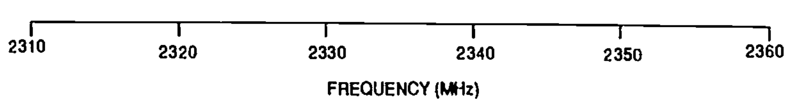
SATELLITE DAB FREQUENCY PLAN

(2310 - 2360 MHz)

Center Frequencies 2315, 2325, 2335, 2345 and 2355 MHz



Center Frequencies 2320, 2330, 2340 and 2350 MHz



NOTES:
1. SHADING SHOWS OCCUPIED BANDWIDTHS (± 4 MHz from center frequencies)
2. ALLOCATION CENTERED AT 2315 MHZ MAY NOT BE ASSIGNED

LHCP - LEFT HAND CIRCULAR POLARIZATION

RHCP - RIGHT HAND CIRCULAR POLARIZATION

FIGURE 3

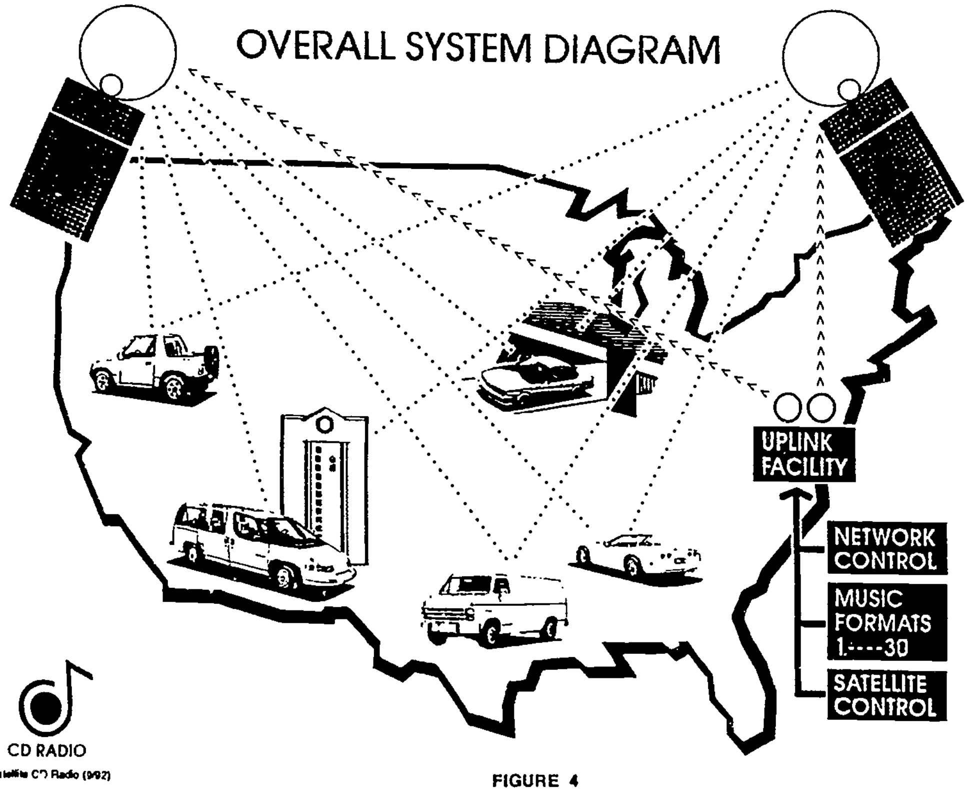
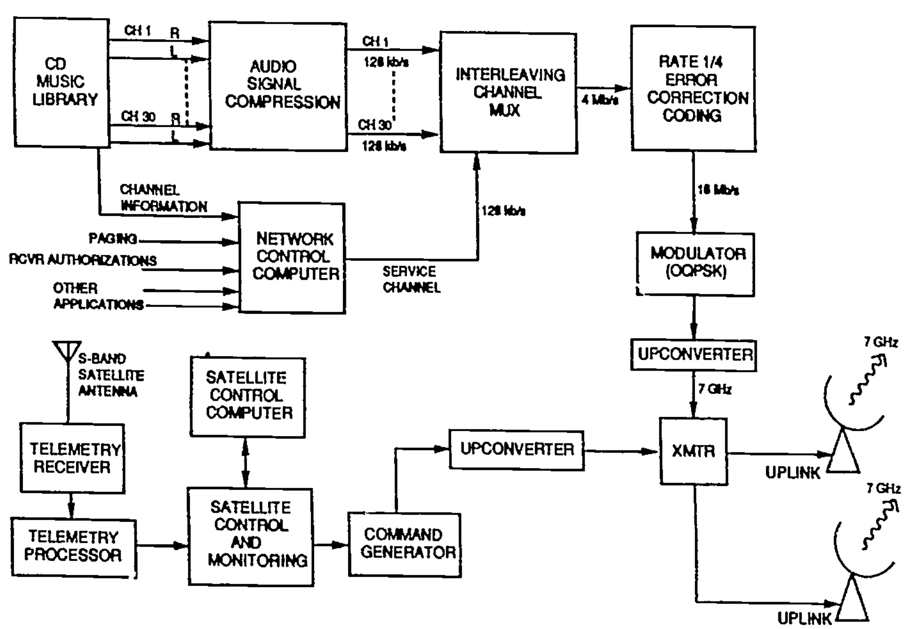


FIGURE 4

SCDR PROGRAMMING / UPLINK / OPERATIONS CENTER



Note: System redundancy eliminated to clarify drawing

FIGURE 5

SMALL SATELLITES FOR MOBILE AND ENVIRONMENTAL DATA COMMUNICATIONS:

EFFECTIVELY SOLVING ECONOMIC, SOCIAL AND TECHNOLOGICAL ISSUES

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ABSTRACT

"Small" satellites are nowadays frequently envisaged in alternative to traditional, "large" satellites, often exploiting orbital characteristics different from the Geostationary Earth Orbit (GEO), e.g. circular orbits closer to the earth or elliptic orbits. Mobile (Personal) Communications (including Vehicle Radiolocation, RDSS) and Environmental Data Communications/Remote Sensing are the most attractive areas of applications, reasonably regulated in terms of frequency spectrum allocation by the 1992 World Administrative Radio Conference (WARC-92).

In this context, TELESPAZIO is developing a commercial "micro"satellite system (*TEMISAT*) providing *Data Collection and Distribution from/to autonomous networks*. This kind of application is well suited for both developed and developing countries to *provide low data rate, non real-time services across geographical areas where a multitude of remote terminals with limited throughput is widespread on*. From one hand it would be quite costly to implement a terrestrial telecommunication infrastructure to link those terminals, from the other hand, utilizing the microsatellite technology, a space-based data collection and distribution network results much more cost-effective than with traditional (large) satellites.

1. INTRODUCTION

In the last few years, the commercial satellites community has strongly re-considered the problem of spacecraft size/power consumption, developing a number of attractive system concepts taking advantage of small satellites technology. Within the class of small satellites it is customary to define "micro"satellites those birds having a mass up to 50-100 kg (100-200 pounds roughly), whilst "mini"satellites range from this limit to several hundred kilograms (1000-1500 pounds). It is just marginally worth mentioning that these limits are merely indicative, mainly aiming at identifying which class of spacecraft in broad sense we are talking of.

The idea behind the trend reversal going towards a reduction of satellite mass lies in that, under certain circumstances, the overall investment cost to implement *several, single-mission, "small"* spacecrafts instead of *one "large" multi-mission* satellite *may* result substantially lower, at the same time reducing the risk for launch failures, only affecting a portion of the mission rather than the entire mission. There are scenarios where the satellite limitation in size is the key feature to reduce the investment costs, while the continuity of service against the growth of traffic demand is assured by multiple, subsequent launches of spacecrafts in co-located (GEO) orbits as long as the previous birds are saturated in traffic [1]. Up to 4 satellites can be reasonably co-located in the same 0.1° box (GEO orbital slot), so that, assuming a *linear* vacancy curve (transponders filled-in uniformly versus time), subsequent launches of spacecrafts to allow for the previous one(s) being saturated permits to defer the investment costs, although the cost of one single (much larger) satellite handling four times as much traffic is in general lower than the sum of smaller birds plus launches.

In addition, several applications/services - Mobile Satellite Systems (MSS), mailbox/electronic mail, store-and-forward data transfer, tactical communications, coarse resolution remote sensing, earth observation for social security, ... - might be exchanged via the aggregation of several Low Earth Orbit(LEO)/Highly Inclined Orbit (HIO)/Highly Elliptic Orbit (HEO) spacecrafts, whose mass/cost can be kept reasonably small. The technology sophistication/lifetime can be kept reasonably fair to limit the expenditure, since the low-cost availability of spares to replace in-orbit failures can balance the sub-optimum hardware reliability. Lastly, multiple launches might be arranged with substantial cost saving due to economy of scale.

As a general remark, LEO small satellites inherently result well suited for *specific missions* where *limited data rates* are requested to be handled by each spacecraft. It only flies across the service area for some tens of minutes a few times a day, depending upon the orbital parameters - differently from the geostationary orbit (GEO), where the satellite at 36,000 km over the equator is *fixed* with respect to the earth, the period of revolution round the earth of a low orbiting (LEO) spacecraft is much *less than a day* -. Thus, a real-time service is not allowed unless a complete constellation of LEO's is operational.

On the other hand, very often - e.g. for most of previously mentioned services - a real-time, continuous link availability is not mandatory; this was the rationale for starting our Telespazio activities on small satellites with an environmental data collection and distribution system, where the need for monitoring remotely located environmental parameters (earth-based sensors) is not continuous but rather satisfactorily met by exchanging data once or twice a day for a short while. It is only marginally worth noting that *the same architecture can be used to collect and distribute data* *different from environmental parameters* but with the same absence of real-time requirements (e.g. short messages from extremely cheap mobile terminals, that can constitute *the only viable. low-cost telecommunication infrastructure for remotely located areas* like rural territories). In this way a good answer can be given to economic and social issues requiring to provide services even when they may *not be remunerative* with "standard" telecommunication infrastructures, but needed by *social* implications.

The paper addresses now the potential *services* able to be provided by the small satellites technology (Section 2) and related *orbits/frequency bands* (Section 3), then gives a brief description of the Telespazio *TEMISAT micro-satellite programme* (Sections 4 and 5).

2. SERVICES/APPLICATIONS

Several attractive services can be envisaged utilizing the small satellite technology, such as:

- Personal Communication Services (PCS) in general sense;
- Digital Audio Broadcasting (DAB);
- Environmental Data Collection and Distribution;
- Remote Sensing;
- Military Applications in general.

Concerning PCSs, several applications come to mind naturally such as paging, mailbox/electronic mail, hand-held or portable terminals for mobile communications,... These services can be extremely well provided in principle by small satellite systems; in addition to that, applications not rigorously classifiable under the PCS category but nevertheless quite related are store-and-forward data transfer, remote/rural areas communications, Embassies communications, educational programs transmissions (e.g. UNESCO, UNICEF,...). Furthermore, Radio Determination/Automatic Position Reporting (RDSS/APR) is easily available, although at a coarse level, exploiting some specific features (e.g. Doppler measurements with LEO spacecrafts, providing about half-a-mile resolution).

It is worthwhile mentioning that, from a commercial standpoint, Personal Mobile Satellite Services are extremely attractive since they cover a substantial sector of the (cellular) market. This market is growing up at an enormous rate. At least 10 million people in the world would likely need personal communications by 1996, a reasonable portion of which could migrate to MSSs provided they are timely introduced, full coverage (not easy with terrestrial systems) and, possibly, utilizing hand-held or very compact size terminals. Recent projections indicate 2-to-4 million MSS subscribers in the world by the year 2000, and over 10 million by 2008. It is evidently a multi-billion US$-per-year business, mostly addressed by the "big" LEO systems operating at L/S band (Motorola's IRIDIUM, Loral GLOBALSTAR, TRW's ODYSSEY, Constellation Communication Inc.(CCI) ARIES and Ellipsat's ELLIPSO), but also by below 1 GHz systems (ORBCOMM, STARSYS, the Russian GONETS, LEOSAT). It has also to be mentioned the INMARSAT Project 21 system, still in the design phase, and VITA (Volunteers In Technical Assistance), proposing a non-profit international store-and-forward communications system for developing countries consisting of 2 LEO satellites operating at VHF bands.

3. ORBITS/FREQUENCIES

Table 1 sketches the orbital characteristics of the systems mentioned earlier. It can be seen that now IRIDIUM envisages 6 orbital planes - instead of 7 as originally planned (will the name "Iridium" be changed into "Dysprosium"?...) - with 11 spacecrafts per plane, which sums up to

SYSTEM	ORBIT ALTITUDE	INCLINATION	PERIOD	ORBITAL PLANES	SATELLITES PER PLANE	TOTAL # OF SATELLITES
GONETS	Circular 1390 km	83°	113.56'	6	6	36
LEOSAT	Circular 970 km	40°	104.47'	3	6	18
ORBCOMM	Circular 970 km	50° 90°	104.47'	3 2	6 1	18 2
STARSYS	Circular 1300 km	60°	111.59'	4	6	24
ARIES	Circular 1018 km	90°	105.5'	4	12	48
ELLIPSO 1	Elliptic 576/1439 km	63.5°	105.25'	2	3	6
ELLIPSO 2	Elliptic 426/2900 km	63.4°	119.57'	2	9	18
GLOBALSTAR	Circular 1389 km	47° 52°	113.53'	8 8	3 6	24 48
IRIDIUM	Circular 765 km	90°	100.13'	6	11	66
ODYSSEY	Circular 10373 km	55°	359.53'	3	4	12

TABLE 1. ORBITAL PARAMETERS FOR SOME PROPOSED SYSTEMS

66 satellites instead 77. It is worth mentioning that, as of August 1992, ORBCOMM, STARSYS and VITA ("little" LEOs below 1 GHz) have obtained from the US Federal Communications Commission (FCC) experimental licences; Leosat Corporation, who submitted in September 1990 an application to provide intelligent mobile services, has been negotiating with FCC to remove some bureaucratic obstacles. Concerning the "big" LEOs above 1 GHz, all of them have been granted experimental licenses.

The problem of radio frequency management for non-GEO satellite applications has been addressed recently by the February 1992 World Administrative Radio Conference (WARC-92) in Malaga, Spain. One of the most relevant decisions taken at that Conference was to allocate the 1610-1626.5 MHz (L band) and 2483.5-2500 MHz (S bands) slots to LEO satellite services on a *worldwide, primary basis*, thus enabling "big" LEOs to have a reasonable amount of spectrum (i.e. capacity) to (potentially) serve a substantial number of subscribers and reach/exceed the break-even point to remunerate the service provision. Table 2 depicts the situation for those systems, including some indication on cost.

However, the presently available amount of spectrum at L-band is hardly sufficient to permit several systems to operate cost-effectively. This brought Motorola to ask FCC for additional 10.5 MHz slot to be "selectively" utilised by the different systems as a function of the multiple access method. So doing, one part of the overall spectrum would be used by FDMA/TDMA systems (Iridium only in practice), whereas the remaining part would be used by CDMA systems (the others). This has been strongly opposed by "the others", and the situation, although in principle technically solved by WARC-92 with the allocation of a reasonable amount of spectrum, is still fluid in practice due to the economical unattractiveness of several systems being placed simultaneously in the same (narrow) frequency window.

4. TEMISAT PROGRAMME

The TEMISAT (TElespazio MIcroSATellite) Programme foresees the implementation of a Data Collection and Distribution Service for geophysical environmental monitoring based on an autonomously managed network. This network will adopt innovative communications technologies to provide environmental protection services.

Such a collection of environmental data requires the deployment a multitude of sensors over wide areas usually difficult to reach or lacking in communications infrastructures. A satellite system for environmental monitoring services can offer a unique opportunity for an efficient solution. In particular, taking advantage of the existing technology it is possible to provide the required communications capability through a microsatellite-based system.

In the early stage of operations the service will be provided, *at least on a daily basis*, to private and public users located in the Italian territory and the surrounding European and Mediterranean Regions. It is our intention to *extend gradually the service to other geographical regions*, such as South America and Pacific Rim.

As already pointed out, *the same architecture can be used to collect and distribute data different from environmental parameters* (e.g. short messages from extremely cheap mobile terminals, that can constitute *the only viable, low-cost telecommunication infrastructure for remotely located areas* like rural territories). We are studying at present the possibility of implementing and launching other microsatellites to increase the system capacity and to provide a quasi-real-time capability by exploiting constellation features. Our production line is such as to assure the design, implementation and launch of a new product/service in less than 2 years, typically 18-to-22 months. To this end, we are also interested in partnership to share the investments/provide the services in the various regions of the world.

The main applications of the present TEMISAT system envisage monitoring of:

* Basin Level
* Snow Level
* Vehicular Traffic
* Structures (buildings, dams,...)

in addition to:

* Geological Monitoring
* Oceanographic Monitoring
* Seismic Monitoring
* Climatological Monitoring.

The environmental data are acquired and collected through earth-based sensor subsystems, then temporarily stored on ground and logged by autonomous terminals until the uploading request (polling) from the TEMISAT spacecraft. Once the data are received on board, they are transmitted from TEMISAT to User Collection Centres.

SYSTEM	FREQUENCY		SERVICE		COST
	User Link	Feeder Link	Voice (kbps)	Data (kbps)	(U.S.$)
GONETS	VHF/UHF		YES (in 1997)	4.8 (in 1995)	300 M
LEOSAT	VHF	UHF	NO	4.8	21 M
ORBCOMM	VHF	VHF	NO	4.8	320 M
STARSYS	VHF	VHF	NO	4.8 up 9.6 down	200 M
ARIES	L/S band	C band	YES (4.8)	2.4	292 M
ELLIPSO	L/S band	L/S band	YES (4.8)	NO (RDSS)	214 M
GLOBALSTAR	L band uplink S band down	C band	YES (2.4/4.8/9.6)	9.6	657 M (24 sats) 1,200 M (48 sats)
IRIDIUM	L band	Ka band	YES (2.4/4.8)	2.4	3,370 M
ODYSSEY	L/S band	Ka band	YES (4.8)	9 6	1,300 M

TABLE 2. SOME COMMUNICATION PARAMETERS AND COST

5. TEMISAT PARAMETERS

The TEMISAT system is composed by three main segments:

(i) a Space Segment, consisting of two micro-satellites (35x35x35 cm size, about 30 kg weight each), implementing a low cost satellite system based on TDMA/SCPC access scheme. The expected operational life of each satellite is 5 years.

The major characteristics of the satellites are:

- RX capacity: up to 9 VHF (148-150.05 MHz) channels plus 1 UHF (401-403 MHz) channel;
- TX capacity: 3 + 3 (cold redundant) VHF (137-138 MHz) SSPA transmitters (1-5 W);
- 3 transmitter antennas plus 2 receiver antennas;
- Data rate: 2.4 kbps (user link)/9.6 kbps (data collection centre down link);
- On-board data demodulation, storage and handling;
- Redundant data handling CPU (transputer-based);
- Redundant 10 Mbyte mass memory (about 6000 pages of A4 format capacity) with error correction;
- Real-time and store-and-forward capacity;
- Direct or on-request access;
- High reliability/Full functional redundancy.

A semi-passive Attitude Control System is present (magnetic stabilization to the local magnetic field of the earth), whereas the power generation is assured by 6 panels mounted on the external spacecraft surface. A fully passive spacecraft temperature control is obtained by appropriate coating of the satellite surface areas.

(ii) a Ground Support Segment, consisting of a Mission Control Centre. This Centre processes, manages and stores the mission data, and prepares the User Routing Matrix that contains the polling sequence, the synchronization and the addressee identification codes.

The Mission Control Centre is responsible for :

* Mission Planning
* Polling Optimization

(iii) an User Segment, consisting of two different types of terminals:

- User terminal, and
- Data Collection Centre terminal.

The User terminals are connected with the block of sensors, which are set for acquiring the measurements and for storing them temporarily. As soon as the satellite polls the user terminal, the commands exchange between the user terminal interface and sensor terminal adopting the standard RS-232 will make available the data for packetization and transmission, provided by the user terminal equipment. More than 1000 user terminals are planned to be used in the final network configuration, each one able to serve several sensors.

Of course the standard interface available as I/O of the user terminal can allow to connect the terminal to any type of equipment ready to select, prepare, acquire the data or alphanumeric messages to be transmitted.

The main characteristics of the User Terminal are:

* Standard Interfaces
* Low Power Consumption
* Easy Installation

The Data Collection Centre is enabled to receive the down-link data flow from TEMISAT corresponding to the information collected from the user terminals belonging to its Closed User Group (CUG). It is also envisaged the transmission from each Centre of command packets to the satellite: these commands are delivered to the addressed user terminals inside the polling packets.

The main characteristics of the Data Collection Centre are:

* High Flexibility
* Closed User Group (CUG) Control
* Low Cost and Low Complexity

The first TEMISAT unit is planned to be launched from Plesetsk as co-passenger of METEOR 2 Satellite (nominal LEO altitude 950 km, inclination 82.5°, orbital period approximately 110 minutes) by the Russian Launcher TSYCLON in June 1993. The second unit is being manufactured together with the first one; it will be stored on ground for about three years and then will be launched to assure the service continuity and to increase the in-orbit capacity.

The manufacture and overall mission implementation is estimated to cost less than 10 M U.S.$ and, on the basis of the investment plans, the system offers innovative commercial prospects.

6. CONCLUSIONS

The paper has considered the potential applications of "small" satellites in commercial environments, also addressing issues related to orbits, frequency spectrum allocation and cost.
A specific "micro"satellite programme has also been illustrated, the Telespazio TEMISAT Environmental Data Collection & Distribution system, to be launched in 1993. This kind of architecture is well suited for both developed and developing countries to provide *low-cost services across sparsely populated regions* where a multitude of remote terminals with limited throughput is widespread on.

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Economics Of The New Smaller And Shorter Lifetime Geostationary Communications Satellites

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1. ABSTRACT

This paper compares the characteristics, prices and economics of currently available large, medium and small geostationary (GSO) communications satellites, focusing on specific GSO lightsats currently in production. A listing of current international GSO lightsat suppliers and currently signed contracts for GSO lightsats will be presented. The paper addresses the selection of the proper size and lifetime of a geostationary (GSO) communications satellite for a particular project.

2. SUMMARY

It is shown that the many currently available GSO lightsats have fewer transponders, lower communications payload mass fractions and a resulting higher cost/transponder and cost/transponder-year delivered on orbit, coupled with shorter lifetimes and lower total lifecycle revenues. GSO lightsats would appear on the surface to suffer from the economies of scale that have led to the steady historic increase in size of commercial GSO communications satellites. However, GSO lightsats actually provide a surprisingly competitive return on investment (ROI) when compared to conventional large and medium GSO satellites, even for larger markets. And when modest transponder vacancy rates are included, the GSO lightsats can compare favorably with the annual ROI's of large and medium GSO satellites with only a fraction of the required investment capital. The paper presents cost/benefit net-present-value (NPV) analyses showing small profit in purchasing a satellite lifetime over 10 years. Since entrepreneurial, new market ventures are very sensitive to both competitive ROI's and total start-up capital required, GSO lightsats are emerging as the system size of choice for particular projects.

3. LARGE, MEDIUM AND SMALL GSO SATELLITE CAPABILITIES

Table 1 presents a comparison of the capabilities of typical 'large' GSO satellites with 48 transponders (e.g., HS-601, GE7000/5000, Eurostar 2000, etc.), typical 'medium' GSO satellites with 24 transponders (e.g., HS-376, GE3000, Matra/Fairchild's UltraSat 24, etc.), and 'small' GSO satellites with 12 transponders.

Small GSO lightsats are generally modern, powerful, high quality, rapidly produced communications satellites which are characterized by their smaller payloads and smaller GTO launch mass (<1000 kg). These new GSO lightsat are only now being offered by numerous suppliers because of the recent advancements in satellite technologies, components and manufacturing, as well as the recent availability of assured launch opportunities (dedicated and piggy-back) from several suppliers targeting this new 800-1000 kg small satellite GTO market. For large markets, GSO lightsats can be co-located (up to four in the same slot for full frequency utilization) and incrementally placed on orbit to track the market demand and reduce the required initial up-front financing. Table 2 shows the characteristics and supplier contacts for several 'small'

TABLE 1. GSO SATELLITE SYSTEM CAPABILITIES COMPARISON

	LARGE GSO SATELLITES	MEDIUM GSO SATELLITES	SMALL GSO SATELLITES
TYPICAL SATELLITES:	HS601, Eurostar 2000, GE7000/5000, etc.	HS376, Eurostar 1000, GE3000, UltraSat-24, etc.	HS376L, Afristar, AMOS, UltraSat-12, BGS-700, GE2000
PRODUCTION TIME (months):	36 months	30 months	28 months
SATELLITE EOL POWER (W):	4000 W	1500 W	1000 W
PAYLOAD EOL POWER (W):	3200 W	1100 W	750 W
NUMBER OF TRANSPONDERS:	48	24	12
LIFETIME (yr):	15 years	12 years	10 years
NUMBER OF TRANSPONDER-YEARS:	720	288	120
GTO MASS (kg):	3000 kg	1500 kg	900 kg
TYPICAL LAUNCHERS:	Atlas II Ariane 4 Long March 2E	Delta II Atlas IIAS Ariane Spelda Long March 2E	Ariane SDS Long March 2C Delta II Piggyback IAI Next

TABLE 2. SMALL GSO SATELLITE SYSTEMS

	Afristar 1	AMOS	BGS-700	GE 2000	HS 376L	UltraSat 12
MANUFACTURER:	ITI	IAI	Ball	GE	Hughes	Fairchild
FIRST LAUNCH:	1994	1994	TBD	(1975)	1994	TBD
FIRST CUSTOMER:	Afrisat	Israel	Brightside	(RCA Americom)	Thailand	Sat Time/UNICOM
PRODUCTION TIME (months):	28 mo.	28 mo.	28 mo.	30 mo.	24 mo.	27 mo.
SATELLITE EOL POWER (W):	1060 W	940 W	1000 W	900 W	850 W	1100 W
PAYLOAD EOL POWER (W):	750 W	620 W	700 W	600 W	500 W	770 W
NUMBER OF TRANSPONDERS:	12	12	12	12	12	12
LIFETIME (yr):	10	10	10	10	10	10
NO. OF TRANSPONDER-YEARS:	120	120	120	120	120	120
GTO MASS (kg):	800 kg	900 kg	1000 kg	1000 kg	1000 kg	1000 kg
TYPICAL LAUNCHERS:	Ariane SDS CZ-2C	Ariane SDS CZ-2C	Ariane SDS CZ-2C	Ariane SDS CZ-2C Delta II	Ariane SDS CZ-2C	Ariane SDS CZ-2C Delta II Piggyback
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TABLE 3. GSO SATELLITE PROJECT COST COMPARISONS

Program Area	GSO Satellite Type Large	Medium	Small
Satellite & Payload	$ 95.00	$ 50.00	$ 40.00
Launch Services	$ 85.00	$ 45.00	$ 20.00
TT&C Facilities	$ 3.00	$ 2.00	$ 2.00
TT&C Operations	$ 15.00	$ 12.00	$ 10.00
Launch & Ops Insurance	$ 28.80	$ 15.20	$ 9.60
Debt Service (10%)	$ 21.18	$ 11.22	$ 7.16
Total Cost (FY '92 M$) =	**$ 247.98**	**$ 135.42**	**$ 88.76**

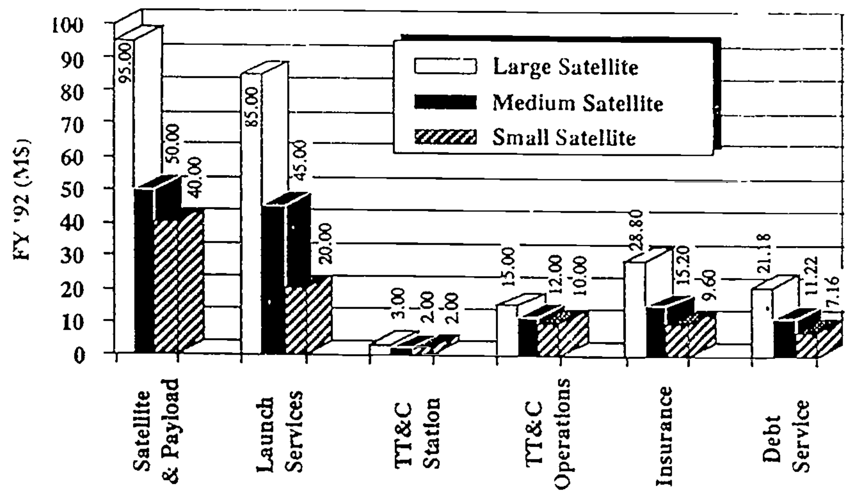

FIGURE 1. GSO SATELLITE PROJECT DEVELOPMENT COST COMPARISONS

TABLE 4. TRANSPONDER COST COMPARISONS

	PROJECT DEVELOPMENT COSTS (FY92 M$)	NUMBER OF TRANSPONDERS	SATELLITE LIFETIME (YEARS)	NUMBER OF TRANSPONDER-YEARS	COST PER TRANSPONDER (FY92M$)	COST PER TANSPONDER-YEAR (FY92M$)
LARGE GSO SATELLITE	248 M$	48	15	720	5.17 M$	0.344 M$
MEDIUM GSO SATELLITE	135 M$	24	12	288	5.63 M$	0.469 M$
SMALL GSO SATELLITE	89 M$	12	10	120	7.42 M$	0.742 M$

GSO satellites which are currently in hardware development, or currently being marketed/proposed (e.g., Hughes HS-376L, Fairchild UltraSat 12, ITI Afristar, IAI AMOS, Ball BGS-700/400, GE2000, etc.).

Small GSO lightsats are generally modern, powerful, high quality, rapidly produced communications satellites which are characterized by their smaller payloads and smaller GTO launch mass (<1000 kg). These new GSO lightsat are only now being offered by numerous suppliers because of the recent advancements in satellite technologies, components and manufacturing, as well as the recent availability of assured launch opportunities (dedicated and piggy-back) from several suppliers targeting this new 800-1000 kg small satellite GTO market. For large markets, GSO lightsats can be co-located (up to four in the same slot for full frequency utilization) and incrementally placed on orbit to track the market demand and reduce the required initial up-front financing. Table 2 shows the characteristics and supplier contacts for several 'small' GSO satellites which are currently in hardware development, or currently being marketed/proposed (e.g., Hughes HS-376L, Fairchild UltraSat 12, ITI Afristar, IAI AMOS, Ball BGS-700/400, GE2000, etc.).

4. PROJECT DEVELOPMENT COSTS

Table 3 and Figure 1 show a comparison of current, typical construction costs for large, medium and small GSO satellite project elements (space segment, launcher service, TT&C ground station, TT&C operations, insurance and debt service). Projects with large satellites (48 transponders) cost only 80% more than medium satellites (24 transponders) and only 180% more than small satellites (12 transponders).

5. TRANSPONDER COST COMPARISONS

Table 4 comparisons show that GSO lightsats appear to be at a severe disadvantage with respect to large satellites, with a 25% higher cost per transponder and a 216% higher cost per transponder-year. Note that the longer revenue-producing lifetime (years 10-15) of larger GSO satellite systems produces a marked improvement in the costs per transponder-year. This will be shown later not to be reflected in the actual annual ROI benefits.

6. PROJECT DEVELOPMENT PAYMENT PROFILE

Economic analyses of return on investment (ROI) require the actual timed cash flow profiles for expenses and revenues. Figure 2 shows a typical construction payment profile for a small GSO satellite. Similar payment profiles (based on actual projects) have been used for the space segment, launcher service, TT&C ground station, TT&C operations, insurance and debt service cost elements in the ROI analyses.

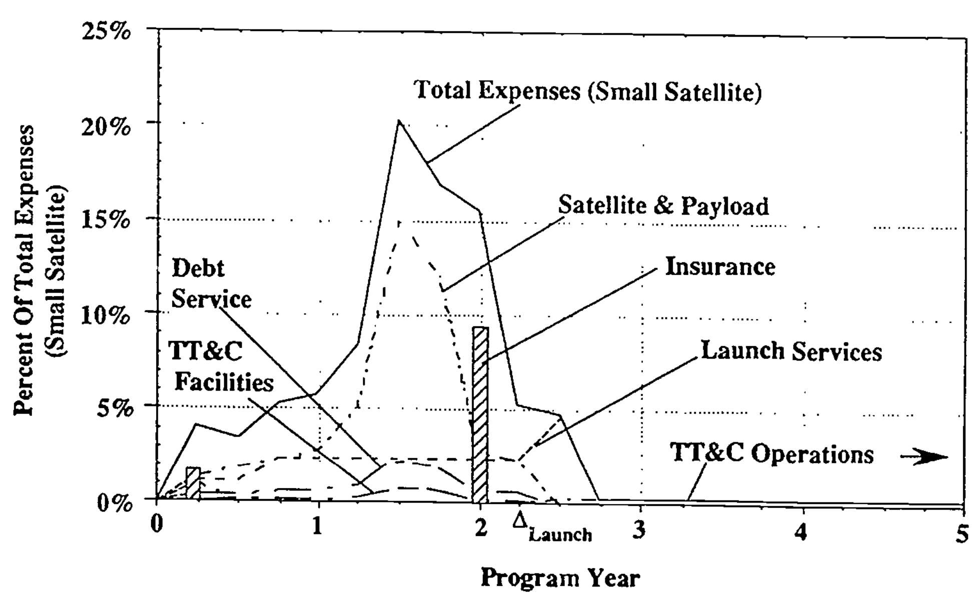

FIGURE 2. PROJECT DEVELOPMENT PAYMENT PROFILE

7. MARKET DEMAND CURVES

Since the actual market demand for a proposed GSO satellite project is a major variable, three possible market demand curves are defined in Figure 3 which determine the vacancy/lease profile experienced after launch, for use in the economic analyses. In general, established markets (such as those serviced by Intelsat) may begin service with up to 2/3 of the transponders leased, and the remaining 1/3 leased after a few years. For new markets, in general, only about 1/3 of the transponders are initially leased and the remaining 2/3 are leased over several or many years. The three market demand curves in Figure 4 provide 1/3 and 2/3 initial capacity for medium and large satellites. The shape of these 'S' curves are not untypical of the experience of several satellite operators.

Each of these market demands is analyzed for the three different size satellites, along with the fully loaded cases. Figure 4 shows the various transponder leasing profiles that are derived from selecting various size satellites in an uncertain market. For the large satellites, the 'High' market demand curve represents an 'established market' condition (2/3 initial transponder loading), and for the medium and small satellites a fully loaded market demand condition. The 'Medium' market demand curve represents a 'new market' condition (1/3 initial transponder loading) for the large satellites, an 'established market' condition (2/3 initial transponder loading) for a medium satellite, and a fully loaded demand for the small satellite.

8. PROJECT CASH FLOWS

Economic analyses of ROI require the timed cash flow profiles for expenses and revenues. A constant transponder lease rate of 2.5 M$ is assumed. As an example, Figure 5 shows the payment/revenue streams for a large GSO satellite (48 transponders), with different market demands: 100%

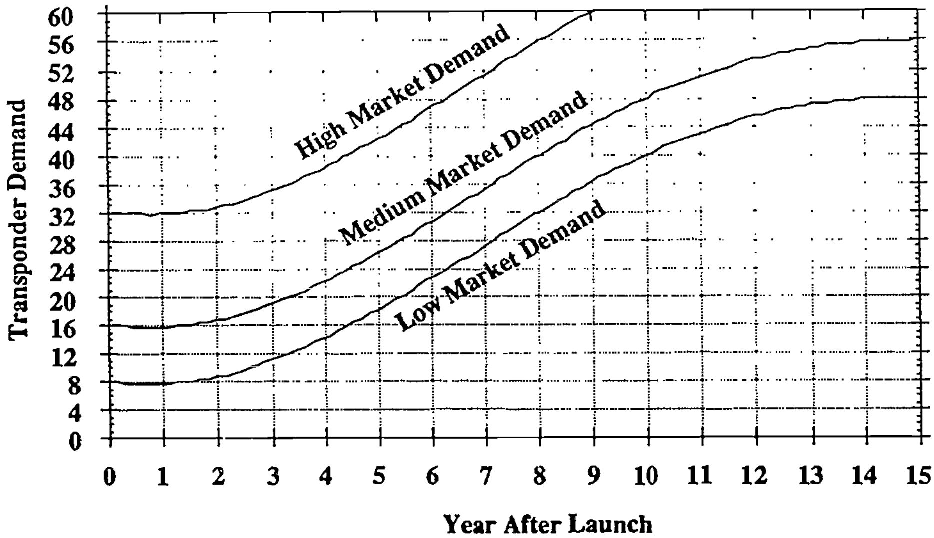

FIGURE 3. TYPICAL MARKET DEMANDS

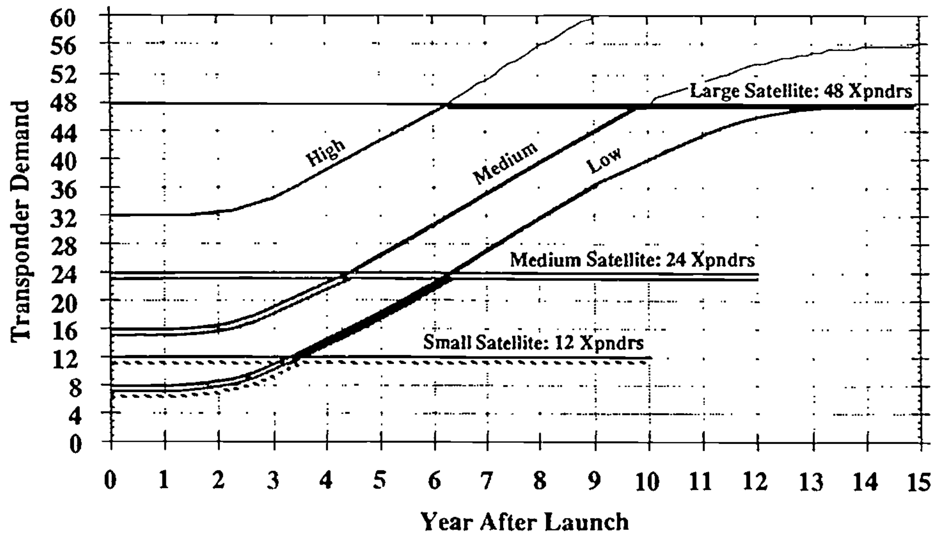

FIGURE 4. TRANSPONDER LOADING PROFILES

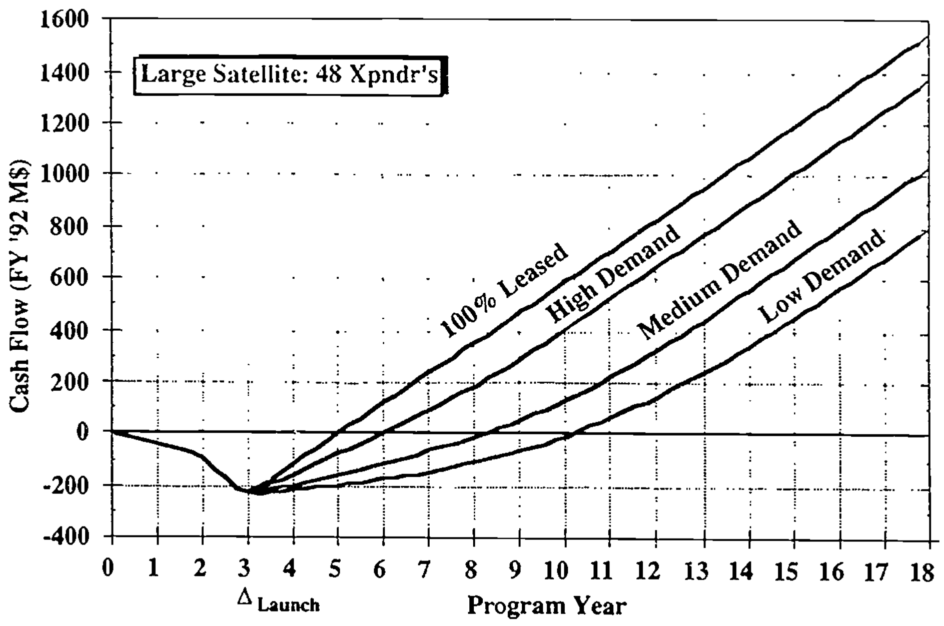

FIGURE 5. PAYMENT/REVENUE CASH FLOWS

leased at launch, high demand (established market condition), medium demand (new market) and low demand (only 1/6 leased at launch). The maximum negative cash flow ends in the quarter following launch with a capital investment of about 200M$. The break even times for a large satellite vary over the various market conditions from 5 years to 10 years. The net profit at end of life (15 years) varies from 800M$ to 1,540M$. Similar cash flows have been developed for the medium and small GSO satellites as the inputs for the following ROI computations.

9. RETURN ON INVESTMENT (ROI) COMPARISONS

Annual ROI's are computed for each case of the selection of a large, medium or small GSO satellite in view of low, medium, high or 100% loaded actual market conditions. Table 5 shows comparisons of the costs per transponder, costs per transponder-year and annual ROI's for various market conditions: from fully loaded at launch to high, medium and low market demand (as defined in Figures 3 and 4). Table 6 then compares various initial loading conditions

TABLE 5. ROI VERSUS MARKET DEMAND

	COSTS (FY92M$)			100% DEMAND		HIGH DEMAND		MEDIUM DEMAND		LOW DEMAND	
	Dev. Costs	Per Xpndr	Xpndr-Year	Annual ROI	Initial Loading	Annual ROI	Initial Loading	Annual ROI	Initial Loading	Annual ROI	Initial Loading
LARGE GSO SATELLITE	248 M$	5.17 M$	0.344 M$	33.8%	Full	27.5%	2/3	19.7%	1/3	15.2%	1/6
MEDIUM GSO SATELLITE	135 M$	5.63 M$	0.469 M$	33.1%	Full	33.1%	Full	27.3%	2/3	20.0%	1/3
SMALL GSO SATELLITE	89 M$	7.42 M$	0.742 M$	26.2%	Full	26.2%	Full	26.2%	Full	21.8%	2/3

TABLE 6. ROI VERSUS INITIAL LOADING

	COSTS (FY92M$)			INITIAL TRANSPONDER LOADING (With Previous Market Demand Curves)		
	Development Costs	Per Transponder	Transponder-Year	FULL Annual ROI	2/3 Full Annual ROI	1/3 Full Annual ROI
LARGE GSO SATELLITE	248 M$	5.17 M$	0.344 M$	33.8%	27.5%	19.7%
MEDIUM GSO SATELLITE	135 M$	5.63 M$	0.469 M$	33.1%	27.3%	20.0%
SMALL GSO SATELLITE	89 M$	7.42 M$	0.742 M$	26.2%	21.8%	16.0%

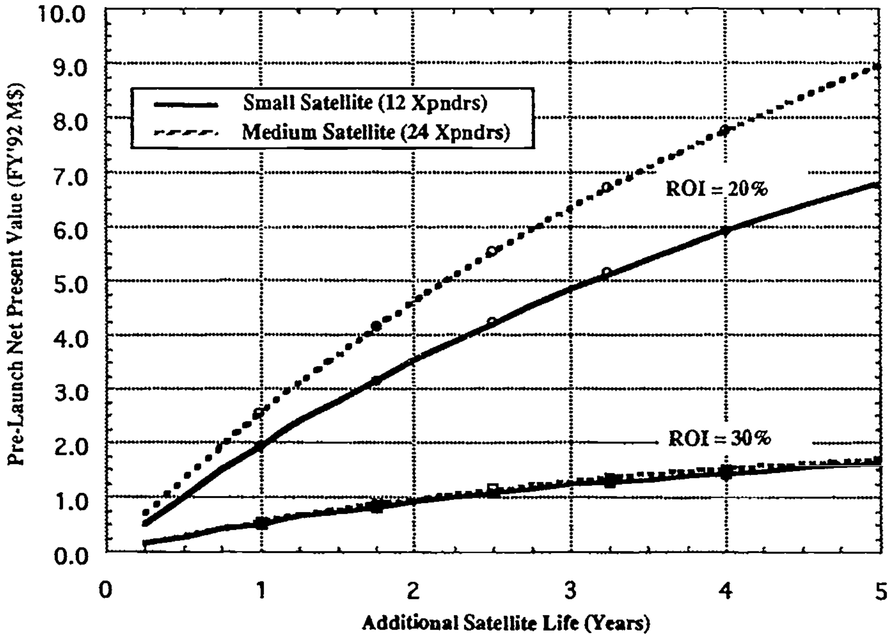

FIGURE 6. ECONOMIC VALUE OF LONGER LIFETIME

(from fully loaded, 2/3 initially loaded to 1/3 initially loaded) for each satellite size.

10. LONGER LIFETIMES

The surprisingly low economic value of extending the lifetime of satellites over 10 years can be quantified using the same economic assumptions and analyses already presented in this paper. In order for the extended lifetime satellite to be financially attractive, the incremental cost to extend the satellite life must be less than the net-present-value (NPV) of the additional revenues. Figure 6 shows the NPV of the extended lifetime revenues (with the satellite 100% leased) at one year before launch for the medium and small communications satellites with ROI's of 20% and 30%.

As the target ROI goes up, the discounted revenue cash flow for the longer lifetimes yeilds a significantly lower pre-launch NPV. It is clear from Figure 6 that the typical costs to extend satellite lifetimes for 5 years (40-50% lifetime increase) far exceed the actual net present value of the additional revenues, even at full 100% leased capacity. Even without discounting for economic risk factors attendant with longer lifetimes (such as increased market risks, technololgy aging risks, inflation risks, etc.), longer satellite lifetimes than about 10-12 years are difficult (and often impossible) to justify economically.

11. CONCLUSIONS

The economic analyses presented in this paper clearly show that for large, medium and small satellites:

1) The actual differences in annual ROI's (<7%) do not reflect the large, but specious, differences in costs per transponder or costs per transponder-year (>200%). Expected ROI and required investment capital are the meaningful parameters for business selection of the proper satellite size.

2) The up front development cost Δ's associated with purchasing longer lifetimes (especially years 12-15) do not yield significant annual ROI benefits, since up front investment Δ's earn no return (0% ROI) for first 10-12 years.

3) For the same market conditions, selecting the next larger satellite, with a 50-85% larger capital investment can yield less than 7% higher ROI's in the best case, and in the worst case over 7% lower annual ROI's.

4) Annual ROI's are better when the selected satellite size is appropriate to the market demand, so that a majority of transponders will be initially leased.

5) Overestimating the actual market demand yields lower expected ROI's than underestimating the actual market (and selecting a smaller satellite).

GSO lightsats are now a real alternative when selecting the proper size of a GSO satellite for a new program. While GSO lightsats would appear on the surface (cost per transponder, cost per transponder-year) to suffer from economies of scale compared to medium and large GSO communications satellites, GSO lightsats actually provide surprisingly competitive annual ROI's. And when market uncertainties with attendant transponder vacancy rates are included, the GSO lightsats compare favorably with the annual ROI's of large and medium GSO satellites, and with only a fraction of the required investment capital. Since entrepreneurial, new market ventures are very sensitive to both competitive ROI's and total start-up capital required, GSO lightsats with moderate lifetimes are emerging as the system of choice for particular projects.

EXPORT CONTROL: CURRENT LEGAL AND POLICY ISSUES AFFECTING SATELLITE AND TELECOMMUNICATIONS VENTURES IN THE PACIFIC RIM

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1. ABSTRACT

Export controls are an important issue for U.S. companies pursuing satellite and telecommunications business opportunities in the Pacific Rim, and for their foreign investors, partners and customers. Fundamental changes in export controls are occurring which reflect shifts in the global geopolitical situation, increased concern about missile proliferation and the emerging global marketplace for satellite and telecommunications technology and services.

2. INTRODUCTION

Export control, perhaps more than any other regulatory issue, reflects a dynamic, and frequently shifting, tension between foreign policy, national security and international trade. The balance between these competing concerns has a practical impact on the U.S. satellite and telecommunications industries, and their foreign customers, investors and partners. Export controls can affect the ability of U.S. companies to export technology, components and complete satellite systems; to provide technical assistance or consulting services; and to enter into joint ventures with foreign partners. From the standpoint of customers and investors in the Pacific Rim, export controls may affect the timing, cost and availability of technology or services and can even restrict reexports of U.S. technology once abroad.

To assist companies that are pursuing or considering business activities in the Pacific Rim, this paper provides a brief overview of the U.S. export control regulatory scheme as it affects satellite and telecommunications ventures. Following this overview, the paper focuses on recent regulatory/policy trends and developments in the export control area that promise to increase the ability of U.S. industry to export high-technology products and services. These developments include: (1) the simplified controls for exports of certain communications satellites; (2) liberalization of exports to the former Soviet Union; (3) recent U.S. government decisions approving satellite flights on the Russian Proton and Chinese Long March launch vehicles; and (4) a November 1992 State Department decision authorizing, for the first time, export of descramblers that can receive encrypted TV signals. In addition, this paper discusses the recent tightening of missile technology controls under the Enhanced Proliferation Control Initiative (EPCI), a development which potentially affects exporters of any commodity or technical data.

3. OVERVIEW OF U.S. REGULATORY SCHEME

3.1 EXPORT LICENSING

In the United States, there are two primary agencies involved in administration of export controls of interest to the satellite and telecommunications industries: the State Department and the Commerce Department.

First, the Department of State's Office of Defense Trade Controls or ODTC, operating under authority of the Arms Export Control Act, is responsible for the licensing of exports of defense articles and defense services, as enumerated on the U.S. Munitions List. The U.S. Munitions List requires licensing of defense products or "hardware", as well as defense-related technical data, including consulting, technical assistance or manufacturing license agreements involving the disclosure of technical data.

The second major player in the export licensing area is the Department of Commerce acting under the authority of the Export Administration Act or, given the currently lapsed state of that statute, the International Emergency Economic Powers Act. Basically, the Department of Commerce exercises its licensing authority with regard to non-military products and technical data specifically enumerated on the Commerce Control List under the Export Administration Regulations. In addition, Commerce has jurisdiction over the Enhanced Proliferation Control Initiative (EPCI) which may impose an additional layer of regulation applicable to any exports that might have a prohibited end use (e.g. nuclear, chemical and biological weapons and missile technology.)

While telecommunications technology is largely within the Commerce Department's jurisdiction, satellites have a unique status. Satellites are "dual use" technologies in that the technology potentially has both civilian and military uses. In the United States, communications satellites have, in the past, been deemed to be predominantly defense articles for purposes of export control and therefore subject to ODTC licensing requirements. As a result, ODTC's prior approval has been required for the export of communications satellites, as well as their components and related technical data, including through technical assistance agreements.

Significantly, export is defined to include a transfer of title to a satellite from a U.S. to foreign entity, even if that transfer occurs in-orbit.

In a recent development, jurisdiction over communications satellites has been shifted, in certain limited cases, to the Commerce Department as discussed in greater detail below.

Depending on the technology level of the product or technical data concerned and the specific end user destination involved, Commerce may require an individual validated license or IVL authorizing the export. Under newly adopted rules, exports of certain communications satellites will be subject to an IVL in the future. For other telecommunications technologies, Commerce may permit the export under one of a number of general licenses available under the Export Administration Regulations which do not require Commerce's express prior written approval of the export. Commerce, like ODTC, also maintains controls on reexports of products and technical data.

3.2 COMMITTEE ON FOREIGN INVESTMENT IN THE UNITED STATES (CFIUS)

In addition to the outward-bound controls of the export licensing scheme summarized above, the President has authority under the Exon-Florio amendment enacted in 1988 to review and block inward-bound acquisitions that may affect U.S. national security. The review authority is delegated to the Committee on Foreign Investment in the United States (CFIUS). CFIUS review applies when, for example, a U.S. company that provides products for key technologies essential to the U.S. defense industrial base is being acquired by a non-U.S. company. The regulations would appear to subject to potential CFIUS review any joint venture involving the transfer of production or R&D facilities in which technology or personnel are transferred to a foreign person. A simple license of technology by a U.S. party to a foreign person is not subject to review by CFIUS (but may, of course, be subject to export licensing under certain circumstances.)

4. RECENT TRENDS AND DEVELOPMENTS

As a result of the profound changes in the global geopolitical situation over the last three years and as a reflection of the increasing concerns over enhancing U.S. competitiveness, the United States and its allies in the Coordinating Committee for Multilateral Export Controls or COCOM in Paris have been pursuing a broad agenda to simplify and reorient the export control regimes maintained by the United States and COCOM. A number of recent trends and developments are particularly relevant in the satellite and telecommunications context and deserve mention here.

4.1. SIMPLIFIED CONTROLS ON SATELLITES

There has been an effort to simplify export controls or in the words of Former Secretary of State James Baker, to "erect higher fences around fewer items." This is an on-going process, but the first, major step was undertaken with the so-called "COCOM core list review" in 1991. In addition, the United States has taken measures, at President Bush's direction, to "rationalize" controls between ODTC and Commerce, a development which promises to have important implications for the satellite industry as discussed below.

On November 16, 1990, President Bush signed Executive Order No. 12735 which, among other things, required, as part of the export control "rationalization" process, the removal from the U.S. Munitions List of all items contained on the COCOM core list unless significant U.S. national security interests would be jeopardized. Since that date, various interagency working groups have been meeting to develop guidelines for treatment of spacecraft and related components, among other items.

As a result of this effort, on October 23, 1992, the State Department issued a final rule which moved certain spacecraft-related items from the U.S. Munitions List to the Commerce Control List. A corresponding rule was proposed by Commerce to transfer jurisdiction over these items. In the future, communications satellites will not inherently be considered defense articles. Rather, the focus will be on specific technologies incorporated within satellites that may have military implications.

Communications satellites whose capabilities and characteristics are sufficiently "military" will be subject to continued control under the U.S. Munitions List. Among the satellite capabilities that have been deemed to raise military concerns are the following: anti-jam capability; cross-links; cryptographic items; kick motors; spaceborne baseband processing equipment; and certain antennas, propulsion systems and attitude control and determination systems.

The advantages of falling under Commerce Department jurisdiction include a "presumption of approval" system at Commerce and a generally shorter time frame for licensing. Commerce Department jurisdiction also means that U.S. companies will not need export licensing in order to respond to RFPs. In contrast to State, the Commerce Department has formal appeal procedures which are also expected to make the process more responsive to industry concerns.

While this simplified control process is generally a positive development from the standpoint of international trade, it is important to emphasize that the State Department still retains jurisdiction over many communications satellites, particularly those involving state-of-the-art satellite technology. In addition, detailed design, development, production or manufacturing data for all spacecraft systems remain covered by the USML regardless of which agency has jurisdiction over the satellite hardware.

4.2. TRADE WITH FORMER SOVIET UNION

Second, and related to the first development of simplified and rationalized controls, is a broad effort by COCOM member countries, including the U.S., to liberalize East-West controls. This liberalization will facilitate high-technology exports to and trade with the Former Soviet Union, including the Russian Far East. Potential ramifications of this East-West liberalization could include the greater availability of Russian space technology, hardware and services, as well as the possibility of teaming arrangements between Russian and U.S. companies in the Pacific Rim.

Traditionally, COCOM (an international body composed of all NATO countries minus Iceland, plus Australia and Japan) imposed strict export controls on technology transfers to the Soviet Union. Responding to a changing world order, efforts are underway to streamline exports of technology, including telecommunications, to former Soviet Bloc countries contingent upon the establishment of effective export control regimes in those countries. Countries may apply to COCOM to be eligible for new favorable consideration procedures upon demonstration that they can effectively track reexports, supply export and delivery certificates and guarantee that technology will be used for civilian purposes.

Poland, Czechoslovakia and Hungary have implemented export control safeguards. Each has been accorded "favorable consideration" status, and attention is now turning to their removal from the list of COCOM proscribed destinations. A similar approach can be expected for the Baltic States.

Moreover, in November 1992 COCOM formally moved to admit the countries of the former Soviet Union into associated status through the recently established COCOM Cooperation Forum.

In addition to multilateral developments at COCOM, a noteworthy U.S. development is the recently enacted "Freedom for Russia and Emerging Eurasian Democracies and Open Markets Support Act" which is intended to facilitate trade and investment opportunities with the Former Soviet Union (FSU) involving space hardware, technology and services. Among other things, the bill, known as the Freedom Support Act, will provide assistance to U.S. companies in entering FSU markets and will expedite consideration of licenses relating to "possible acquisition of any space hardware, space technology or space services" for integration into U.S. space projects or commercial space ventures.

4.3. TIGHTENING OF MISSILE TECHNOLOGY CONTROLS

Concurrently with the "rationalization" of controls on dual use technologies such as satellites, and the East-West liberalization, a third major development is the tightening of controls on U.S. missile technology. This development reflects a fundamental reorientation of the unilateral U.S. export control regime from East-West to North-South.

In 1991, the U.S. Commerce Department began to implement the Enhanced Proliferation Control Initiative or EPCI which is designed to control the spread of nuclear, chemical and biological weapons and missile technology. EPCI imposes new and expanded export controls which require the attention of any exporter of commodities or technical data (including software.)

EPCI requires an individual validated license for the export, reexport or transfer of <u>any commodity or technical data</u> which the exporter "knows," "has reason to know" or "is informed" is destined for a nuclear, chemical or biological weapons or missile development end use or end user. EPCI thus imposes on all U.S. exporters a "know your customer" rule. Significantly, knowledge by an employee will be imputed to the employer.

EPCI's prohibitions extend not merely to sensitive weapons-related technology but also to any commodity, including those items that are not otherwise subject to control, which the exporter "knows" or "has reason to know" might have a prohibited end use. Thus, the new export controls cover seemingly innocuous items like paper clips and rubber bands. Put simply, EPCI imposes new, stringent requirements that exporters and their employees know what and to whom they are selling, as well as where the exported item is going and why.

Because the Department of Commerce recently has made it clear that EPCI will be a top enforcement priority, it is important for each U.S. exporter (including those in the satellite industry) to have in place at least a minimal internal control procedure to monitor indications of suspicious transactions. Certain informal guidelines have been available, and the Department of Commerce recently published a more formal list of "red flags." For example, under existing guidelines, if an exporter knows or has reason to know that a customer does not wish to take advantage of commonly available installation or maintenance services, the exporter is under an obligation to investigate the transaction. Similarly, the presence of an end-user on Commerce's published denial list is a bar to the transaction. An exporter may not ignore "red flags" or avoid asking necessary questions of a customer.

Regulations adopted in June 1992 by the Commerce Department will potentially apply to technology that would aid development of satellite launching programs in several countries. In defining particular situations where validated licenses are required (and presumably will be denied), Commerce included satellite launching programs in North Korea, Brazil and India. Missile technology export controls have also been tightened with regard to China, Iran, Pakistan, Iraq, Israel, Saudi Arabia and Egypt.

In addition to the unilateral EPCI controls, the United States has been pursuing multilateral controls on similar weapons of mass destruction through the Nuclear Suppliers Group, the Australia Group and other bodies. Given recent successes in these talks, the prospects for broad multilateral regimes aimed at prohibiting the spread of weapons of mass destruction appear to be good.

4.4 RUSSIAN AND CHINESE LAUNCH VEHICLES

Two recent decisions relating to the use of Chinese and Russian launch vehicles have a potential impact on satellite and launch activities in the Pacific Rim. Traditionally, the U.S. has denied exports of U.S. satellites for launch by China or Russia because of technology transfer concerns. The availability of alternative launch vehicles could mean increased competition in launch services and, potentially lower implementation costs for satellite ventures and more diverse launch capabilities.

In September 1992, the President approved the launch of five U.S.-built satellites on the Chinese Long March vehicle. This decision affected the following satellite projects: APSAT (Asia Pacific Satellite), Asiasat 2, Intelsat VIIIA, STARSAT, Afrisat and the Chinese-built Dong Fang Hong 3 (which contains U.S.-built components). Where exports to China are involved, the President has authority to grant a waiver of export restrictions where the national interest so warrants. In the case of the foregoing satellite projects, the national interest considerations were deemed compelling.

This waiver decision has been criticized by the U.S. launch industry, among others, on the grounds that China has been violating a bilateral 1989 agreement with the U.S. by significantly undercutting U.S. satellite launch companies. (The 1989 Agreement allows China to launch 9 U.S.-built communications satellites through 1994 at prices comparable to those offered by Western companies.) There has been speculation that the new Clinton-Gore Administration may take a stronger position on this issue, based on an October 1992 speech by Vice President-elect Al Gore who spoke out against China's violations of its launch agreement with the U.S.

U.S. launch providers have also criticized the State Department's June 1992 decision to waive export restrictions to allow flight of the Inmarsat III satellite on Russia's Proton rocket, if that launch vehicle is selected by Inmarsat. The waiver has been characterized as a one-time exception to the State Department's long-standing policy prohibiting export of U.S. satellites for launch in the former Soviet Union. To address U.S. launch industry concerns about below-market pricing of the government-subsidized Proton, the U.S. is currently attempting to negotiate an agreement with Russia relating to satellite launches.

4.5 SATELLITE DESCRAMBLERS

In another recent development relevant to the satellite and telecommunications industries, the State Department, in November 1992, authorized the export of descramblers, manufactured by Titan Satellite Systems, that can receive encrypted TV signals. Cryptographic technology is covered by the U.S. Munitions List and the State Department has traditionally taken a highly restrictive view of exports involving cryptographic capability, largely at the insistence of the U.S. National Security Agency (NSA). This development will be of particular interest to companies interested in encrypted satellite programming delivery.

5. CONCLUSION

As the above discussion reflects, the U.S. export control scheme is undergoing dramatic changes, fueled by even more dramatic changes in the geopolitical situation and global economy. Another factor creating an impetus for change is the expanding global marketplace for satellite and telecommunications hardware and services. U.S. companies are increasingly looking to international markets for their products and services, at the same time that countries in the Pacific Rim, and elsewhere, are recognizing the importance of a strong telecommunications infrastructure as a foundation for social and economic development. In addition, the increasingly global nature of the communications industry, and the practical reality of strategic partnerships involving companies and investors from diverse countries, means that export control issues will continue to have a major impact on satellite and telecommunications activities in the Pacific Rim.

With the possible exception of proliferation concern, these political and economic factors are generally moving the U.S. in the direction of reducing export control barriers and making the export control process faster and more certain. For many in the U.S. satellite industry, however, these changes are still too few and too slow, and are perceived as imposing constraints on commercial activities that international competitors may not face.

The future challenge will be to balance industry pressure to reduce trade barriers while ensuring that national and global security concerns are met. While it is still too early to tell which direction the new Clinton Administration will take, it is likely to accelerate the trend toward government promotion of U.S. exports in new foreign markets.

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CONVERGENCE, UNIVERSAL SERVICE AND PUBLIC POLICY

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ABSTRACT

This paper addresses the phenomenon of convergence between telecommunications and information technology, and looks at the implications for the participants. It identifies some of the key drivers and looks at public interest considerations and the challenges these present to public policy formulation. The paper notes that convergence also encompasses broadcasting - an area that has been considered to be quite separate from the world of tele-communications. The issues stemming from convergence are only now beginning to be addressed.

1. Convergence and the Public

On 20 July 1969 Neil Armstrong walked on the moon - and millions of people around the world watched spellbound, glued to their television screens. Within a few short years, the Apollo missions and deep space probes which brought back colour pictures of Mars and Venus barely excited interest.

While critically inspecting the photographs reproduced in the media, we took for granted our ability to extract from the background "noise" of electromagnetic emissions of interstellar space the incredibly weak telecommunications signals coming across millions of miles. Technology and public expectations were reconciled. It was no longer "news". But it should have been.

In much the same way, convergence is the revolution that never happened. There has been no startling new discovery; no particular breakthrough to focus our attention; and no wild panic among public policy makers in Government. Not yet.

These exciting achievements have stemmed from an inexorable and largely invisible integration of the familiar world of telecommunications with the rapidly changing world of information technology. Such advances have been disguised in bland terms like "signal processing", which are "information free" to the public as well as to the expert commercial executive or Government policy analyst.

Signal processing, for example, has allowed us to build "intelligence" into a space communications receiver system. The super-fast transaction times now achievable by computing chips and parallel architectures make it possible to apply a number of testing and sorting programs (or algorithms) in real-time to the incoming telecommunications data stream.

The addition of this "intelligence", which can include the insertion of statistical tests and comparative information, enables us to "filter out" the unwanted signals. We can also "enhance", by predictive logic, the wanted signal that emerges. All under the grey guise of "signal processing".

It is the ability to store, sort and manipulate huge amounts of information from a number of different sources in real-time and at low cost, that lies at the heart of convergence. And at the heart of the modern telecommunications network lies the "switch" or the PABX (if you are a telecommunications network planner), or a high speed digital parallel processor (if you are an information systems person).

The impact of convergence will be all the greater because it has been such a long time in coming. The changes have been almost imperceptible: a natural part of our on-going adjustment to technological change. As users and service providers, we have progressively created a vast and increasingly inter-linked base of services, technologies and applications. But none of us has been required to address the totality of what we have been creating.

Our unbending focus has been on greater "functionality", more flexible "service offerings", low cost "connectivity", "data highways", "wideband services" - and other wonderfully non-descriptive labels to achieve our business objectives. Our banners have been "client service", "flexibility" and "response time", in the context and language of our industries and client base.

The clear focus has been on "outcomes", not on "inputs" or how they got there. Or how these inputs could be accessed for purposes other than our own.

2. The Third Wave

If the advent of the *Telegraph* was the first wave to fundamentally and forever change the way in which people and businesses communicated with each other, then the second wave was the *Telephone*. The third wave has been with us for some time, but for the lack of a hyphen it has eluded our focus and our vision: not telecommunications, but *Tele-communications*.

The third wave is about to break. What we are seeing is the merging of two very different cultures, markets and classes of users, each of which is itself evolving. World-wide, the formerly highly regulated world of telecommunications is rapidly being liberalised and moving towards competition, openness and a new-found focus on client service rather than technology.

Equally, the relatively unregulated but highly competitive world of information technology is burgeoning with a mind bending mix of new applications and information management services.

The convergence of these sectors will give rise to unprecedented opportunities for businesses to exploit. For the first time, the services demanded by users are not limited by technology.

Perhaps even more importantly, the Telcos will now be more willing to focus on meeting client needs rather than offering the standard "plain vanilla". It would seem that users have quickly embraced the "unbundling" game initiated by the FCC.

An imperceptible part of convergence has been the breath-taking growth in inter-working and network information flows. While this has significantly expanded the service potential of interconnected networks and databases, it has also resulted in a major change in the nature and type of users.

Intelligent communications services are no longer the province only of major companies and organisations. The availability of central exchange services such as Centrex provide an affordable entry point to even small companies that cannot justify the cost of their own PABX.

It is becoming increasingly difficult to differentiate between an information systems user and a telecommunications user. For example, the operation of an interconnected virtual data network depends fundamentally on the intelligent functionality programmed into the software incorporated into the telecommunications network.

Whether such differentiation continues to be relevant with the advent of convergence is a moot point.

Convergence is generally thought of in terms of an integration of technologies. While that is certainly both a determining factor and an outcome, the challenges to service providers (and, to an extent, users) result principally from the convergence of services. It is this convergence that has thrown together the different user bases and their different needs.

The conundrum for policy makers and Governments, however, is the services potential that these initiatives present.

3. ISDN

No paper on convergence would be complete without addressing ISDN: that was another revolution which has taken a long time to happen! We are all familiar with the various meanings attributed to this acronym over the years. It is also interesting to recall the ways in which the concept of ISDN itself has changed to reflect technological and service realities and timeframes.

With the benefit of hindsight, it could be argued that the "solution looking for a problem" was, in fact, searching for a revolution - the revolution of convergence.

The two sectors have remained separate mainly because telecommunications networks have been analogue and computing networks digital. Computer to computer communications have required the use of a modem and analogue-digital converters. Each sector also has a separate history, and practitioners have grown up in their particular environment.

While in many countries digital data networks have been installed as an overlay on the analogue public switched telecommunications network (PSTN), convergence could not become a reality until the whole network has been converted to digital.

It takes time and considerable investment of resources to upgrade analogue networks and exchanges to deal with the transmission and switching of 64 kbps digital bit streams offered by ISDN. In some countries there are likely to be several generations of switching equipment operating side by side - mechanical, electro-mechanical and solid state. This requires considerable ingenuity in planning and execution.

Thus while ISDN may be the engine for driving convergence and the key to opening up exciting new service opportunities, both are dependent upon the digital conversion programs for analogue networks.

As implementation of ISDN gathers pace, exciting opportunities will emerge for developing a wide range of new tele-communications services. It will also enable these services to be accessed, perhaps for the first time, at relatively low cost by small to medium sized businesses which could not previously justify the expense.

What tends to be overlooked is that the benefits offered by ISDN, which could be considerable, will accrue principally to businesses and the commercial sector - and to the service providers. There will be little benefit for the public, who tend to want only a voice service. However, as the vast variety of new tele-communications services begin to be marketed, there may well be spin-offs for the individual.

Another aspect is that a common strategy for Telcos is likely to be to give priority to first upgrading exchanges and lines in the Central Business District of the major cities, and then spread out to the suburbs and regional areas as and when their maintenance and development plans permit. While that may make good commercial sense, it could be perceived by public interest groups as potentially divisive for the community.

4. Opportunities and Cans of Worms

With the down-turn in the world economy, all businesses have had to become more efficient and competitive. The greatest impact in business management over the last five years has been the quiet explosion in information management systems.

There has also been a realisation that integration of all of the company's existing discrete information systems, wherever the information may currently reside and whether in manual or electronic form, would provide the company with a significant competitive edge. To meet this burgeoning demand, convergence offers tantalising opportunities for almost every business.

The users are many and varied: banks, travel agents, airlines (which are becoming increasingly vertically integrated), consumer credit agencies (American Express, Visa, Diners, Mastercard etc), supermarket chains, legal services, Government Departments (which are increasingly cross-matching data), motor vehicle distributors, customs agents, land use agencies and developers, transport companies, - and Telcos and service providers themselves.

The above list is not exhaustive, but it is illustrative of the way in which tele-communications services have had a pervasive influence on every sphere of commercial and Government activity. Already the ability to mix voice, data and graphics as integrated services and communicate via a digital network has excited many service offerings. We also have more new terms to assimilate, such as *Multimedia*, *Frame Relay* and *Centrex*.

To cope with the tele-communications services revolution we have seen the emergence of "interconnect companies". These are versatile and flexible firms with strong skills in telecommunications and information technology, who are able to integrate and configure the services provided by the network operator to meet the unique needs of each client. The outputs of the interconnect companies are also likely to be new and innovative bundles of services.

To deal successfully with the tele-communications revolution arising from convergence, businesses will need to acquire and develop a range of new skills. Most successful companies discovered "client service" during the 1980s. In Australia, Telecom discovered it in the late '80s under the threat of competition.

With the competing telecommunications carrier Optus now up and running, Telecom (now AOTC) is performing miracles under the guidance and direction of its new CEO Frank Blount, whose credo is to "delight" AOTC's customers. There has been a noticeable change in the response one gets today from a Telecom Business Office.

These changes have not been without pain. AOTC has fundamentally reviewed its operations and systems, and discovered that it really did not have a satisfactory picture of how the business was performing from day to day. It formed the brave conclusion that AOTC was not well structured or equipped to deal with the client challenges of the 1990s and beyond, and set about rectifying the situation.

AOTC has now significantly restructured its operations to provide greater client focus, and shed labour in the process. It has set up a range of separate business units and equipped them with processes and systems to run their business effectively. And Blount has stood the traditional pyramid on its head, challenging his executives to justify what they were doing to support AOTC's client base, at the TOP of the inverted pyramid.

As any large organisation adjusting to change will have discovered, there is more to restructuring than simply moving a few lines on an organisation chart and talking wisely about flatter structures! Such major restructuring certainly requires new skills, but it also requires a change in the culture of the organisation itself: an understanding and a commitment to doing things differently.

Successfully negotiating cultural change takes commitment, guts and determination, and a shared vision of where the people want the organisation to be. It demands on-going consultation with the staff. And it takes time. At a time of economic down-turn, it also takes commercial courage.

Some argue that these are normal business risks. With such promises of plenty, where are the problems? As always, it depends on one's perspective as to whether something is good or bad. In the ideal world of Pareto optimality, the "gainers" compensate the "losers". However, why is it that the potential losers always seem to shout loudest and those who stand to gain keep a low profile!

The issues that emerge are not commercial or market related - those are well provided for under existing machinery. It is the minefield of public interest considerations that invites attention. These represent the proverbial "can of worms".

5. The Information Society

Western countries have been slow to comprehend the magnitude of the changes stemming from the technological initiatives described above. Not only will these advances cause excitement and perplexity in commerce, but the realisation of the possibilities of what the services can provide will suddenly explode on a largely unsuspecting public.

Convergence also represents a revolution in information availability and access. A preoccupation with technology has tended to blind us to the greater revolution within the revolution. Japan, for example, recognised the potential, and as long ago as 1986 it coined "the information society" and addressed the issue on a national basis.

Japan set course not only on developing the various technological streams, but also ensuring that as a nation, the people would be empowered to benefit from and share equally in the national goal of an Information Society. We are relatively unprepared.

With convergence the key public interest issues resulting from the integration of information processing technologies and systems with telecommunications are

* equity of access
* privacy

Each of these considerations recur in most policy analyses of Government initiatives. While these basic concepts are well understood and have been provided for in past legislation, the implications of convergence are yet to be specifically addressed.

6. Universal Service

In Australia, as in most advanced countries, people are considered to have (and expect) the right to affordable communications. This right has been preserved in various Acts of Parliament and Government policies.

There is a further consideration for countries such as Australia which have a large land mass and a relatively small population, a small but significant part of which lives in rural and remote areas. These people tend to consider themselves pioneers opening up "the outback", and see no reason why they should not enjoy the same quality and standard of services as their city cousins.

As a result, the *Telecommunications Act 1975* made general provision for the carrier (Telecom) to provide "universal service" at a price that was "affordable". This was translated by Telecom to a fixed maximum rate (which was heavily cross-subsided) for the connection of any telephone service in the outback, irrespective of location.

There was much debate about the level of cross-subsidy to users in the rural and remote areas, figures varying between \$250 to \$850 million. Whatever the real figure, it was considerable - and hidden from public scrutiny. That was not seen as a problem by the National Country Party, although this was not a view shared by the Labor Government.

Despite the strong and rapid drive for deregulation of telecommunications, the Government stopped short of privatising Telecom Australia. While the new *Telecommunications Act 1991* (the second new Act in two years) considerably liberalised the environment and provided for the introduction of competition, it retained the public interest requirement that AOTC should be the carrier of last resort.

The Government reaffirmed that the principal obligation for AOTC to provide and maintain basic telephone services to residential and business users throughout Australia, including the rural community, would remain. It recognised that this would be a Community Service Obligation, and appropriate arrangements would be explored to compensate AOTC.

With convergence, there will be so many new and innovative tele-communications services available that it will be almost impossible to define a "basic telephone service". The FCC found similar problems with differentiating between *basic* and *enhanced* services. In Australia, the regulatory body AUSTEL recently issued a controversial opinion on what are *basic carrier services* and *higher level services.*

As more and more low cost tele-communications services become available, the whole question of universal service and equity of access will become open to debate. What will be the "basic telephone services" that AOTC has the obligation to provide under the Act? No doubt AUSTEL will be invited to provide another opinion!

There will no doubt be many attractive and useful information services competing on the market. While competition will keep the prices attractive from a commercial point of view, it will be interesting to see whether community groups begin to lobby the Government to legislate for even greater access and at even lower cost so that none in the community will be disadvantaged or excluded.

With an abundance of service offerings at increasingly lower prices, it will be interesting to see whether such public interest arguments carry much weight.

7. Privacy Considerations

The greatest impact from the explosion in tele-communications services arising from convergence will be on the privacy of individuals and organisations. The integration of advanced signal processing techniques with information systems and databases, accessed through an intelligent digital telecommunications network provides an awesome capability.

Database security is an issue that has received increasing attention. While we are all familiar with the "hacker" and the apparently world-threatening feats that they can achieve, such as getting into a Pentagon database, the impact of these events is minuscule. But it is a great theme for an exciting movie and makes a rattling good read in the tabloids.

The real damage is created usually by people already within an organisation - or those who have only recently "departed"! White collar crime is well established, and all countries are seeking innovative ways of dealing with it. Convergence will only add a further degree of difficulty to trying to contain such abuses, fraud and theft.

All of the problems noted above relate to economic harm or monetary gain. By far the greater issue, and its potential impact, is that of privacy. George Orwell's *1984* was prophetic and the notion of "big brother" looking at our affairs is abhorrent to most people. In more general terms, it is about unauthorised access to personal information, and an individual's right to privacy.

In Australia, a few years ago the issue of the "Australia Card" for every citizen excited wide public debate. The intensity of the debate significantly over-shadowed concern about the economy and other catastrophes. The Government had no option but to back off. And that was before convergence had really taken off.

There have been other incidents which have caused either annoyance or mild concern, and a mild element of surprise. I am sure we have all received "personalised" junk mail inviting us to subscribe to this, or buy that, or support this worthy cause. Yet none of us solicited that mailing. Because the "damage" was at best irritation, most of us have just let it be.

There are organisations which make a lot of money out of selling "mailing lists". These come from electoral rolls, conference attendance lists, telephone books, surveys, credit card memberships, and even genuine mailing lists (the ones we actually subscribed to!) We have also filled in at various times an entry form for a competition - a free flight, a new car, \$1000 worth of groceries, lottery tickets, etc. There are no doubt other avenues which would boggle the mind.

It all sounds pretty harmless, until we look deeper. Recently in the press in Australia there have been instances where confidential information on individuals has been bought from Government Departments by banks and insurance companies, presumably to check credit worthiness or financial standing - but why did they need medical histories? The inquiry revealed that the trade in confidential information was well established and wide-spread.

To an extent, the individual's protection against such abuse has been the poverty of our national databases. They were slow, localised, and often did not even suit the needs of the organisation itself (because these had changed since the system was established). Most data in Government was held on file - the manumatic system. The effort required to correlate several sources of different data acted as a brake to runaway abuse.

That has all changed. The cost of computing and communications has halved every two years, while the hardware capacity of systems has quadrupled every two years (what is a "mini" today?). It has been estimated that the price per MIP has fallen from $250,000 in 1980, to $2,500 in 1990. Increased functionality, falling costs and rapidly expanding capacity are fuelling the revolution of convergence.

Most businesses are capitalising on these developments. In Australia, the Taxation Office has established computer-based lodgement of your tax return - to give the client quicker service. All Government Departments are moving rapidly to install large, national databases.

With all that low cost functionality becoming rapidly available, cross-referencing between databases becomes a simple exercise. The Tax Office already has statutory powers to cross-check information such as interest and dividend payments with banks and financial institutions. Some people are already concerned that the existing privacy safeguards are not adequate to deal with the changing situation.

But the issue does not rest solely with Governments wanting to extract accountability and revenue. Business organisations are also developing and enhancing their information management systems to improve their control and profitability. While in most cases these tend to be local or regional systems, there is no constraint on linking systems nationally or internationally.

Because of various concerns about trans-border data flows, copyright, and protection of intellectual property, some organisations have made the decision to located their central database in, for example, Hong Kong. Because of convergence and the availability of enhanced tele-communications services, the location of the database is transparent to the users, wherever they may be around the world.

With convergence there is an explosion in the number and combinations of systems and integrated technologies which open the door to easily accessible information management and transfer. Human nature and native cunning will ensure that the types of abuses discussed above are unlikely to disappear. But their potential impact will be far greater as convergence gathers momentum.

8. More Convergence

The phenomenon of convergence does not stop with telecommunications and information technology. For some time now, there has been a growing convergence also with broadcasting services. For example, television can be broadcast "free to air" as a radiated service, distributed by satellite (and either received directly by design or "fortuitously"), or carried by cable into the home.

This presents problems because in the public interest, Governments tend to have firm ideas about the role of the media in national development and culture. They are also aware of the compelling ability of television to influence the public's opinions, even about politics and politicians.

Consequently, broadcasting has been rigourously regulated - not only programs and viewing hours, but also concentration of media ownership, eligibility for a broadcasting licence, and broadcasting licence conditions. In Australia, there are firm limits on levels of foreign ownership, and cross-media ownership laws apply.

The *Broadcasting Act 1942* sought to regulate both carriage and content. By tightly regulating the technology and controlling the means of transmission, the broadcasting industry was kept separate and unique. There were policy objectives for broadcasting, such as the promotion of diversity and choice, universal access, and a distinct national character. The Act also laid down machinery (the Australian Broadcasting Tribunal) to regulate content and control ownership.

As technologies and broadcasting practices changed, the Act was constantly amended to close off loop-holes. As technology presented more and more intricate policy challenges, the Act finally ran out of band-aid solutions. Australia now has a new Broadcasting Act which focuses on *services* rather than *technologies*, and a new regulatory body is being established - the Australian Broadcasting Authority.

The driving force behind these changes has been convergence. The technology used for broadcasting is no longer only broadcasting-specific. Satellites, for example, have made a nonsense out of exclusive geographic service areas which used to approximate to terrestrial transmitter coverage. To protect the service areas of existing broadcasters, the national distribution of television programs by satellite had to be encrypted to prevent unauthorised reception.

The Government was forced to agree several years ago to a satellite-delivered "non-broadcasting" pay television service restricted to "pubs and clubs". There was no provision for such a service under the old Broadcasting Act, so the service was authorised under the *Radiocommunications Act 1983*. However, the Government had no power under that Act to regulate content or ownership, so agreements parallelling the requirements under the Broadcasting Act were negotiated with the operators.

9. Pay-TV

The issue of Pay-TV has put considerable pressure on existing free-to-air broadcasters, and the moratorium on Pay-TV has now expired. Multipoint Distribution Services (MDS) provided further concern, because they could offer limited "broadcasting" services (for a fee) using frequencies that were not in the Broadcasting Bands. Cable, however, was regulated under the *Telecommunications Act 1975* and could not be used for "broadcasting" - or even for "narrowcasting"!

The Government has shunned Pay-TV for a number of reasons, including the fact that there was considerable concern about the possibility of "siphoning" - that a Pay-TV operator would siphon off the best programs that were currently being broadcast free-to-air, and these could then only be viewed for a fee. This would create a culture of "information rich" and "information poor", widening the divide in society.

With the deregulation of telecommunications and the selling off of AUSSAT Pty Ltd to the new competing carrier, these concerns were put to the test. When the competition for the second carrier licence was faltering and it looked as if the revenue to be gained from the licence and the sale of AUSSAT would fall considerably short of initial projections, the Government finally agreed to permit Pay-TV and provided that this will be delivered only by satellite as a DBS service.

The Pay-TV decision did not prevent the Kalori consortium from withdrawing, leaving Hutchison Whampoa as the surviving member to contest the licence with Optus. Since then there has been considerable argument and debate about the terms and conditions under which Pay-TV will be allowed, foreign ownership limits, exclusivity period, number of channels, participation of the Australian national broadcaster (the ABC) etc. Surprisingly, there has been little debate about the use of optical fibre cable.

Following several public inquiries and reversed decisions, the Government has now decided that Pay-TV will be delivered by digital technology. By waiting for developed digital compression techniques, each transponder will be able to carry up to ten channels instead of the initially envisaged single channel.

While the arguments tend to focus on diversity and choice, and dilution of ownership, there would seem to be a more pressing reason for this decision. Given the small population of Australia and the high cost of leasing a transponder (about $6.8 million p.a.), with no exclusivity period and three or more licences to be offered, Pay-TV would find it hard to be profitable. To pay $680k for leasing a channel instead of $6.8m, significantly changes the economics.

Digital compression technology suitable for Pay-TV is unlikely to be available until 1993/94. Meanwhile, AOTC (formerly Telecom) is continuing to upgrade its exchanges to digital and install more and more optical fibre cable into the local loop. It is also continuing with its trials of wideband services to the home - free to the participating householders, as it gains experience in handling a range of digital services, including television.

For a small but widely distributed population like in Australia, such developments bring with them a number of public interest issues. For example, Pay-TV via satellite will cost the consumer some $800 for a "squarial" antenna and receiver, an installation fee (perhaps $250), plus monthly payments of around $40 - an outlay of around $1,530 in the first year. If there were a viewer base of 300,000, this would equate to a national consumer outlay of around $460 million.

As AOTC is installing transmission and switching facilities for wideband services to the home as part of its upgrading of tele-communications services, Pay-TV could be provided at marginal cost. In addition, with the huge expansion in mobile services and the competition for spectrum, the ability to take broadcast television programs "off air" and deliver them via cable to the home presents an attractive option, particularly in the major cities.

Such an approach would still leave over-the-air broadcasting as the preferred approach for rural, regional and outback areas. In these situations, frequency congestion is not an issue, but the cost of cabling to sparsely distributed households could be prohibitive.

Such decisions involve many trade-offs. With convergence, the separate communities of telecommunications, information technology and broadcasting are coming together. Each of these is also an integral part of the greater community and entitled to consideration by Governments on a national basis.

The public policy challenges this presents are many and complex. There are a number of legitimate but mutually competitive economic ends being pursued by the various interest groups. The Government also has to deal with the wider issues of Australian character, effectiveness in the use of national resources, equity of access and implications of universal service.

Any decision made by the Government which may advantage one group, will immediately be seen as detrimental to the aspirations of others. Formulators of public policy in a time of economic downturn and rapid technological change face an unenviable task.

With convergence, the challenges are even greater because the implications of what is unfolding are yet to be fully understood. It underscores the way in which public policy formulation is often depicted by practitioners as the "dismal science" - having to make impossible allocations of limited resources between the infinite needs and wants of the population.

By comparison, the complexities of the technologies of convergence are easy!

CANADA EMBRACES LONG DISTANCE COMPETITION

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1. ABSTRACT

This paper describes the evolution of competition in the Canadian telecommunications market culminating in the CRTC's decision in June of 1992 to permit public long distance competition. Economic and technical aspects of the CRTC's landmark decision are examined as well as opportunities for new carriers, resellers and hybrids.

2. INTRODUCTION

On June 12, 1992, the Canadian Radio-television and Telecommunications Commission (CRTC) released its long awaited decision on long distance competition (Telecom Decision CRTC 92-12, Competition in the Provision of Public Long Distance Voice Telephone Services and Related Resale and Sharing Issues).

In its decision, the CRTC approved an application by Unitel Communications Inc. to provide a public long distance voice service in competition with the regional telephone companies comprising Stentor (formerly called Telecom Canada) which had enjoyed a monopoly in the provision of MTS/WATS services until this point in time.

While the CRTC did not approve the terms and conditions of entry proposed by a second applicant (the BC Rail/Lightel (BCRL) consortium), it did indicate that BCRL and other potential competitors could apply for interconnection on the same terms as approved for Unitel.

This decision represents a very dramatic change in CRTC philosophy since 1985, when the CRTC turned down a competitive long distance application by CNCP Telecommunications (Unitel's predecessor). At that time, the CRTC was not prepared to allow CNCP to take the risk of entering the market on more onerous terms of compensation than the company had proposed and its business plan could accommodate. Now, in Decision 92-12, the CRTC has indicated that it will leave it up to the shareholders of new entrants to determine whether they wish to take the risk of entering the market in accordance with the terms and conditions established.

The CRTC has also stated that it will also be favourably disposed to applications by new facilities-based entrants, including "hybrids" who wish to provide long distance services using a combination of their own facilities and leased facilities, or who wish to serve particular regions of the country or other niche market..

In Decision 92-12, the CRTC has also made significant changes to the regulatory regime governing resale activity in a manner which removes many of the distinctions between resellers and facilities-based carriers. Coupled with another important CRTC decision two days earlier in which the CRTC decided that it had to regulate resellers as carriers, little now remains of the sharp regulatory distinctions between resellers and facilities-based carriers that had previously existed. The CRTC has made it clear that resellers may now cross the line and make use of a combination of leased and owned facilities in hybrid networks. At the same time, the CRTC has permitted facilities-based carriers to resell the MTS/WATS services of the telephone companies to augment their networks. The CRTC wants the decision to lease or buy facilities to be based on economic rather than regulatory considerations.

While certain aspects of the CRTC's decision dealing with the allocation of switch modification costs and the level of contribution payments (to subsidize local access) have been appealed to the courts by the regional telephone companies, the main elements of the decision stand unchallenged. Unitel began to offer its new competitive voice services in November of 1992 and the new resale rules became effective in mid-August of 1992.

This paper describes the evolution of competition in the Canadian telecommunications market and provides highlights of the CRTC's landmark decision.

3. EVOLUTION OF COMPETITION IN CANADIAN TELECOMMUNICATIONS

The CRTC's decision to permit competition in the provision of public long distance services should be viewed in the context of a gradual evolution over the past 15 years from a near total monopoly environment to one in which most aspects of telecommunications services are now subject to some degree of competition.

The CRTC has no statutory mandate under its governing legislation (principally the 1906 Railway Act) to favour either a monopoly or a competitive industry structure. The existing legislation gives no clear direction in this regard. This has left the CRTC, an independent regulatory agency, to determine the extent of competition that should be allowed in the Canadian telecommunications industry based largely on how it perceives the "public interest."

This has been an incremental process based on specific applications by parties either seeking relief from restrictive tariff provisions, or applying for interconnection with the telephone companies' local exchange networks. In the former case, the CRTC has relied largely on the provisions of section 340(2) of the Railway Act which prohibits unjust discrimination or the granting of undue preferences or advantages by carriers. In the latter case, the CRTC has applied a test of whether interconnection is in the "public interest." This gives the CRTC an opportunity to consider a wide range of factors in assessing the impact of allowing interconnection.

In practice, this has led to a situation in which the CRTC weighs the pros and cons of introducing competition on a case by case, sector by sector basis. The CRTC has described its approach in the following terms:

> The Commission wishes to emphasize that, under the existing legislation, it has no mandate to favour either the monopoly or the competitive supply of telecommunications services per se. In previous decisions with regard to the private line, terminal equipment, enhanced services, mobile telephone, and cellular radio-telephone markets, the Commission has permitted various types of competition to take place. Each of these decisions was based on an assessment that it would afford significant advantages to users generally in terms of price and service and that such advantages outweighed any potential disadvantages that might arise. The underlying regulatory approach was, and is, to weigh the potential advantages and disadvantages of any proposal for liberalized entry and to seek to balance fairly the often conflicting interests of all concerned, including the interests of the various groups of subscribers, the carriers and competitors in a manner that is most likely to serve the public interest broadly defined (Telecom Decision CRTC 85-19, pp. 11 - 12).

A brief chronology of some of the significant milestones in this evolution is presented below.

1977 - Mobile Telephone Service: The CRTC struck down as discriminatory restrictions in Bell Canada's tariffs which prevented customers from using competitively supplied mobile telephone equipment in association with Bell Canada's automatic mobile telephone service (Challenge Communications Ltd. vs. Bell Canada, Telecom Decision CRTC 77-16).

1979 - Private Line Interconnection: The CRTC approved an application by CNCP Telecommunications (now Unitel) to interconnect its private voice and data networks with the local telephone exchanges of Bell Canada enabling CNCP to offer dial-up access. (CNCP Telecommunications - Interconnection with Bell Canada, Telecom Decision CRTC 79-11).

1979 - Paging: The CRTC ordered Bell Canada to permit a competing paging company, Colins Inc., to connect its paging terminal to Bell Canada's local exchange network for purposes of providing dial-up paging services (Colins Inc. vs. Bell Canada, Telecom Decisions CRTC 1979-12 and 14).

1980 - Terminal Attachment: The CRTC allowed customer ownership and competitive provision of both single and multi-line terminal equipment, including key systems and PBX's. (Attachment of Subscriber Provided Terminal Equipment, Telecom Decisions CRTC 80-13 and 82-14).

1984 - Enhanced Services: The CRTC allowed the provision of enhanced telecommunications services on an unregulated basis by non-carriers. This enabled service providers to resell basic telecommunications services in the course of providing some enhanced form of service - other than basic transmission service. (Enhanced Services, Telecom decision CRTC 84-18).

1984 - Cellular and RCC Interconnection: The CRTC approved interconnection between cellular telephone networks operated by Rogers Cantel Inc. and the local exchange networks of Bell Canada and BC Tel. In the same decision, the CRTC approved similar interconnection arrangements for other competitive suppliers of conventional mobile radio telephone services. (Radio Common Carrier Interconnection with federally Regulated Telephone Companies, Telecom Decision CRTC 84-10).

1985 - Local Area Networks: The CRTC allowed the interconnection of privately owned local area networks (LANs) to the public switched telephone network allowing dial-up communication from private voice networks and both public and private data networks. This has led to limited competition from some cable television companies in the provision of local network services (Interexchange Competition and Related Issues, Telecom Decision CRTC 85-19).

1987 - Resale and Sharing: The CRTC allowed unlimited resale and sharing of telephone company facilities for the provision of data services, and limited resale and sharing for the provision of voice services. Resale of WATS was not allowed and private lines could not be resold on a joint use basis to provide MTS equivalent service to the public (Resale and Sharing Interexchange Services, Telecom Decision CRTC 87-2).

1990 - Resale of Private Lines: The CRTC liberalized its resale rules to allow resale of interconnected private line services to provide MTS equivalent service to the public. However, resale of WATS was still not allowed (Resale and Sharing of Private Line Services, Telecom Decision CRTC 90-3). Resale of overseas private lines on a reciprocal basis was also allowed in 1990 (Teleglobe Canada Inc. - Resale and Sharing of International Services, Telecom Decision CRTC 90-2.

1992 - Public Long Distance Competition: The CRTC allowed competing carriers to interconnect with local telephone exchanges and toll offices for the provision of competing MTS/WATS services. The CRTC also removed the remaining restrictions on resale activity (Telecom Decision CRTC 92-12).

4. THE UNITEL PROCEEDING

Unitel's application of May 16, 1990 commenced the longest and most thorough telecommunications proceeding in Canadian history. By the time it was over more than 50,000 pages of evidence had been filed and 90 days of oral testimony had been presented at regional and central public hearings.

In its application, Unitel promised to offer MTS/WATS services on a competitive basis to both business and residential customers and expand the range of advanced network services available to Canadian business users.

Unitel did not propose to build a duplicate local exchange network. It sought instead to connect its long distance network via digital trunk connections to the telephone companies' class 4 toll offices in order to provide universal access to Unitel's service on day one of service introduction. Unitel also requested the right to connect to the telephone companies' class 5 local offices, at its option. Unitel also proposed to use direct access lines for connectivity to Unitel's network by large users. Unitel proposed to use Common Channel Signalling No. 7 (CCS7) to achieve a higher level of efficiency in its network and to provide advanced network services. It therefore requested connection of its Signal Transfer Points (STPs) to the telephone companies' STPs using standard interconnection protocols.

As mentioned above, the CRTC applies a public interest test in deciding whether to allow interconnection of competing networks.

In weighing the public interest, the CRTC places a wide scope on the test and considers any significant benefits or disadvantages that would arise as a result of the application before it. This includes those presented by the applicant and respondents and interested parties who make submissions to the CRTC or present evidence during the public hearing process.

In its public notice inviting public comment on Unitel's application, the CRTC asked interested parties to indicate the advantages and disadvantages associated with Unitel's and BCRL's applications in terms of their impact on the following:

(1) the revenues of the respondent telephone companies;

(2) rates for interexchange services and the practice of route averaging;

(3) affordability and accessibility of local service;

(4) regional differences and different classes of subscribers, such as rural, urban, residence and business;

(5) telephone companies' obligation to serve;

(6) non-respondent telephone companies and their subscribers;

(7) the long-run costs of supplying telecommunications services;

(8) the efficiency of telecommunications network planning and design;

(9) service quality and choice, supplier responsiveness, innovation, research and development, and supplier efficiency;

(10) international competitiveness of Canadian business; and

(11) bypass of Canadian network facilities.

(CRTC Telecom Public Notice 1990-73, p. 10)

A central issue raised by Unitel's application was the impact of long distance competition on local telephone rates. Historically, local rates have been set at a relatively low level to encourage subscription to the telephone system and extend the universality of telephone service in Canada. In order to accomplish this goal, public long distance services have been priced well above cost and have made a greater "contribution" to the cost of local loop plant, than has local service. Route averaged pricing has also assured the availability of affordable long distance services in more remote areas of Canada where the cost of providing telephone service is greater. Again, value of service pricing principles have led to a situation in which rural telephone service is considerably less expensive than urban service, despite relatively higher costs.

This system of price regulation has resulted in very high telephone penetration in Canada, approaching 98% - a remarkable achievement considering the geographically dispersed population and the vast rural and remote regions of the country.

Many of those who opposed competition in the long distance market in Canada feared that it would upset this rate structure and threaten the universal availability of telephone service at affordable rates.

On the other hand, pressure had been mounting from business groups in Canada for more competition in the long distance market and lower long distance prices. Deregulation of the long distance market in the United States had brought a lot of pressure to bear on the relatively high cost of long distance services in Canada. As telecommunications expenditures grew to become a more important element in the total budget of businesses, this price imbalance led some businesses to claim that they were at a competitive disadvantage in comparison with their American rivals in the North American market. The lack of service competition has also led to claims that Canadian business is unable to fully respond to opportunities presented by the advent of the information age.

For their part, some of the telephone companies responded to Unitel's application with proposals for "rate rebalancing" rather than competition. These plans involved the lowering of long distance rates (principally for large volume business users) and the raising of local rates to bring them both more into line with their associated costs. The telephone companies argued that competition would result in network and system duplication that would be less efficient than a restructuring of monopoly rates. They also argued that competition in long distance services would lead to a reduction in contribution from long distance and an increase in local rates.

In order to respond to these types of concerns, Unitel's application proposed that Unitel pay the local telephone companies "contribution" payments towards the cost of access facilities (local loops) used to access its service. These payments would be in addition to any payments for facilities dedicated to Unitel's use and in addition to payments for switching and traffic aggregation functions performed by the telephone companies for Unitel.

It was Unitel's position that these "contribution" payments, coupled with market stimulation and productivity improvements that it said would result from competition in the market, would ensure that local telephone rates need not rise as a result of its entry into the long distance market.

It was Unitel's position that competition would result in customers being more efficiently served at a lower cost and that customers would benefit from more rapid introduction and diffusion of new technology and services. In its application, Unitel cited recent experience in the United States, United Kingdom and Japan in support of the proposition that competition has resulted in lower prices, greater innovation and more responsive service providers than existed under the former monopoly regimes.

The telephone companies countered this with evidence that their productivity, service and efficiency already exceeded that which existed under the former monopoly regimes in these other countries.

Unitel also raised the issue of Canada's competitiveness in the global economy. Unitel argued that in order to compete effectively, Canadian business must have the same freedom that businesses in these other highly developed economies enjoy to control their telecommunications costs and to take advantage of productivity-enhancing telecommunications services. As Canadian businesses become more efficient, consumers will benefit from lower prices for a wide range of goods and services, and Canada's competitive position internationally will be strengthened.

5. CRTC'S DECISION ON THE BENEFITS OF COMPETITION

In Decision 92-12, the CRTC has strongly endorsed a competitive industry structure in the Canadian long distance market and has expressly rejected a regulated duopoly structure.

> The Commission is in agreement with most parties that increased competition should not be based on a regulated duopoly market structure. In order to exploit fully the benefits of competition, the Commission considers that it would be in the public interest to provide a framework which would allow other applications for interconnection by facilities-based interexchange carriers (IXCs) that would be subject to federal regulation, if the shareholders of such applicants are prepared to assume the risks and obligations associated with the terms and conditions set out in this Decision. Accordingly, the Commission has indicated its willingness to order the BCRL respondents to interconnect with BCRL, if BCRL wishes to enter on terms and conditions comparable to those approved for Unitel (Decision 92-12, at pp. 13 - 14).

In reaching this conclusion, the CRTC made a number of key findings concerning the advantages of a competitive industry structure over the traditional monopoly structure.

<u>Long Run Costs</u>: The CRTC rejected arguments by the telephone companies that long run costs would be lower in a monopoly environment due to economies of scale and scope. It found that no convincing evidence had been presented that demonstrated the presence of such economies in the long distance business. The CRTC held that any inefficiencies that might arise in the initial stage of entry should be measured against longer run costs and the potential benefits of competition.

The Telephone Companies' Reference Plans: The respondent telephone companies had presented evidence of their plans to reduce long distance rates in an extended monopoly environment, if Unitel's and BCRL's applications were rejected. These "reference plans" were intended as a bench mark from which to gauge the applicants' case in favour of competition. The reference plans targeted rate reductions to larger businesses and were designed to move Canadian long distance rates closer to U.S. rates.

In assessing the reference plans, the CRTC found that the telcos had overestimated future productivity gains and underestimated future toll costs, as well as overestimating the rate of technological change. For these reasons, the CRTC found that the reference plans would not produce the level of toll rate reductions predicted, without an increase in local rate levels. It also found that the other members of Stentor would not be able to produce the same level of toll reductions as Bell Canada (approximately 40% by 2002).

Productivity: A lot of conflicting statistical and econometric evidence was filed by the parties respecting the impact of competition on telephone company productivity. While the CRTC had difficulty in isolating the impact of competition on productivity, it did conclude that competition would lead the respondent telcos to increase their efforts to minimize costs and improve productivity. The CRTC has assumed that competition will result in increases in telco productivity of approximately 1.0% over the period 1995 to 1998. While this is only half the 2.0% gain projected by Unitel, the telcos had argued that their productivity would decrease in a competitive environment due to such factors as network changes, increased administration and lost economies of scale occasioned by the advent of competition.

The CRTC's finding of a 1% productivity increase was, however, very significant because it helped to offset any negative impact on local rates brought about by Unitel paying a lower rate of contribution than the telephone companies (as discussed further below).

Non-Price Market Stimulation: The CRTC accepted Unitel's arguments that non-price factors such as increased marketing efforts, increased customer awareness, more service options and increased supplier responsiveness, would lead to stimulation of the overall telecommunications market. The CRTC has assumed that market growth caused by non-price factors would increase by 0.5% each year from 1995 to 1998 as a result of competition.

Again, this finding had a dramatic impact on the CRTC's analysis of local rate impacts, since it helped to offset the effects of Unitel paying a lower level of contribution than the telephone companies.

Impact on Local Telephone Rates: One of the most important issues in this proceeding was the impact that long distance competition would have on local telephone rates. A great deal of evidence was presented by the telephone companies relating to U.S. experience, and the shift of local access costs onto local telephone subscribers through the subscriber line charge mechanism.

The CRTC specifically rejected the American model for imposing subscriber-line charges on local telephone subscribers.

The CRTC concluded that the level of contribution payments prescribed for competing carriers, coupled with the other charges prescribed for the recovery of start-up costs and transport costs, will result in a minimal impact on local telephone rates. The CRTC was also of the view that any shortfall of contribution to local access costs would be more than offset by increased productivity and increases in the overall size of the long distance market due to increased competitive marketing efforts and the introduction of new services.

Impact on Independent Telcos: In light of the fact that Unitel has undertaken to negotiate interconnection arrangements with the independents on terms that are similar to their existing settlement arrangements with the members of Stentor, the CRTC did not foresee any significant economic impact on independents.

International Competitiveness, Rates, Choice, Supplier Responsiveness: The CRTC accepted the evidence of an unprecedented number of business users who appeared at its regional hearings. These business users had stressed that competition was required to decrease telecom costs, increase service options, and improve service responsiveness. They argued that this in turn would increase the international competitiveness of Canadian business.

The CRTC accepted their evidence that competition will result in greater choice, supplier responsiveness and service diversity, particularly in the business sector and on high density routes, as a result of the repackaging and repricing of services in order to meet the specific needs of a variety of users and user groups. The proliferation of innovative pricing and service packaging, regardless of whether accompanied by the development of new technologies, was considered important by business users appearing at the regional hearings (Decision 92-12, at pp. 59 - 60).

Facilities Bypass: The CRTC accepted evidence that bypass of Canadian telecom facilities via the U.S. was continuing, despite its efforts to curb the problem. The CRTC has decided that competition would assist in lowering the current differential in Canadian and U.S. long distance rates, and thereby reduce the economic incentives for bypass.

Route Averaging: The CRTC has maintained an obligation on facilities-based carriers (not resellers) to maintain route averaged prices for basic MTS and volume discount services. This will help ensure equitable treatment of subscribers in rural and remote regions. At the same time, the CRTC has acknowledged that "targeted volume discounts" will be a feature of the new competitive environment and that the introduction of enhanced services may be limited to urban and high volume routes.

Quality of Service: The CRTC has discounted the evidence presented by the telephone companies relating the early U.S. experience with divestiture and the introduction of competition. Since divestiture and balloting are not part of the CRTC's regulatory scheme, and since the technical problems associated with equal access have already been resolved in the U.S., the CRTC does not foresee a negative impact on service quality. It has however expressed concerns relating to the provision of competitive operator services. In order to address these concerns, the CRTC does not intend to permit competitors to provide pay telephone services, or have access to billing and collection databases, until the CRTC has approved a detailed tariff that addresses its concerns.

6. INTERCONNECTION ARRANGEMENTS

In its application, Unitel indicated that trunk side interconnection with telephone company toll offices would be its primary method of access, and trunk side interconnection with select end-offices a secondary form.

The CRTC accepted both forms of access, and indicated in its order that Unitel may file a request for interconnection with each of the telephone companies at any time. In addition, the telephone companies are to provide line side access if requested. Interconnecting circuits are to be furnished at existing tariffed rates.

Signalling: Both applicants requested CCS-7-based interconnection, where available. Indicating that it views CCS-7 as the "new signalling standard," the CRTC supported the applicants' position. IXCs will be allowed to interconnect their STPs to those of the telephone companies via CCS-7 gateways. Where telephone company switches are not equipped with CCS-7 (eg. BC Tel GTD-5 switches), MF signalling is to be provided.

Equal Ease of Access

Both applicants requested "equal ease of access" enabling "1+" dialling with pre-subscription, and "10XXX" dialling for casual calling. The applicants suggested that a centralized database (SCP) approach, rather than the U.S. switch-based Feature Group D (FGD) approach, might be used to implement EEA. An interim dialling plan of "1+950-0XXX" access, based on FGB, was also proposed.

The CRTC supported the applicants' request for equal access, indicating that it expects all telephone companies to provide it in a timely fashion. The CRTC determined that FGD, augmented with CCS-7 where available, should be used initially for equal access, as it was not satisfied that cited benefits of the SCP approach could be achieved. FGB is to be used as an interim arrangement wherever FGD cannot be implemented by the time the applicants desire interconnection. DMS-10 and analogue switches will not need to be modified for FGD.

The telephone companies were directed to file proposed availability intervals by switch type for the implementation of "1+" and "1+950" access.

Operator Services: The CRTC approved Unitel's proposal to offer operator services to subscribers in accordance with the pre-subscribed carrier of the originating line. Unitel or other IXC operator service tariffs will require approval to ensure adequate consumer protection in respect of rates, access and confidentiality of consumer information. Telephone company proposals for "Billed Party Preference" (BPP), wherein the operator is determined by the billed party rather than the calling party, where rejected by the CRTC due to the magnitude of projected costs and uncertain availability.

Pay Telephones: The CRTC approved Unitel's proposal to connect long distance pay telephones via DALs to its network. The networks of all IXC's and telephone companies are to be accessible from any party's pay telephone.

Access to Databases: The CRTC denied Unitel's request to access telephone company calling card databases in order to honour non-Unitel calling cards. The CRTC agreed with the telephone companies that calling cards can be characterized as a competitive long distance tool, and accordingly did not agree that denial of access would be unduly discriminatory.

The CRTC approved Unitel's request for access to telephone company line information databases (LIDBs) for verification of location and credit status of casual callers.

Billing and Collection Services: Unitel requested that the telephone companies provide billing and collection for casual callers and calls charged to a line not pre-subscribed to Unitel. Notwithstanding telephone company opposition, the CRTC approved Unitel's request, noting that it would exercise sufficient control over IXC rates to ensure unreasonable charges do not arise. The CRTC agreed with Unitel that refusal to provide access to billing and collection services that the telephone companies make available to themselves by virtue of their local monopoly position would constitute an undue preference contrary to section 340 of the Railway Act.

6.1 RECOVERY OF START-UP COSTS

Start-up costs reflect the switch modification and other initial costs that will be incurred by the telephone companies to provide interconnection (both "1+" and "1+950") to IXCs.

In the proceeding, Unitel had argued that start-up costs should be borne by the general body of subscribers. The telephone companies argued that since start-up costs are causal to entry, they should be borne by the IXCs.

The CRTC determined that start-up costs should be allocated among IXCs and telephone companies based on the CRTC's projection of their respective long-term market share. Accordingly, 30 percent of start-up costs will be recovered from IXCs over a ten-year amortization period. The following per minute charges will apply to all trunk side access minutes that originate or terminate on the telephone companies' networks:

Figure 1

Bell	$0.0011
B.C. Tel	$0.0017
Island Tel	$0.0010
MT&T	$0.0020
NB Tel	$0.0020
Newfoundland Tel	$0.0013

6.2 RECOVERY OF ONGOING COSTS

Ongoing costs include switching and traffic aggregation costs, customer and operator services and carrier billing functions.

While accepting that switching and aggregation costs are distance-sensitive, the CRTC has adopted a single rate for access and egress to the telephone companies' networks since a single rate is less complex to administer and will further promote the roll-out of competitive services to rural and remote areas. The initial rate set by the CRTC is $0.011 per minute for trunk side access. Initially, this charge includes all associated switching, transport and signalling functions performed by a telephone company at the originating or terminating end of a call, including:

(a) hardware answer supervision;
(b) delivery of calling line identification;
(c) casual calling;
(d) pay telephone access;
(e) busy line verification;
(f) barge-in services;
(g) directory assistance;
(h) billing and collection services; and
(i) database queries/access.

The CRTC indicated that it expects the telephone companies to develop unbundled rates for each of these services over time.

6.3 CONTRIBUTION PAYMENTS

Contribution payments refer to payments made by competing service providers to help off-set the cost of non-traffic sensitive access costs (primarily related to local loops). These access costs differ for each telephone company and are calculated using the CRTC's Phase III costing methodology.

A lot of time in this proceeding was devoted to the issue of whether new entrants should pay the same level of contribution as the incumbent telephone companies, or some lesser amount.

In its decision, the CRTC has opted for Unitel's proposal to pay contribution based on the amount of foregone contribution that arises as a result of its entry. Under this approach, Unitel will pay a sufficient amount to maintain local rate levels - rather than paying the same rate per minute as is imputed to the telephone companies.

<u>Contribution Level</u>: Using these principles, and its estimate of market size and relative market shares, the CRTC has derived a per minute contribution charge for each of the respondent telephone companies. This varies from $0.05446 per minute for Bell Canada, to $0.08163 for MT&T.

These rates are then translated into a monthly per access trunk calculation, based on 7000 minutes per month per trunk. The CRTC has then established different rates depending on the size and efficiency of various access trunk groups.

The initial monthly contribution charges for trunk-side connections to each of the six respondent telephone companies are set forth in Figure 2.

Figure 2

Per Circuit Contribution Charge						
No. of Circuits	Bell	BC Tel	Island Tel	MT&T	NB Tel	Nfld Tel
1 - 3	$ 35	$ 40	$ 35	$ 55	$ 45	$ .0
4 - 6	115	125	115	180	150	130
7 - 9	165	185	165	260	215	190
10 - 14	205	230	205	325	270	235
15 - 19	240	270	240	375	315	275
20 - 29	270	300	270	425	355	310
30 - 39	300	330	295	465	390	340
40 - 49	315	350	310	495	410	360
50 - 74	335	370	330	520	435	380
75 - 99	350	390	345	550	460	400
100 plus	370	415	365	580	485	425

These charges are payable on all "interconnecting circuits", which generally refer to the trunks that connect the IXC's network to the telephone companies' class 4 or 5 switches.

The CRTC's rationale for expressing contribution in terms of monthly trunk charges was to achieve administrative efficiency and to encourage carriers to provide residential services in off-peak hours.

<u>Contribution Discount</u>: The contribution rates set forth above embody a discount of 25% off the rate that an IXC would otherwise have to pay.

This discount is intended to offset the advantages that the incumbent telephone companies will have over new entrants including 1+ dialling, market coverage and control of the local network. This discount will be eliminated over a six year period based on the following schedule:

1993 - 25%	1996 - 25%
1994 - 25%	1997 - 10%
1995 - 25%	1998 - 0%

Feature Group A: The contribution rates specified above apply for 1+950-XXXX access and equal access, which will not be available immediately. In the meantime, Unitel may also avail itself of FGA (line-side) access at a 15% discount off the contribution rates cited above.

7. BCRL AND OTHER NEW ENTRANTS

BCRL had applied to the CRTC to provide a competing long distance service in British Columbia, Quebec and Ontario. It had proposed to use a combination of its own facilities and other carriers' facilities in its network. BCRL proposed to pay contribution of $200 per IX circuit - the same level as was payable by resellers at the time that BCRL filed its application.

While the CRTC rejected BCRL's proposal to pay this lower level of contribution, it did not reject market entry by BCRL. Instead, the CRTC has indicated that BCRL may enter the facilities market if it is prepared to pay the same level of contribution, abide by the same terms and assume the economic risks of entry.

At the same time, the CRTC has indicated that other companies may apply to enter the market on the same terms. The CRTC appears willing to allow entry on a hybrid (facilities/resale) basis and on a limited geographic basis as well as on a full service national basis. The CRTC clearly envisages a competitive market with a variety of carriers serving a variety of market segments or regions.

8. RESALE AND SHARING

As mentioned above, the CRTC has also totally overhauled its resale and sharing regime in Decision 92-12.

The CRTC has removed its previous restrictions on the resale of WATS and other discount long distance services offered by the telephone companies. This means that, as a general rule, all telecommunications services or facilities may be resold as part of a reseller's network. The only restrictions that remain relate to the provision of local pay telephone services and the use of 800 service to originate MTS/WATS traffic in areas outside the CRTC's jurisdiction.

Resellers are now also permitted to build their own transmission facilities to augment their resale network so the new regime provides resellers with more flexibility to configure their networks in a cost effective manner.

The CRTC has also altered the obligation of resellers to pay contribution for access and egress to local exchange networks. The new contribution regime for resellers is very similar to the regime for facilities-based carriers described above. Contribution is levied on "interconnecting circuits" that connect a resellers' switch or facilities to a telephone company's central office or centrex switch. The main difference is that resellers will enjoy a discount off the contribution rate payable by facilities-based carriers. Resellers' contribution payments will start out at 65% of the rate set for facilities-based carriers, rising by 5% a year to 85% in 1997. This discount is in addition to the discount enjoyed by facilities-based carriers in the first five years of operation and is intended both to cushion the impact of imposing higher levels of contribution on resellers and offset the effects of an inferior form of network access. Notwithstanding these discounts, resellers now find themselves paying significantly more contribution now than they did under the old resale regime.

As in the case of facilities-based carriers, no contribution will be payable when direct access lines are used for interconnection.

Although the CRTC's decision assumes that hybrid carriers might want to obtain trunk-side access and avail themselves of an equal access regime, the decision is silent as to whether resellers can avail themselves of the same opportunities. The CRTC has recently convened a public proceeding to consider this issue. It appears likely however that resellers will be given this opportunity since most of the other distinctions between resellers and facilities-based carriers have been removed. This would be consistent with the CRTC's desire to allow all carriers to configure their networks in the most cost-effective manner possible and to compete for the same customer base.

Resellers have also made progress in other recent proceedings before the CRTC in obtaining Answer Supervision and ANI.

All of these changes have forced resellers to reconfigure their networks in the past few months to take advantage of the new opportunities available and to accommodate the higher contribution payments on "interconnecting circuits."

9. CONCLUSION

Decision 92-12 represents a dramatic departure from prior CRTC policy. The CRTC has embraced competition in the long distance market and clearly envisages a competitive market consisting of carriers, resellers and hybrids making the best use of all network technologies and services available. New facilities-based carriers will be permitted to enter the market on the terms established for Unitel.

NETWORK INTERCONNECT IN NEW ZEALAND

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1. Abstract

This paper overviews the technical aspects of interconnect with the two current telecommunications operators in New Zealand: Telecom Corporation of New Zealand and CLEAR Communications Limited. The telecommunications environment in New Zealand is among the most deregulated in the world and this creates special challenges for prospective service providers. General conclusions regarding network interconnect are drawn as a result of CLEAR communications interconnect negotiations with Telecom.

2. Introduction

The Telecommunications industry in New Zealand is regulated only by the commerce act and the fair trading act. There is currently no independent regulatory authority to which potential service providers may apply for advice (or even a final decision) concerning aspects of interconnect.

Given such an open telecommunications market, how does a potential service provider get started?

The generic requirements for network setup by a prospective operator as a whole are developed, including major activities and consideration of their time sequence. These are presented by means of work breakdown structures and sub-tasks detailed below the main network design and operational tasks. Network design encompasses start-up activities such as site development, linking, transmission, switch selection, implementation management and growth strategies. Operational requirements, examples of which are personnel, operational philosophy and marketing strategies, are discussed. Comparisons are made between the interconnect requirements of the two current national network operators, Telecom Corporation of New Zealand and CLEAR Communications Limited. These include details of required responses to Telecom's Permit to Connect (PTC) documents , CLEAR Communications' requirements and network commissioning tasks (eg 'type' testing, interface testing).

General conclusions concerning time frames and sequence of events for prospective network operators are drawn. The paper concludes with a summary of the steps involved in negotiating and implementing technical and operational interconnect agreements in New Zealand.

3. Overview of Project

The major activities required to set up a network operator in New Zealand are given in figure 1.

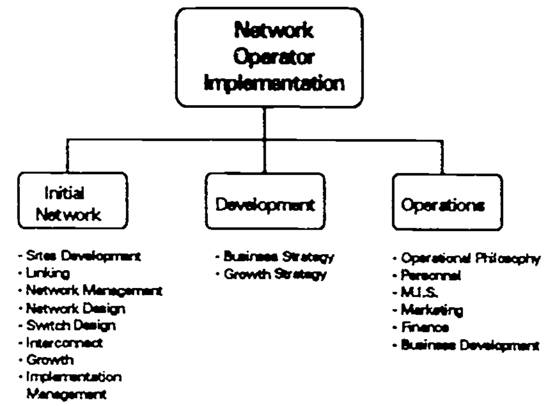

Figure 1: Overview of major activities to set up a network operator in New Zealand.

The initial network work package is concerned with implementation of a network that meets the objective of the initial business plan while building in the capability for network growth. It is concerned with development of the switch sites, switch selection, linking, network design, growth strategy compliance and initial interconnect.

Similarly the operations package is concerned with providing the administrative and operational systems to ensure smooth start-up and operation of the network. Important factors are the operational philosophy, M.I.S. and billing systems, marketing, finance etc.

There is considerable interdependence of these work packages. The initial business plan and growth strategy are clearly early elements required, but these are required to be considered in terms of the initial and subsequent network design criteria, not the least of which is the local interconnect constraints.

While there are many diverse activities requiring detail for the project to be successful, the single element that

* Work towards the content of this paper was performed by Teleconsultants NZ Ltd

differentiates network operator start-up in New Zealand from anywhere else is interconnect. The technical aspects of interconnect are focussed on specifically in this paper.

4. Technical Requirements for Interconnect

Currently, network interconnect in New Zealand falls into two major categories: interconnect with the Telecom network and interconnect with the CLEAR network. These are examined separately below, with later consideration of the prospective network operator's internal communications an.. typical response format.

4.1. Telecom Interconnect

Negotiating the technical aspects of interconnect with Telecom requires complete responses to a selected set of Telecom's PTC documents (see figure 2). The process is as follows:

- Determine the PTC documents that require response.
- Develop responses (including detailed transmission level plans).
- Submit responses to Telecom's Access Standards Division (TAS).
- Negotiate to reach agreement on any outstanding issues.
- Sign off agreement with TAS.

There are in excess of 20 inter-related PTC documents, only a few of which are shown in figure 2. For convenience, electrical safety interconnect requirements (Telarc approval) have been differentiated from transmission and signalling requirements. The responses to the PTCs must comprise a statement of compliance to the individual clauses, and in the event of non-compliance, an alternative response for negotiation with TAS.

Depending on the extent of non-compliances, modifications may be required to the prospective operator's equipment. In that event, 'type' testing of modified equipment according to an agreed schedule is required. This is shown under the commissioning heading in figure 2.

4.2. CLEAR Interconnect

This necessitates complete signalling and transmission plans, satisfactory completion of which will result in sign off by CLEAR. The extent of the plans will depend on the type of interconnect sought.

As with Telecom, modifications will require 'type' and interface commissioning testing as shown in figure 2.

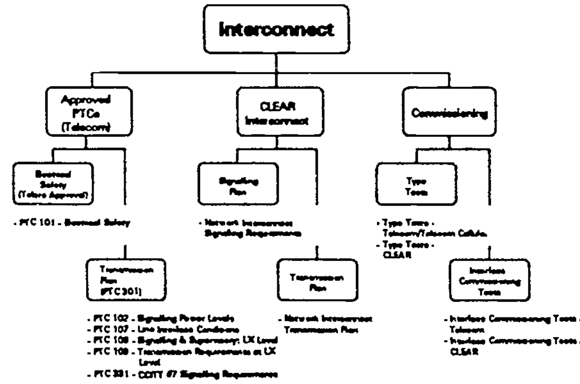

Figure 2: Work breakdown structure for Telecom and CLEAR interconnect.

4.3. Network Operator Internal Communications

In addition to interconnection with the existing communications networks, the new service provider will need to provide its own internal communications. The carrier will find it advantageous to interconnect to the Telecom network for this purpose. In addition to the PTC documents shown in figure 2, a response to PTC 207 (General Requirements for PABX Equipment) is required.

Satisfactory response to PTC 207 will allow the operator to use its exchanges as PABXs connected to Telecom at the local exchange (LX) level.

4.4. Typical Response Format

The format of the Telecom responses to the PTC documents could then be as follows:

- PTC approval for connection of the exchange equipment to Telecom's as a PABX
  Statements of Compliance to PTC 207 (note that PTC 207 refers to PTCs 107,108 and 109 listed in figure 2).

- Responses to PTCs as shown in figure 2 (including a detailed transmission plan)
  This is covered by a Statement of Compliance to PTC 301, which also refers to sections of PTC 107,108 and 109. A typical detailed response format could be:

  Interface Description: A description of all terminal and trunk interfaces including the limits as a function of loop length of send level ratings (SLRs), receive level ratings (RLRs) and sidetone masking ratios (STMRs), together with required balance impedances.

  Network Topology: A generic description of the network topology emphasising the interfaces required.

Network Topology: A generic description of the network topology emphasising the interfaces required.

Transmission Diagrams and Matrices: Diagrams showing SLR's and RLR's (including limits for loop lengths) for every type of propose connection.

Echo Control: A description of echo control intentions for national and international circuits.

Quantization Distortion Unit (QDU) Assignment Plan: Diagrams showing the worst case QDU assignment between the network operators. This is relevant to long-haul national, international and calls involving private PABX networks using low bit-rate signalling.

The process is complicated by service offerings such as Centrex. This service requires a variety handsets operating at widely varying distances from the exchanges and hence careful consideration of transmission level and loop length limits. For sign off in this case, Telecom requires complete loss-level matrices showing pad values and transmission levels with respect to the port test reference point (PTRP) not only for every combination of interface type, but also all loop limit extremes.

5. Conclusions

The deregulated Telecommunications industry in New Zealand necessitates significant up-front work on the part of prospective network operators requiring to interconnect with the Telecom network. General Conclusions are as follows:

-The generic sequence of events for network operators contemplating start-up in New Zealand is:

- initial business plan and growth strategy
- initial network design
- initial operations plan

A fundamental part of the network design is the interconnect negotiations with existing operators. An elapsed time of 6 months to 1 year from initial concept to finally certifying equipment for interconnect is not unrealistic. The overall plan is best arranged to start interconnect negotiations early to avoid their being on the critical project path. Interconnect may have significant cash flow implications if it is in the critical path.

-Specific requirements to be met for the existing network operators in New Zealand are:

Telecom: Formulate statements of compliances to selected PTC documents. This may require re configuration or even modification of the prospective operators switches or equipment for sign off by both parties.

CLEAR: Provide satisfactory transmission and signalling plans for sign off.

-Resolution of disputes concerning technical issues is left to the prospective operator themselves and may be done either by negotiation leading to sign off or by legal recourse against the Commerce or Fair Trading acts, the latter being time consuming and expensive.

-The effectiveness of early negotiation may be enhanced by the use of independent, unbiased parties familiar with interconnect requirements in New Zealand, thus minimizing recourse to the law.

Determining Optimal Supply Level of Switching Systems and Local Cables : An Inventory Model

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1. Abstract

The purpose of this study is to find out theoretically the optimal supply interval and the optimal supply quantity of a switching systems and local cables for each end office. The methodological tools applied are the inventory models such as Economic Order Quantity(EOQ) and Dynamic Lot Size(DLS) and the simulation. Simulation is used in two directions. One is to calculate supply interval with minimum cost by each end office(SIMULATION I), the other is to find out a fixed supply interval with minimum cost applying to all the end offices(SIMULATION II).

2. Introduction

To solve the chronic backlog of telephone shortage in Korea, Korea Telecom had started its massive supply of telephone lines and switching system from the early 1980s under the so-called 'the more, the better' policy. Thanks to its dedicated efforts over years, the Korean telephone sector has witnessed a leap-frog development, resulting in a complete elimination of the backlog by the end of 1980s. However as such supply-driven investment policy used to bring, the over investment in plant has come up as a new problem in the early 1990s. Under these circumstances, Korea Telecom felt a strong need to improve its current investment policy, especially starting from the inefficient supply of switching systems and local cables for its more than 230 end offices. The purpose of this study is to find out theoretically the optimal supply interval and the optimal supply quantity of a switching systems and local cables for each end office.

3. KT's Facility Supply Planning

3.1 Switching System

When existing switching system lines of an end-office evaluated as of (Y-1) year end are not expected to meet the quantity demanded until March of (Y+1) year, it will be selected as one of those end-offices to which facilities will be supplied. Here, Y represents the year in which lacking end-offices are planned to be supplied with facilities. With the data of forecasted demand and existing switching system lines, the quantity and interval of supply to the lacking end-offices will be determined to the level sufficing demand up to 18 months after the completion of installment. Installation is completed two months before the estimated shortage time. The minimum supply unit is 100 lines.

3.2 Local Cable

As with the case of switching system, when feeder cables of an end-office evaluated as of (Y-1) year end cannot meet 1.43 times the expected demand of (Y) year end, it will be selected as one of these end-offices to which cables will be supplied. Supply interval of 5 years is applied if after being supplied for 15 years average annual increase rate of demand is less than 11%, and 3 years for more than 11%. According to the above rule the quantity being supplied will be 1.43 times more than the quantity demanded during the determined supply interval. The multiplier(1.43) is derived from the usage rate of feeders which is assumed to be 70% (1/0.7 = 1.43).

4. The Models

As the setup cost and the opportunity cost of the allowance facilities are in a trade-off relation, and since we assumed that the deterministic demand during the planning periods is known, the optimal ordering cycle and quantity are obtained by using deterministic inventory model with no shortages. In this study, Economic Ordering Quantity(EOQ) Model and Dynamic Lot Size(DLS) Model are discussed.

4.1 Economic Order Quantity(EOQ) Model

The basic concept of the EOQ model is the balancing of ordering cost and holding cost. According to the concept, we can find the ordering quantity and reordering point where the total cost of the above two is minimized. There are two approaches to the EOQ problem, one is a classical analysis and the other is the present value of discounted cost over an infinite period. In this study, the easier classical analysis is used, since the former is an approximate of the other mathematically.

Suppose that constant annual demand rate(d), ordering cost per cycle(k), unit variable cost(v) and unit holding cost per year(h) are given. If (q) is order quantity at a time and (d) is annual quantity demanded, then the order cycle is q/d, and the total cost per cycle is as follows.

$$k + vq + h(q/2)(q/d) \qquad \text{(1)}$$

Each term in the above expression relates to ordering cost, variable cost, and inventory holding cost, respectively. Therefore, if we divide the total cost in an order cycle by order length(q/d), then, the annual total cost can be obtained as follows;

$$CU(q) = [k + vq + hq^2/2d]/[q/d] = kd/q + vd + hq/2 \quad \text{.......... (2)}$$

The expression(2) is a convex function and CU(q) will be minimum where dCU(q)/dq equals zero. Let this point be q*, then

$$q^* = \sqrt{\frac{2kd}{h}} \qquad t^* = \frac{q^*}{d} = \sqrt{\frac{2k}{hd}} \quad \text{........ (3)}$$

If q* is substituted for q in (2), we get minimum annual total cost CU(q*). The usefulness of the FOQ model in the real world is doubtful because it is unrealistic to assume that demand rate(d) is constant and the cost parameters(k,h) are known. But over a considerable range, the total variable cost curve is fairly flat at the optimal point, and within a range of 0.4 to 2.5 times the parameter, the total variable cost changes by less than 11%. Though these parameters are difficult to measure exactly and errors occur, If and when measured the usefulness of EOQ model is not diluted if exact values of parameters are not available and since the objective function is insensitive to parameters. This is an advantageous property of applying EOQ model to the real world.

4.2 Dynamic Lot Size(DLS) model

In EOQ model, demand rate is assumed to be constant whereas in DLS model, every demand in planning period is deterministic and is allowed to vary from period to period. Let

n = planning period
I_i = inventory at the end of period i
d_i = demand during period i
X_i = ordering quantity in period i

be given, then we can formulate DLS model as follows;

$$\text{Min} \sum_{i=1}^{n} [\, k_i(X_i) + h_i(I_i)\,]$$

s.t.

$$I_{i-1} + X_i - I_i = d_i, \quad i = 1, 2, \cdots, n$$

$$X_i \geq 0, \quad I_i \geq 0$$

$$\text{here, } k_i(X_i) = k\delta(X_i) \quad \delta(X_i) = 1, X_i > 0$$

$$= 0, X_i = 0$$

The objective function is meant to minimize the ordering cost and holding cost, and the constraints indicate that the ordering quantity is balanced to equal inventory and demand. The formulation is solved to be transformed into Integer Programming(IP) problem by changing the ordering cost term

4.3 Simulation

In this study, simulation model is also used for the purposes of testing the fitness of the mathematical inventory model and examining the current supply method. Simulation model evaluates the output of the system with predetermined values of decision variables which minimize the objective function.

5. Cost Analysis

The critical parameters in EOQ, DLS and Simulation models are ordering cost, (k), and annual holding cost per unit, (h).

5.1 Cost Analysis of Switching System Construction

Most of the cost incurred in equipping switching systems is construction cost, material cost and planning cost. Construction cost is divided into fixed cost and variable cost by using simple linear regression. Material cost is included in variable cost. Actually, it is the value of total material cost divided by total lines supp[illegible] from '89 to '91. Planning cost is included in the fixed cost. All the fixed costs are ordering cost, while the variable costs are unit holding cost.

The ordering cost which is fixed construction cost plus average planning cost is 39,683 US dollars whereas unit variable cost which is unit variable construction cost plus unit the material cost is 210US dollars. Multiplying unit variable cost by cost of capital, 5.42%, leads to unit holding cost, 11.4US dollars.

5.2 Cost Analysis of Local Cable Construction

For local cables and conduits, ordering cost is obtained by summing up fixed construction cost, average planning cost and average compensation cost while unit variable construction cost and unit material cost make up unit variable cost. Therefore, unit annual holding cost is obtained by multiplying unit variable cost to the capital cost, 5.42%.

5.3 Cost of Capital

Cost of capital is the minimum required or expected rate of return which a capital supplier wants for the capital he invests. The cost of capital in this paper means weighted average cost of liabilities and equities.

5.3.1 Interest

Interest is defined as the average real interest after tax. In order to get the interest expense, nominal debt cost should be calculated. It is an average of each item comprising debts weighted by the ratio of each item to the total debts. The nominal interest on debts is obtained by deducting income tax rate considering tax credit by expense recognized from interest. The expected inflation rate is taken into account to get the real interest expense

Liabilities in this paper are overdraft, short-term debt, current portion of long-term debt, long-term debt in foreign currency, customer credit and corporate bonds, while nominal interest rates are interest & discount, and interest on corporate bonds. The customer credit account which is a debt involving no interest is a major factor to lowering the interest expenses since it accounts for most part of the liabilities. The real interest rate of KT estimated in this way is -6.5%.

5.3.2 Cost of Equity

Cost of equity is a rate of return required for capital equityholders' pay. As KT has not yet been privatized, the ratio of net income to capital is regarded as the cost of equity. Capitals include, paid-in capital, capital surplus, legal reserve, and beginning retained earning, whereas net income is the one before tax. The estimated cost of equity is 28.31%.

5.3.3 Weighted Average Cost of Capital

Cost of capital which is the weighted average of interest rate and cost of equity is 5.42%.

6. New Facilities Supply Planning

6.1 Various Alternatives

6.1.1 EOQ Model

According to the equation (3), the optimal supply interval, t*, can be computed. As the quantity demanded of each end-office is different, t* of each end-office is also different. However, the quantity supplied varies according to the quantity demanded during the calculated supply interval t* in order to prevent a backlog. Consequently, the supply interval of a certain end-office is fixed but the quantity supplied varies in accordance with the quantity demanded in each year.

6.1.2 Dynamic Lot Size Model

The supply interval and the quantity in DLS model are different by end-office and supply time. The demand data used in the DLS model are monthly under the assumption that demand rises at the same rate in each month. Therefore, annual holding cost is also converted into monthly data.

6.1.3 Simulation I - Simulation for Supply Interval by End-office

In applying EOQ model the quantity supplied is the amount corresponding to the quantity demanded (not fixed demand, d, but variable, di) for the optimal supply interval, t*, which means t* may not be the optimal supply interval representing the minimum cost. With the same cost function as the one in EOQ model, we get the optimal supply interval with the minimum cost changing supply interval by 1 month starting from 4 months to 96 months.

6.1.4 Simulation II - Simulation for a Fixed Supply Interval Applicable to All the End-offices

Simulation finds the fixed supply interval for all the end-offices with the minimum cost, changing the supply interval by 1 month starting from 6 months to 96 months by using the same cost function as EOQ model.

6.1.5 Current Planning Method

In order to compare with other alternatives, we computed the cost by applying the current supply interval, which is fixing 18 months for all the end-offices.

6.2 Results of Analysis

6.2.1 Switching System

<Table-1> shows the result of computation for each alternative.

<Table-1>AVERAGE ANNUAL COST FOR SWITCHING SYSTEM BY ALTERNATIVE

(unit : millon US dollar)

	EOQ	DLS	Simulation 1	Simulation 2	Current Method
Average Annual Cost	18.7	17.9	18.3	21.5	21.9

As shown in <Table-1>, the cost when using DLS, Simulation, EOQ model is much smaller than using the current one. In other words, using supply interval varying according to demand pattern of each end-office is more efficient than applying a fixed supply interval for all the end offices.

However, the difference of cost between the current one and other alternatives is not as much as we have expected. Simulation which applies the fixed supply interval of 1.33 year (about 16 months) is similar to the current cost. It is also noted that EOQ model is similar to Simulation cost.

6.2.2 Local Cable

Using the same method as switching system, average annual cost for local cable is shown by alternatives in <Table-2>.

<Table-2>AVERAGE ANNUAL COST FOR LOCAL CABLE BY ALTERNATIVE

(unit : millon US dollar)

	EOQ	DLS	Simulation 1	Simulation 2	Current Method
Average Annual Cost	177.4	168.4	169.6	200.8	219.6

Contrary to the switching system case, the first three methods for local cable result in cost reduction of about 30 to 40 billion won compared with the last two methods.

If there is any end-office which has difficulty in applying the supply interval recommended by EOQ, DLS or simulation, it is desirable to use the supply interval closest to the optimal, considering the situation of the end-office.

7. Conclusion

As shown in the results of the analysis, the smallest cost is incurred when using DLS model, while the largest cost is incurred from using Simulation or the current method for both switching system and local cable. This results from the fact that DLS model reflects different demand characteristics of each end-office as well as demand changes every year by each end-office.

Accordingly, it is advisable to use the floating supply interval which reflects different demand patterns of each end-office rather than applying the fixed supply interval uniformly to all the end-offices regardless of each end-office's demand characteristics. In the case of switching system, the total cost of other alternatives was similiar to that of the current supply scheduling. And the supply interval of other alternatives was also almost same as .the current one. For local cables, the total cost of other alternatives was smaller than that of the current one.

Estimates of the ordering cost and the cost of capital should be continuously tested and revised with more reliable data for exact comparison of the annual total cost among the alternatives. In this paper, supply interval of the intra-office trunk lines was not examined. Comprehensive analysis on all the network elements including trunk lines is a subject worthy of further pursuit.

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Network Management for Users in Japan

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1. Abstract

The objective of this paper is to examine the origins and the activities of the two independent established bodies in Japan, the Open Network Council and the Network Management Study Group, and to evaluate their influences on Japan's telecommunications policy. A few suggestions are made, including one that some interworking of the two bodies will be fruitful.

2. Introduction

For operating a private network, it is critical and strategic to choose suitable network elements such as circuits and computers. Network management is a necessary work for business firms not only to obtain information for constructing and improving their own networks but also to operate the networks efficiently.

For most companies, whose businesses are not directly based on telecommunications, getting cooperation from vendors and carriers is indispensable to do network management. However both of vendors and carriers have their own reasons for not being able to respond to the customer's request for the cooperation quickly.

Major reason on the vendor side seems to be the reality that the cost benefit would not be enough for vendors to develop an interoperable system. On the other hand, carriers feel difficulties in responding to a particular user within their limited resource, because their primary concern is a universal provision of services.

Moreover, a Japanese tradition tends to hamper a user to negotia e the cooperation with vendors and carriers. Japanese companies have been paying much respect for keeping long term, stable trade relations with their counterparts. In fear of breaking such a relation, few companies ask a required cooperation on a pure business basis, thus preventing a purely market-oriented relationship to develop between users and vendors and carriers. The above situation seems to be unfavorable for the future network development.

On these backgrounds it is noteworthy that two bodies in Japan related to network management started recently; one is the Open Network Council, the other is the Network Manage Management Study Group. The purposes of the bodies are not same, but common on the ground that they are aimed at meeting user needs. It is believed that the role of users in the activities of the bodies will be a test paper for the future telecommunications in Japan.

Examination of the origins and the activities of them and evaluation of their effects on Japan's telecommunications policy are discussed below.

3. Open Network Council

3.1 Origin

A brief history of the Japanese open network policy is shown in Table 1 .

Table 1. History of open network policy

Date	Outline
Apr. 1985	"Telecommunications Business Law" enforced
Mar. 1990	"Measures to be taken in accordance with article 2 of the supplementary provisions of the NTT Corporations Law" (The Japanese government adopted the measures to secure open networks)
Mar. 1991	"Mesures to ensure fair and effective competitive in the field of value-added services" (Special white paper based on mutual agreement between Japan and the USA)
Apr. 1991	Report of "Open Network Policy Study Group" (Proposal for a plan to secure fair and effective competition between NTT and TYPE II s)
Jul. 1991	"Open Network Council" established (Meeting between NTT and TYPE II s about the openness of NTT networks)
Mar. 1992	The first version of "NTT's plan of providing network capabilities, network information and other features for TYPE II s" (The discussions at the Council meeting in fiscal 1991 were taken into account)

The most influential event was the release of the special white paper from the Ministry of Posts and Telecommunications (MPT) on an open network policy in Japan. In this document MPT policy was fairly clearly expressed although some ambiguities remained. Apparently Japanese domestic activities toward open network promoted mainly with the issue of the document.

As of October 1990 a study group on open network was established by MPT. The study group mainly discussed the fair competition between NTT and TYPE II carriers (*) , because TYPE II s have to depend in most cases on NTT for access circuits from customers.

In April 1991, the study group recommended the three points; ① to have discussions periodically between NTT and TYPE II s, ② to clarify and release NTT's plan of providing network capabilities, network information and other features, and ③ to reflect requests from other telecommunications carriers in the

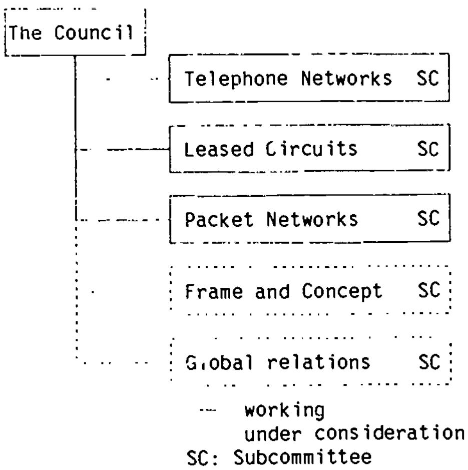

Fig. 1. Structure of Open Network Council

development of NTT networks.

Taking into account the first two recommendations, NTT and four TYPE II business industry groups (i.e. Special TYPE II Telecommunications Carriers Association, General TYPE II Telecommunications Carriers Council, Japan Audio VAN Association, and Japan Information and Communications Association) agreed to establish an industry liaison council called the Open Network Council.

3.2 Outline of Open Network Council

The mission of the Council is to facilitate the development of NTT networks that satisfy requests from TYPE II s and to provide effective network capabilities to TYPE II s.

The Council consists of ① the council and ② the subcommittees (see Figure 1). The council shall be responsible for providing a forum which will facilitate the information exchange, discussion and consensus resolution of members, ensuring the availability of appropriate subcommittees, and monitoring the work and the progress of the associated subcommittees that may include final review and approval of all subcommittees' output, recommendations and resolutions. The three subcommittee may clarify the details of requests for each service category and to develop the detailed specifications.

The Council is considering whether the two more subcommittees are necessary.

MPT representatives participate the Council, as well as its subcommittees as observer.

Because there are a large number of network capabilities, network information and other features, items to be discussed by each subcommittee are first restricted to those to be deployed quickly by NTT. Therefore those that might be found difficult to deploy during a series of discussions still remain as they are.

Table 2. Items that Special TYPE II s expected to discuss and their results in 1991

Item/Contents	Result
Route diversity; Designation of the route or multi-routing	○
Notification within 60 sec. of any interruption; Delivery to TYPE II s about the status of interruption every 60 seconds	○
Very high speed local leased circuits; Provision of 52Mbps or 156Mbps leased circuits	◎
Provision of circuit configuration data; Provision of routing information and line-loss data	○
Provision of circuit trouble records; Provision of an access service to trouble history data-base since the beginning of service	○
Prompt response to order circuits; Provision of an electric media to order circuits	○
Circuit reconfiguration; Provision of a capability to control to control reconfiguration directly by TYPE II	△
Dynamic changing of bandwidth; Provision of a capability to change bandwidth or circuit speed rectly by TYPE II	△
Traffic monitoring; Provision of a capability to monitor traffic of a circuit directly by TYPE II	×
Access to testing and/or analyzing systems; Provision of an access to testing and/or analyzing systems of NTT	×

◎ means NTT deploys it in fiscal 1992
○ means NTT deploys it in fiscal 1993~1994
△ means the study is continued
× means not discussed yet

conditions for deployment;
① MPT authorization
② Agreement on prices and other terms between NTT and TYPE II s

3.3 Contribution to Network Management

Of the three subcommittees, the leased circuits subcommittee discusses items related to network management for users.

Shown in Table 2 are the items related to network management that Special TYPE II Telecommunications Carriers Association expected to discuss and the current results. In fiscal 1991 the subcommittee chose 8 of the 10 items shown in Table 2. The remaining two items, monitoring traffic and access to testing and/or analyzing systems, were not discussed yet and would be considered again.

After holding 7 meetings in fiscal 1991, the subcommittee reached a consensus for 6 items. Taking into account discussions at the Council meetings, NTT developed its plan of providing network capabilities ar i etc. Items for further study, dynamic changing of bandwidth and circuit reconfiguration, would be continued to be studied, because they are remarkably demanded by TYPE II s.

3.4 Evaluation and Future Task

There have been two important results of the Council activities to date from the view point of network management. One is the NTT's deployment plan of 6 items, the other is to maintain periodical meetings between NTT and TYPE II for openness of NTT networks.

The 6 items are not enough but a valuable first step for improvement of network management. Periodical meetings have possibilities to be a mechanism for NTT to pick up user needs quickly.

For the future, some problems will have to be solved for expanding the Council activities.

First, the mission of the Council is currently restricted such that NTT and TYPE II s should discuss what is a fair competition before talking about the detailed services as they did. This is one of the reasons that the Council considers to set up frame and concept subcommittee (see Figure 1).

Second problem is the limited membership that the Council omits other TYPE I s, users categorized not in TYPE II, and independents. Therefore it is feard that NTT might lead discussions at the Council against TYPE II s, because NTT is huge in comparison with TYPE II s; for example NTT sold 5,746 billion yen in fiscal 1991, while all of 36 Special TYPE II companies totally sold 489 billion yen in the same year.

Third problem is how to tackle the global open network issue. Because open network is one of common issues all over the world, the Council will have to contact in some way with counterparts in other countries, especially USA and EC, in order to harmonize its movement. Particularly discussions about the OSS (Operational Support System), which plays a big role for network management, for ISDNs and INs are so critical that the Council may talk about more ways, terms and conditions of OSSs.

4. Network Management Study Group

4.1 Origin

From 1987 to 1991 the telecommunications bureau of MPT held meetings of a study group to discuss network management every year. These studies led Japan's network management but not always consistently. Because MPT were required to submit a report on each study, and only 10 or so companies joined a study due to terms and conditions of MPT. It could thus be said that the main purpose of the study was not in grasping user needs related to network management but in publicizing the activity of MPT.

To overcome the above mentioned shortcomings, the Foundation for Promotion of Telecommunications services (FPT) established the Network Management Study Group based to encourage the development of future networks that are as advanced as possible, consistent with ensuring network integrity and avoiding the imposition of uneconomic costs.

4.2 Outline of Network Management Study Group

The purposes of the Study Group are to contribute to build an integrated network management system under multivendor/multicarrier circumstances and to provide users with chances to talk with not only each other but also vendors and carriers.

The Study Group has a plan to make recommendations to TTC (Japanese Telecommunications Standard Body), MPT, vendors and carriers. Already the Study Group had a meeting with NMF (Network Management Forum) twice in two years, to exchange views of network management.

Table 3. Changing Difficulties in Network Management
(Awareness of the Members of the Study Group)

Difficulties felt in doing network management	Normarized Data	
	1990 FY	1991 FY
Insufficient human-power for operation	0.97	1.24
Inefficient operations to locate a trouble	1.50	1.00
Difficulty to follow the rapid expansion of network	-	0.86
Complexity in multivendor environment	0.87	0.55
Less-flexibility of network configuration	0 37	0.41
Improper organization structure	0.32	0.38
Increasing cost	0.26	0.38
Insufficient support from a vendor	0.18	0.24
Insufficient back-up system	0.53	0.17
Insufficient security system	0.13	0.17
Difficulties to build in accounting management		0.17
Lack of understanding by accounting people	0	0.17
Training end users	·	0.17
Inability to make full use of network management equipment		0.14
Others	0.11	0.14

means first appeared in 1991

The Study Group is open to any party with a direct and material interest in the Study Group processes and activities. At the moment the Study Group has the members of 48 companies, categorized roughly into the following 3 groups;

User	26	companies
Carrier	12	"
Vendor	10	"

Dr. Aida, the University of Tokyo, chairs the Study Group of which secretary work is done by FPT and IFTECH. The MPT supervises FPT, but does not join the Study Group.

All members join together 7 or 8 times in a year and discuss various matters.

4.3 Contribution to Network Management

The Study Group has officially proposed nothing yet, but several magazines have been taken the Group's activity by articles. It can be said that people are getting to recognize the Study Group as a useful forum for network users.

Table 3 shows the changes of difficulties in network management in the past two years according to a survey of awareness of members at the Study Group.

Some findings from the results are as followings:

- the most and rising serious factor was "insufficient human-power",
- "inefficient operations to locate a trouble" showed a considerable decrease, but stayed at the second worst,
- "insufficient back-up system" dropped sharply
- "Complexity in multivendor environment" showed a slight decrease,
- "difficulty to follow the rapid expansion of network" showed a sharp increase, and
- "increasing cost" showed a higher figure in 1991.

It was found that almost all companies faced troubles of their own systems, to begin with the top two items in Table 3, in particular.

The results, however, will be usefully used by a network manager for his or her company executives to understand that the problematic management of a network is rather a general case than their own one. This will make enough contributic for informing necessity of network management.

In addition, the Study Group pointed out the facts that an average company operated its information system under multivendor environment and received badly short network information of leased circuits, while hardly managing to operate systems for lack of human resources to cope with increasing complexity of network equipment.

These facts are hoped to be a kind of trigger for realizing a favorable network management system.

Other contribution is that the Study Group offers informal talking among users, vendors, and carriers with very suggestive information, because there are few such forums as this in Japan.

4.4 Evaluation and Future Task

It is believed that the most valuable job of the Study Group is to hold successive meetings with regard to network management, aiming at realization of a favorable network management system. In fact, the Study Group is receiving g good appreciation for the successive activities.

Based on the results in the past two years, the Study Group should pursue solutions to the issues discussed so as are to make their requirements clearer for a favorable system, to define a priority of the each issue for implementation, and to estimate the largeness of the market demand, which shall be essential for a purely marketoriented relationship between users, vendors, and carriers.

The Study Group has several objectives for improving its management. One is to build a standing mechanism to reflect their recommendations on the market or telecommunications policy.

The second objective is to broaden publicly the Study Group activities. In so doing the Study Group will get more support from industrial firms and organizations, which would give more incentive for the members to work for realizing better network management environment. As a concrete measure, the Study Group is going to publish a book by combining contents of the past annual reports published. Another measure is to build a more close relation with NMF.

The third objective is to make a transition from complaining body into body to be appreciated to give recommendations, maintaining advantages such as friendly and earnest talking among users, vendors, and carriers.

5. Summary

It is important for private network users to play a major role for realizing a favorable network management system. It can be said that since the introduction of competition in telecommunications in 1985, users in Japan have come to have to bring up the market, while getting expanded customer choices.

Both MPT and NTT should consider matters not only on the logic of providers but also on the logic of customers, to change their positions on Japan's telecommunications policy.

Regarding to this, the roles of the Council and the Study Group are very important, since the TYPE II carriers and network users are given through the Council and the Study Group, respectively a good chance to reflect their own voices on Japan's telecommunications policy. Moreover, the cooperation of the two bodies for network management will be fruitful on some of the issues pointed out in this paper.

In order to promote activities of the two bodies, it is highly desired that top ranked managers of user companies explicitly show its recognition and support for these activities. For the future, users will be required to have their own body independent from MPT and NTT, because both of the Council and the Study Group are currently supported by them in finance as well as in personnel.

Also each user need to build business relations with several vendors.

Through resolving these issues, users will likely to contribute to raising opportunities to enjoy the various advantages of advanced services related to network management and to vitalize the whole telecommunications market.

While the two bodies are at an early stage of development, both of them, born in the competitive environment, should be a test paper to estimate how much the Japanese competitive market would grow.

Footnote:

(a) The definition of TYPE I and TYPE II from the Telecommunications Business Law in Japan is the following;

Of the companies that are in the telecommunications business, those in possession of their own facilities are called TYPE I carriers. Those engaged in advanced services using facilities leased from TYPE I carriers are called TYPE II carriers. TYPE II carriers consist of Special TYPE II providing large scale/wide area services or international services, and General TYPE II furnishing services other than those of TYPE II.

As of November 1992, MPT had received the registrations of 37 companies as Special TYPE II and notifications of 1,064 companies as General TYPE II respectively.

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The Politics of Telecommunications Reform in Developing Countries

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ABSTRACT

This study examines in comparative perspective the politics of privatization and liberalization of the telecom sector in Asia (Malaysia and Thailand) and Latin America (Argentina and Mexico). The central aim of the study is to explore why do countries with similar socioeconomic profiles, trying to implement shared telecom reform goals under similar historical circumstances, achieved divergent outcomes in their restructuring efforts. Grounded in political-economy analysis this paper suggests an answer based on the openness of the political system of each country.

I.- Introduction*

Puzzling and counterintuitive economic reforms are quickly spreading throughout the Third World. Less developed countries (LDCs) are opening their economies to market forces at a striking pace, despite well grounded and convincing arguments that structural constraints in the international system shaped Third World preferences for protectionism and state intervention.(1) In the pursuit of liberalization, the transformation of the economic and political role of the state has become crucial. Reforms such as privatization of state-owned enterprises (SOEs), liberalization of the economy, and reduction of state regulation are at the center of this historical shift in the organization of developing societies.

Among the public services and state industries that are being restructured in most developing nations, one that has emerged as spearhead and showcase of a broader reform program is the telecommunications sector. This study explores the politics of privatization and liberalization of this dynamic and politically controversial sector of the economy.

Although state reform is viewed as an homogeneous trend throughout the Third World, a closer look at some of the countries in which reforms are most advanced reveals few commonalities. Regardless of their "common goals", countries have followed very different paths in their journeys to a free market economy. In the telecommunications sector, LDCs show today a range of policy models that cover a complex and diverse variety of combinations of ownership (public/private) and the degree of competition (closed/open markets).

In LDCs current telecom reforms have clear political underpinnings. A long tradition of state intervention and politicized markets assured a pervasive role for politics. This study hopes to unveil some of the political puzzles that underlie the various forms that telecom privatization and liberalization have adopted in LDCs. The question that drives the research is: *why do countries with shared telecom reform goals and similar patterns of development achieve such different outcomes?* As a part of the quest for a better understanding of regulatory reforms in the telecom sector of LDCs, this study outlines an argument supported by data and evidence drawn from recent transformations in four major countries of Asia and Latin America: Malaysia, Thailand, Mexico, and Argentina.

Efforts to explain policy formation and policy outcomes have concentrated on different factors, such as the role of ideas and ideology, the impact of domestic political coalitions or the institutional structure of the political system. After assessing the explanatory value of these approaches for the particular inquiry pursued in this work, I will concentrate in the relative autonomy of the state and the substantive distribution of power within the state apparatus as important dependent variables in the explanation of telecom policy reform in LDCs.

Based on the data collected from the Asian and Latin American cases, I will argue that two elements are crucial to an explanation of the viability of reform in the sector. The first is the relative autonomy of the state vis-a-vis political pressures, and the second, the degree of power concentration in the executive branch of the state. Specifically, evidence suggests that a low degree of state autonomy and power concentration within the state is strongly correlated with likelihood of failure in the reform of state monopoly. In other words, LDCs with highly controlled and vertically integrated political structures, such as Mexico and Malaysia, are more prone to achieve reform in their public sectors than are those countries with a highly volatile and profusely dispersed power structure, such as Argentina and Thailand. In this way, the study points to the ironic fact that state "dismantling and retreat" calls for the presence of a strong and autonomous state. Moreover, it reinforces an emerging trend of political studies that argue that, in LDCs, economic liberalization is synonymous with political restriction.(2)

The goal of the project is not to search for "universal principles", nor to understand a historical process in light of a neatly designed model, but -- as Skocpol puts it -- to look "for answers based on valid causal connections that... account in potentially generalizable terms for different outcomes across space and time in otherwise similar cases."(3) This study will rely heavily on the methodological tools offered by comparative historical analysis.(4)

The paper is divided in five sections. In the first I introduce the problem in the context of a broader political and economic transformation in LDCs. In the second, I present a general framework of the recent transformation in the telecom sector of LDCs. In the third, the main argument of this work, along with various theoretical approaches to policy making are discussed and assessed against the general patterns of the Asian and Latin American cases. In fourth section, Argentina, Thailand, Mexico, and Malaysia's political systems and its impact in telecom restructuring are explored in detail. The concluding section reviews and summarizes the argument in light of the specific cases.

II.- Recent Telecom Trends in LDCs

In the light of the increasing integration of the global economy (with a dominant component of information) and the simultaneous economic opening in many LDCs, telecommunications is now a fundamental prerequisite of any growth project. Mindful of the fundamental shift in the role of telecommunications, and pressed by economic, fiscal, managerial, and technological constraints, many LDCs are struggling to move telecoms from a second priority "public service," to a first priority "international trade tool." As Mexican President Carlos Salinas de Gortari has asserted: *"Telecommunications will become the cornerstone of the program to modernize Mexico's economy."*(5)

In the pursuit of this radical transformation, LDCs embarked on state reform programs. The four countries studied here initiated between 1987 and 1989 a wide state reform program that placed telecommunications as a crucial sector in reform process.(6) In the four countries the general guidelines for the restructuring of the telecommunications sector was to transfer the previously state-owned telecommunications company (SOTE) to private entrepreneurs, to liberalize market entry in most services, and to reduce or eliminate state regulations.(7) But telecom reforms are not the mechanical outcome of policy implementation. To the contrary, they are the product of complex and dynamic interactions among diverging and many times conflictive interests. Therefore, LDCs diverge sharply in the profile of their new systems.

The four countries examined here clearly portray the range in the degree of reforms achieved by nations that intended to privatize and liberalize their systems. As table #1 shows, the outcomes for the four cases diverged notably. Thailand represents the case with the least degree of privatization and a relative opening to competition of its telecom market. Argentina, on the other hand, privatized its national common carrier, Empresa Nacional de Telecomunicaciones (Entel), but failed to open the market to competition. Differing from the previous cases are Malaysia and Mexico. The Southeast Asian country has privatized part of the SOTE and considerably liberalized the sector. While Mexico shows the deepest reform among the four cases. It has completely privatized Teléfonos de México (Telmex) and extensively liberalized its telecom market.

Table #1: Degree of Privatization and Liberalization in Telecom Systems of Selected LDCs.

Degree of Competition	*Distribution of Ownership*			
	Government Entity	Public Corporation	Mixed Ownership	Private
CPE, dom. data Cellular				Argentina
Paging & 1				
VSAT & 2	Thailand			
Inter. data & 3				
VANS & 4				
Priv. lease lines & 5				
Inter. basic (potent.) & 6			Malaysia	
Overlay & 7				Mexico

Considering that these four countries initially shared similar reform goals, *how do we understand these and other important variations in policy outcomes?*

III.- Explaining Telecom Policy Reforms

Efforts to explain how and why policy changes are developed and implemented have generally stressed different levels of analysis: ideology and new ideas, electoral mechanisms, institutional structure of the political system, domestic coalitions.

Some policy-making theories have emphasized the role of the ideology in crafting new regulations. From this perspective policy options and outcomes are strongly shaped by the ideological framework of those political parties in power.(8) Suited to explain cases such as England under Thatcher or the U.S. under Reagan, the argument is weak to address cases such as Argentina, Mexico, and New Zealand, where reforms were carried forward by political parties with a long tradition of welfare and state-interventionist ideologies.

Others have stressed the role of ideas.(9) There is little doubt that revived and updated neoliberal ideas contributed to the agenda and the general policy framework under which telecom reforms were carried forward. But there is little evidence that neoliberal ideas affected differently the ways in which each country articulated its own reform. Further, the fact that all four countries shared similar conceptions of what should be reformed and how, indicates that, in these cases, new ideas are not the most appropriate dependent variable to explain variation in policy outcomes.

Electoral and representational mechanisms have been used as a tool to explain the existence of certain regulations in the telecom market. Roger Noll, for example, argues that narrow economic-interest coalitions--such as those pressing for the liberalization of the telecommunications market--are more likely to succeed in political systems with single-member districts elected by plurality vote and a fairly autonomous legislature than in countries with nationwide proportional representation. Legislators in the former case represent a specific constituency, and, therefore, specific interests (in this case telecom reform) are more likely to reach the legislative agenda than in cases of broad-based interest representation.

Generally the dominant authoritarian patterns of most LDCs governments weakens the explanatory power of electoral politics. As Haggard points out, even during democratic periods the relation between electoral politics and the policy process have been tenuous.(10) In Malaysia and Mexico the existence of a long-standing party in power, with a tight control of domestic politics, turns formal elections into a quasi-meaningless political exercise. In the cases of Argentina and Thailand the gap between electoral-campaign discourses and post-electoral government actions are so contradictory that the theoretical causal correlation established between modes of electoral systems and policy outcomes becomes unclear.

The institutional structure of the political system, i.e. parliamentary or presidentialist, also has been studied in relation to LDCs' policy reform programs.(11) Although the approach potentially contributes to the explanation of telecom policy reform in some LDCs, the cases studied here call into question the generalizability of this theoretical framework. Malaysia and Thailand, organized under a parliamentary system, have achieved quite divergent outcomes from their reform policies. Similarly, reform outcomes in Mexico and Argentina, that are organized under a presidentialist system, are widely different.

Finally, domestic coalitions have been considered by political scientists as a key element in the understanding of regulatory politics.(12) This approach has been traditionally applied to industrialized democracies where electoral and legislative coalitions are easily identifiable. In LDCs domestic political coalitions are difficult to identify. In those cases where political alliances are fairly stable, such as Malaysia and Mexico, the actions of the state are so pervasive that it overwhelms the bottom-up activity of social coalitions. This approach is weak in methodological terms since it is difficult to establish causal correlations between coalition preferences and policy outcomes.

The argument

Based on the above analysis, I suggest a conceptual framework based on the substantive distribution of political power in society. Two variables are crucial to understanding how certain features of a country's political system affect policy making and its outcomes: the relative strength and autonomy of the state vis-a-vis domestic and transnational interest group coalitions; and the degree of power concentration within the state apparatus; more precisely in the head of the executive branch (be it President or Prime Minister).

Taking as analitical categories the realtive autonomy of the state from societal demands and the ability of state elites to implement controversial political reforms,(13) it is possible to organize the system of Latin American and Asian countries into two major models of state/society relations. Indonesia, Chile, India, Malaysia, Mexico, for example, can be categorized as countries with a dominantly "state corporatist" political system,(14) while Argentina, Brazil, Thailand, Peru, Philippines, and Venezuela, can be considered countries where a "pluralist-participatory" political system dominates.(15)

State-corporatist countries generally portray a system of interest representation in which: "the constituent units are organized into a limited number of singular, compulsory, noncompetitive, hierarchically ordered, and functionally differentiated categories, recognized or licensed (if not created) by the state and granted a deliberate representational monopoly within their respective categories in exchange for observing certain controls on their selection of leaders and articulation of demands and supports."(16)

On the other hand, countries with pluralist-participatory political systems tend to "minimize participatory barriers and thereby encourage the participation of interest groups in the political process. Coalitions of interests can be assembled relatively free without requiring any formal recognition by the state or other regulatory authority. Moreover, there are typically numerous governmental or legislative channels through which coalitions can try to effect policy change."(17)

Among the cases under scrutiny, Malaysia and Mexico are typical of the state-corporatist political system, while, since the mid-1970s, Thailand and Argentina can be categorized as countries with an increasingly open, volatile, and pluralist political environment. The cohesiveness of the decision-making structure, the professionalization of the bureaucracy, and its degree of insulation from domestic and international pressures are factors that affect the bargaining power of state elites.(18)

In Mexico and Malaysia, the state bureaucracy is a tightly integrated group of politicians and technocrats drawn from groups long in power.(19) The most distinctive feature is that, in both countries, elites isolate themselves from societal demands and pressures while at the same time they legitimize this *modus operandi* by incorporating most social constituents through corporatist organizations.

In the cases of Argentina and Thailand, both countries have been traditionally characterized as turbulent political societies with a markedly stable "underground", or concealed power structure.(20) However, in the early and mid-1970s, both countries suffered structural economic and political transformations (see cases below) that led to the dismantling of traditional political arrangements and the widening of political participation. Since then, the "fluidity" and permanent "renovation" of political elites along with challenges from non-traditional power groups has created not only a non-cohesive decision-making structure, but an anarchic one, where interest groups build and dismantle coalitions in the struggle to gain power.(21)

The second variable crucial to understanding telecom policy reform is the concentration of power at state level. More specifically, the degree of power concentration in the head of the executive branch. Because privatization and liberalization of the telecom sector implies an important reduction of the bureaucracies' control over the economy, resistance within the state apparatus arises as an important political risk to the program's success. In most LDCs telecom restructuring is an initiative of the Executive branch, and hence encounters strong opposition from other sectors of the state apparatus. Examples from Argentina, Brazil, Thailand, Venezuela, etc., illustrate this. This scenario calls for a strong, centralizing force that would enable governing the transition amidst political resistances of various state sources. In most cases a unilateral, closed presidential initiative tends to fulfil that role. Opening the market calls for a closing of the polity.

In Mexico and Malaysia, strong power concentration in the executive branch has been a dominant feature of the political system. In Argentina and Thailand, the processes of political opening at the societal level have affected the patterns of power distribution in the state. In the last twenty years both countries have had a dispersed power structure at the state level. Weak presidents and prime ministers and relatively strong legislatures and popular movements have led to widespread conflicts among governing groups, which often results in a blocking of the policy process. In Argentina, nevertheless, these features were reversed during the current Menem administration. Most state reform was carried out through Presidential Decrees from the Executive branch, a process that excluded the standard mechanisms of checks and balances set by presidential systems. This unusual concentration of power in the president's hand undermined the input of other institutions such as ministeries, technical secretariats, Congress, and provincial or state governments.

If we apply these structural features of the political system to the particular historical transformation of the telecom sector in the four countries, the correlation between (a) state autonomy, (b) power concentration in the head of the executive, and (c) policy outcomes, is fairly clear in all the cases. Events show that, in the case of Thailand, the government decided to postpone indefinitely its early privatization plans due to domestic political opposition (mainly labor, the army, and political parties). In Argentina, the government was able to privatize only when oppositional coalitions where weakened and the President gained special legislative power to reform the sector. In Mexico and Malaysia, traditional state autonomy and strength of the head of the executive branch granted both governments the political muscle necessary to bend opposition from labor, domestic providers, certain political forces, and bureaucrats. In both cases, the state, in control of a vertically integrated and highly disciplined political machinery, was able to reach far into various social formations breaking alliances and disrupting the building of political opposition to telecom reform.

While useful in understanding patterns of reform (i.e, the "success" of Mexico and Malaysia in their reform programs and the relative "failure" of Argentina and Thailand), the central hypothesis of the work fails to explain why Thailand was able to liberalize in spite of failing its privatization attempt, and similarly, why Argentina failed to liberalize in a context of widespread privatization. I will argue that the performance of the domestic economy has, in these cases, overridden the impact of the domestic political system. A sky-rocketing economy in Thailand and a decadent one in Argentina have affected the reform process in very different ways. Further, privatization and liberalization are different processes. While the former implies the loss of proprietary control over the bulk of telecom traffic, the latter affects only the margins of telecom markets in LDCs.(22)

In fast growing economies such as Thailand, pressure is strong from the business community to gain access to new telecom services at cost-based prices. Pressure for the liberalization of the market is paired with the general inability of LDC state-owned telecom companies to provide those services as rapidly as demand requires. On the other hand, in most LDCs basic telecom services are still politically and economically the most valuable segment of the market. Therefore, mounting business pressures on one side and a lower economic and political stake of entrenched interest groups on the other, seems to offer a key to understand the government's "success" in liberalizing some services while failing to privatize the provision of basic services.

In the case of Argentina, economic factors inversely affected the privatization/liberalization process. On one side economic hardship, as it will be analyzed below, dismantled the opposition of labor, state officials, certain political groups, and local equipment providers. But, at the same time, the urgent need for foreign investment to jump-start a stagnant economy led the government to concede monopoly on most services on behalf of foreign capital participation. The strength and autonomy of the government vis-a-vis domestic constituents opened a political space for privatization, but simultaneously its dependency on private capital precluded the possibility of competition in the country's telecom sector.

Summarizing, the analysis of these various theoretical frameworks suggests, as a provisional hypothesis, that countries with higher degrees of power concentration in their political systems are better prepared to carry on controversial regulatory reforms in the public sector than are those with open and pluralist political systems.

IV.- Implementing Telecom Reforms

In the following paragraphs, a detailed analysis of the historical evolution of reform in each country and its relation with the structural and historical features of the political system will illustrate and bring evidence to support the theoretical claims of this study.

Argentina

Argentina has been submerged in political turmoil and chaos since the early 1930s. Cyclical military coups and democratic governments dominated the political scene until the early 1980s, when the most harsh and violent authoritarian government in the Argentine history stepped down from power. From the 1930s to 1989 the country has been headed by 25 different presidents, some of whom lasted only a few days or weeks in power. This shocking record of government instability is indicative of an extremely volatile political system.

Despite this fluid political system, scholars argue that, as in Thai politics, the ongoing political instability in Argentina was only a surface phenomenon that "concealed a quite stable power system, whose dynamics followed consistent patterns." After the mid-1970s a variety of changes in the Argentine political economy coupled with transformations in the global economy led to structural changes in the distribution of power. By the early 1980s the underground power structure's stability was seriously weakened. The political system progressively opened to the participation of a variety of new political forces and innovative realignment of old ones.

In the mid-1980s a the government attempted to carry on a deep transformation of the telecommunications sector. But, the Alfonsin administration was the first, after a long period of closeness and repression, to open the political sphere to the full participation of a plurality of interest groups. The consequence was that, as soon as the government officialized its state reform program, public opposition embodied in the Peronist Party, the unions, and parts of domestic industry arose in an articulated front, blocking further public-sector reforms. When the next President, the Peronist Carlos Menem, took power in July of 1989, Entel was still a government-owned company, holding the same organizational and regulatory status that it had in 1983.(23)

The lessons of the Alfonsin administration point to the fact that if the Menem government intended to succeed in its telecom privatization and liberalization project, it would have to block the participation of institutionalized opposition forces and implement quick reforms in the sector before resistance to the program could mount again. The profound effects of the harsh economic crisis of the 1980s gave a legitimacy to government shock policies, whose efficacy depends on the sudden modification of social expectations. Such modifications generally are attained via quick unilateral decisions and actions.

The unprecedented economic and fiscal crisis of the 1980s put a halt on the early emergence of strong and controversial social demands. Economic constraints discouraged political participation and led to a progressive demobilization of political forces. Economic hardship calls for a realignment of traditional political and economic arrangement making the system of political relations and compromises more fluid.(24) In this context the government gained relative autonomy, insulating the articulation and implementation of new economic and political programs.

Profiting from the weaknesses of the retreating Radical Party and the disorientation of his own party, Menem was able to pass two laws in Congress that are central to the reform process: the Economic Emergency Law and the Public Sector Reform Law. The latter, in particular, concentrated power in the Executive, leaving a strict control of the state reform in the hands of the President. In concrete terms, this meant that the privatization of Entel, and the broader reform of the sector, was carried forward almost completely through presidential decrees. The new legislation buffered the privatization process from the interference of Congress and its slippery politics.(25)

Menem blocked the potential influence of more traditional, welfare-state oriented sectors of his own party by creating a "protective belt" of neoliberal advisors, drawn mostly from the Unión de Centro Democrático (UCD is a party of free-market advocates) and from a few selected followers in his own party. The Radical Party, Menem's main institutional opposition besides the labor movement, found itself politically unable to raise resistance to the new programs, due to its failure in the last months of its ruling to govern the socio-economic crisis. Since the Radicals had been the original authors of state reform and privatization projects, their oppositional stance now garnered little support.

The labor movement in Argentina, one of the country's strongest political forces, entered the privatization period dismantled and weakened. The determination of Menem to break the opposition of this powerful political actor reached its zenith with the government's reaction to a national strike by Entel's union in August of 1990. When the telephone workers disconnected Argentina from the world, Menem responded by calling in the army to operate the system and by firing more than 400 workers. This was the labor movement's last meaningful resistance to the privatization of Entel.

Domestic and international capitalists have had a very unstable relation with governments in the country. In this case, as Menem was coming from the traditionally welfare oriented Peronist party, most entrepreneurs expected a conflictive relations with the new administration. However, Menem, dismantling all negative expectations dissolved resistance from the business community bringing key figures in the sector to top government positions. Finally, to erase any threat to the reversal of the project, the new administration introduced a variety of organizational reforms in the judiciary system, mainly in the Supreme Court.

Once the new Peronist President achieved a high degree of power concentration in the executive branch, he launched a state reform program with two main features. First, only a few government officials outside regular institutional mechanisms of a democratic system guided the process. Second, reform was carried out at a striking pace. On September 12, 1989, Menem signed the decree that began the privatization of Entel. The government asked for 60 percent of Entel's shares a maximum of US$214 million in cash, US$380 million in Argentine foreign debt payable over a three-year period, plus the maximum amount of debt papers that each consortium could offer, with a floor of US$3.5 billion.(26) Fourteen months later the state sold the company to two consortiums. STET/France Cable et Radio would take charge of the operations in north region and Telefónica de España would provide services to the south of the country. the STET consortium that owns Telco Norte, and Compañía de Inversiones en Telecomunicaciones (Cointel), which bought Telco Sur. Each consortium controls 60 percent of the new companies, called Telecom Argentina (north) and Telefónica de Argentina (south), while the remaining 40 percent was divided among Entel workers (10 percent) and the national and international stock markets (30 percent).(27) Although they operate separate monopolies in the north and south of Argentina, Telecom and Telefónica are partners in the provision of international services through Telcintar, and they also share the control of Startel, a recently created company that provides value-added telecom services.(28)

Although the company was rapidly privatized, there is a undeniable gap between the government's original goals and what was achieved a year later. In its initial decree the main target of telecom reform was to: "demonopolize and deregulate the telecommunications service to make it more efficient for the benefit of the users".(29) To achieve these objectives, the central administration aimed at a broad reform in the provision of telecommunications services restructuring the sector in the following ways: a) Entel would be divided in several regional operating companies; b) telecommunications services would be liberalized in such a way that basic international services would be open to competition from the very first moment along with a wide variety of value-added services; c) basic services would also be open to competition after the first five years;(30) and finally, d) to achieve a high degree of competitive environment, the state would step out of the sector and "deregulate" telecommunications activities in the country.

A key target of the reform project was breaking the Entel monopoly in several regions. However, throughout the bargaining process the government repeatedly modified Entel's proposed organization to fit the interests of foreign investors. Finally, the country was divided in two regions. Considering that in the pre-privatization period, Argentina's telecom services were controlled by a public/private duopoly (Entel and Compañía Argentina de Teléfonos), the new duopolic situation only changes owners.

The original project to liberalize the telecom market suffered a similar fate. The initial aim to open international basic services to competition disappeared in the early stages of the process. Long distance and international services were bundled with local basic services. The goal of liberalizing the provision of basic services within five years of privatization was further hindered when the period of protected monopoly was extended to ten years, with no clear legal commitment that it would open afterwards.

Finally, value-added services, that remained in the competitive side of the market until the early days of 1990, were also included in the monopoly package and the sprouts of any meaningful competition in the Argentine telecom market died. The only services left to market forces were the least profitable ones: cellular naval radio communication, national telex, and national data transmission.(31)

The story of the Argentine telecom liberalization suggests that the financially weak condition of the country's economy led the state to a "desperate" search for foreign investments. The country's dependency on foreign capital to revive its economy improved the bargaining position of foreign investors while undermining the preferences of state officials. This situation was reinforced by other international factors, such as widespread competition in the international privatization market. By restructuring the sector in general, along with the privatization of the national telephone company, the government bound the fate of most telecommunications services to the privatization bargain.

The unfolding of telecom reform politics in Argentina is an excellent testing ground for the hypotheses presented in this study. The Alfonsin government, which operated in a highly participatory and pluralist polity, failed to reform the sector due to pressures from various social coalitions. Menem, however, was able to insulate the state apparatus from societal pressures and strongly concentrate power in his own hands, and hence achieved the total privatization of Entel. The evolution of the Argentine reform also highlights the role of the domestic economy in the crafting of new regulations for the sector. While in Thailand the government opened the sector to competitive entry in response to pressures from an extremely active and powerful business community in a booming economy, in Argentina the government closed the sector recreating a private monopoly in order to comply with the interests of potential private investors much needed in a shrinking economy.

Thailand

Thailand, as well as Argentina, has witnessed a recurrent pattern of government instability and political disorder beginning in the early 1930s. Since then, seventeen military coups have overthrown and replaced nineteen prime ministers. During that period thirteen different constitutions guided the normative framework of Thai society

Despite this profile of political disorder and volatility, students of Thai politics argue that, what seemed from the outside to be a state of permanent political chaos, was nothing more than a non-conventional mechanism of political renovation.(32) However, since the early 1970s Thailand has shown major structural changes in its political system. Rapid economic growth over the last 30 years has brought about deep structural socio-economic transformations with a subsequent impact in Thai politics. The country has experienced an impressively high rate of real GDP growth for almost three decades, averaging 8 to 9 percent per annum during the 1960s and 1970s, with a record of 13.2 percent in 1988 and 12.0 percent in 1989. Massive migration from the countryside to urban centers (mainly Bangkok), higher levels of education and health, changes in occupational structure, a growing middle class driven by upward mobility expectations, and a higher penetration of foreign values and alternative modes of social organization have put the traditional political system under high pressure.(33)

Structural transformations in Thai society have dismantled the traditional features of a closed polity dominated by a small military and bureaucratic elite. In the context of rapid economic growth and spiraling social demands for public services, successive governments have worked to upgrade key services such as telecommunications. With only 25 telephone lines per 1,000 people, Thailand has one of the lowest telephones-to-population ratios in the region: approximately 1.8 sets per 100 people.(34)

Telecommunications in Thailand is mainly provided by two state-owned monopolies controled by the Ministry of Transport and Communication (MTC): the *Telephone Organization of Thailand* (TOT) and the *Communications Authority of Thailand* (CAT). TOT operates the domestic telephone network, leased circuits for point-to-point domestic communication, and certain long distance and international services to neighboring countries. CAT mainly provides international telecommunications and all non-voice domestic services. The regulation of TOT and CAT's operations, as well as the system as a whole, is managed by the Post and Telegraph Department (PTD), which assists the Ministry in the development of policies for the sector.

Bad planning, financial constraints, managerial and technological problems, lack of coordination between the two companies, and an average installation charges of approximately US$1,000 surprisingly have not slowed down the rapid growth of telecommunications services in the country. Since 1984, domestic telephone service has increased by an average of 26 percent a year, while the number of connected subscribers has risen by 18 percent. But, inspite of this impressive growth rate, by the end of 1990, the waiting list for subscriber lines climbed to 992,496. Customers wait from six month to ten years to get connected to the public network. International services suffers a similar situation. International calls increased by a rate of approximately 50 percent during the last years of the 1980s. Although both companies have launched new telecom services (such as cellular and data) neither CAT nor TOT have been able to keep pace with growing demand and diversification of services.(35)

Under great pressure from big and small consumers, and confronting serious infrastructural problems, the government of Prem Tinsulanonda launched in 1985 an early restructuring of the telecom sector. The project planned to split the country's post and telephone services, but it met the immediate opposition of telephone workers who struck. This was the first step in a long and uneasy attempt to reform and privatize the telecom system in Thailand.

In August of 1988, Chatichai Choonhavan took office and revived Prem's reform initiatives. By May of 1989 the Minister of Transport and Communications, Montri Pongpanich, was ready to propose a plan for the privatization of 49 percent of TOT's shares, among other SOEs. But, the Choonhavan administration launched the privatization project in a moment of increasing government weakness. Challenges from the powerful state unions, politicians, state officials, and militaries involved in various SOEs, put in doubt not only the viability of the project but the stability of the government itself.

At the legislative level, the government confronted a bicameral legislature in which many of the 357 members in the lower house and 268 members in the senate had vested interests in state-owned enterprises. Since the 1979 election, Parliament consisted of numerous political parties, none of which ever neared achievement of a parliamentary majority. The six-party coalition that lead the g vernment at that time not only faced opposition from other political forces, but it often encountered conflicts and serious disagreements within the coalition itself. The atomized and diverging interests of the legislature, and the fluctuating support of the parties within the governing coalition, left the government without the political leverage necessary to introduce amendments in the statutes of CAT and TOT.

A similar situation was visible at the level of state-enterprises managers. The inability of the government to impose its criteria upon telecom managers became evident in November of 1989, when TOT top managers, in a clear disobedience to orders from the Prime Minister, granted the installation of a digital transmission system to Toyo Menka Keisha of Japan. Despite this overt challenge to the power hierarchy, no disciplinary action was taken against those involved.

Perhaps the most important force in the government's retreat lay in the role of unions and the military. The former in an overt way, while the latter worked behind the scenes. Both efficiently pressured to dismantle the project to privatize SOEs. In terms of sheer numbers, the strong union role is puzzling. Only 5 percent of Thai workers are organized into unions. Moreover, the country's economy was booming during 1989 (12.0 percent of GDP growth). At least two factors explain some of the puzzle. First, Thailand's largest unionized sector are state employees with more than 260,000 workers. Second, state worker salaries and benefits are much better than that of their counterparts working in private companies.(36) Fear of losing their privileged position ran high and led to a huge mobilization against the government. Two massive strikes, one in July 1989 and the other in February 1990, led by one of the state unions and joined by workers of the other 63 SOEs, resulted in the government announcing the indefinite suspension of all privatization plans.

But the unions were not alone in their crusade against the government. Throughout the process, there is reason to believe, there was an invisible military hand inducing labor protest and rebellion. A group of powerful army officials, led by army commander Chaovalit, battled from behind the scenes to defeat the project. Several SOEs, and among them CAT and TOT, have army officials in their board of directors. As in many other LDCs, the army sees the privatization of telecom as a threat to national security.

On March 17, 1990, the retreating Prime Minister Choonhavan told a group of 13 political leaders, "I may be the last prime minister in the democratic system. I have less confidence than ever in democracy,... the privatization issue has weakened it and we [his party coalition] are now plagued with difficulties."(37) A year later, on February 23, 1991, the first successful military coup since 1977 overthrow Chatichai and his government.

Although recent Thai administrations have not been able to privatize the sector as they intended to do, they have nevertheless achieved some liberalization of the telecom market. Several services, including cellular telephony, paging, national data transmission, and VSAT/satellite are provided by TOT, CAT and private companies in a relatively competitive environment.

Cellular telephony is an example of economic boom overriding political struggle. Cellular services offered a quick way of upgrading the scarcity of telephones provided through the public network. Despite its high cost (approximately US$ 3,500 per unit), the service, originally provided by both CAT and TOT, quickly oversold and reached high levels of congestion. Breaking CAT and TOT monopoly over the service was not an easy task due to the political connections of the companies. The government, nevertheless, opened the market, granting licenses to companies like Ucom (a Thai Motorola subsidiary), whose subscribers' list reached 55,000 in the mid-1980s.

Paging services were initially operated by CAT in Bangkok and surrounding areas. However, it showed a growing inability to handle the surging demand for paging services. In 1987, the government granted a franchise to Pacific Telesis Thailand Ltd. (a subsidiary of Pacific Telesis International) to operate a second system. Since then, paging has been opened to competitive entry by third providers with a permission by the government.(38)

Similar situation is detected in data services where, under pressure of the Bangkok business community, the government granted licences for the provision of satellite-based domestic data services to two private companies: Compunet Corp. Ltd and Samart Communications. The former company has been operating since 1989, offering two data communication services: Datasat and Satlink. The latter enterprise mainly has targeted financial community, and it plans to offer three network configurations to its customers: Samartnet, Samartlink, and Samart Broadcast Service. Regarding satellite services, the government has recently granted a 30-year concession to Shinawatra, a Thai communication company, to operate two telecommunications satellites. The concession, which also grants Shinawatra a monopoly in the provision of satellite services for eight years, amounts to US$180 million. Its first satellite is scheduled to be launched in mid-1993.

In summary, the reform process in Thailand has shown that a low degree of state autonomy and a dispersed state power structure made it very difficult for the successive governments of Prem and Chaitchai to privatize TOT or CAT. The inability of the executive to pull together a large enough party coalition to introduce legislative reforms in the sector was a key element in the failure, coupled with the strong opposition of state officials, telephone workers, and certain sectors of the military it is not surprising that the privatization programs were canceled despite long term government commitment to its success.

However, the two governments had been able to progressively introduce minor reforms in the sector which allowed the liberalization of certain non-basic services, such as cellular telephony, paging, domestic data communication, and satellites. A close analysis of these openings suggest that pressure from powerful economic forces and the inability of TOT and CAT to serve these peripheral markets, led to an easing of political resistance to the dismantling of the state monopoly over these services.

Mexico

In formal institutional terms, Mexico can be clustered along with other modern Western democracies: a president, three independent powers (executive, legislative, judicial) with their respective checks and balances, and federalist structures with fairly autonomous local governments. In practice, however, Mexico is governed by an extremely centralized and powerful state, with tight political control over most of Mexican society.(39) The particular dynamics of the Mexican revolution during the 1910s and the constitution of 1917 set the basis for the emergence of an overwhelmingly powerful state, whose political strength and social control continues today. Since 1920, no opposition party has held power. And whenever the opposition posed a serious electoral threat, the government, supported by its powerful corporatist system, simply refused to recognize electoral defeat. Mexico's six decades of political stability and institutional continuity is in sharp contrast to Argentina and Thailand.

This clear pattern of governance indicates that policy making is a closed business in the presidential circle. Most public policies are initiated, elaborated, and implemented by high government officials with the full support of a professionalized bureaucratic elite. Little or no room exists for popular participation in the decision-making process. Social demands are channeled through a sophisticated architecture of interest representation. Interest groups, and even individual citizens, have only one mechanism to bring their demands to the higher levels of the state: through one of the political structures 'licensed' by the state to organize and represent that sector of society (peasants, urban unionized workers, businessmen, teachers, etc.).

In economic terms, Mexico, like some other LDCs, displayed an impressive growth in the post-World War II period. The economy grew at a rate of 6.6 percent from 1960 to 1976, and 8.4 percent from 1977 to 1981. Yet, in 1982 a sharp economic crisis ushered a period of stagnation and recession that lasted until the late 1980s. In its effort to overcome the crisis, the government implemented a profound restructuring of the economy based on three main transformations: state reform (mainly privatization of SOEs), opening of the economy (liberalization and trade reforms), and incentives for private sector growth (new, more lenient regulations for foreign and local investments). Telecommunications is a key element in Salinas' modernization strategy. Reflecting this new conception of development, Mexico embarked in 1989 on the sale of Teléfonos de México, S.A. (Telmex), the second largest company in the country and one of the 30 largest companies in the world.

During almost a hundred years, private entrepreneurs, under government surveillance, provided telephone services. Then, in 1972, Mexico nationalized the telephone company. Since then, and until its re-privatization in 1990, Telmex was an autonomous entity, at least on paper. In practice, the company was under strict government control. The Secretaria de Comunicaciones y Transportes (STC) owned 56 percent of Telmex's shares, held the presidency of the board of directors, established technical norms and standards, controlled procurement, controlled investments, regulated rates, and set general policies for the sector.

Despite several managerial, financial, and technical problems, Telmex grew rapidly during the 1970s. When the company was nationalized, in 1972, there were only one million telephone lines in Mexico, but by 1989 the country had five million lines and ten million telephones.(40) After the earthquake of 1985, the system was largely rebuilt replacing old manual switchboards and mechanized exchanges with electronic switchboards and digital exchanges. In 1986 Telmex began a long term plan for the installation of fiber optics in Mexico City. By 1990 the project was extended to other major metropolitan areas with plans for the installation of 13,500 km, long haul, fiber optic. The company had 49,206 employees. Telmex provided nine systems for public data communication. Besides telecommunications services the company slowly diversified its operation. By 1987 it had 24 subsidiaries that carried out business in areas as diverse as publishing, real state, radio telephony, satellites, and construction. During 1990 this conglomerate of companies had an income of over US$ 3.5 billion.

However, the provision of telecom services in Mexico suffered from a skewed regional development and from a sharp growth set back in the last decade. Fifty percent of all telephone lines, for example, are concentrated in the three largest metropolis, Mexico City, Guadalajara, and Monterrey. In 1990, more than 10,000 rural communities of over 500 inhabitants had no access to any telephone service, and, country-wide, the service reached only 18 percent of the households. During the 1980s, the financial crisis of the country affected the expansion of Telmex. The annual average growth rate of Telmex dropped from 14 to 6 percent throughout the mid-1980s. The quality of service diminished, the expansion of the networks and the diversification into new service faced a period of stagnation, and the complaints and pressures from business and consumers generally increased. And, simultaneously, the national treasury that have traditionally collected profits from Telmex and other SOEs for its redistribution, returned very little money to the telecom company to finance its operations and new investments in the sector.

On September 18, 1989, President Salinas de Gortari announced the privatization of Telmex. There was little opposition. The government had been very careful, during the previous years, to realign forces among different coalitions to dilute any meaningful resistance to a privatization program. The Mexican government faced a very different political environment from the one confronted the Argentine and Thai government.

Although the PRI had, a similar political doctrine to the Argentine Peronist party (i.e., popular base, nationalist orientation, welfare and interventionist state policies, regulated economy, etc.), there was a crucial difference between the two parties. The PRI is characterized by a long tradition of party discipline and clear hierarchical power relations. The Peronists, on the other hand, had been, for a long time, a loose conglomerate of groups with conflicting interests and ideologies reflecting the broader Argentine political scenario. While Menem struggled to keep his party under control, Salinas had the silent and disciplined support of his party constituents.

For example, Telmex managers and government officials in charge of the telecommunications sector are members of the party and loyal followers of the official line, as are most other bureaucrats. Although some voiced disagreement with the administration's policy, it would have meant professional suicide to oppose the program.

Second, opposition parties in Mexico, different from those in Argentina and Thailand, had been very weak for the past six decades. The 1988 election that brought Salinas to the presidency was the first time that the PRI saw its hegemony in serious jeopardy, but a year later, when Telmex was privatized, the political crisis was largely tamed. Opposition forces were again receding from the political scene.(41)

Finally, the labor movement has been one of the traditional constituents and main supporters of the PRI and its administrations. In the telecommunications sector, 41,521 of the almost 50,000 Telmex workers were unionized. In 1976 there was a profound realignment of political forces within the organization. A younger generation of labor leaders, headed by Francisco Hernández Juárez, took over the union's leadership. For the first two years the union was combative and struck several times against government policies. But, by the mid-1980s, government cooptation of the union's leadership induced factional struggles that weakened the union's bargaining strength. Slowly it was brought back to its traditional position within the PRI's structure.

Once the government constrained most opposition forces, the privatization of Telmex proceeded without major complications. The bidding process initially attracted 16 of the most qualified international telecommunications companies. On December 13, 1990, one month after the November 15 bidding deadline, Telmex was sold to a consortium comprising the financial Carso Group (Mexico), and two foreign common carriers, Southwestern Bell (U.S.), and France Cable et Radio (a subsidiary of France Telecom). The government sold privileged type "AA" shares that represented 20.4 percent of the company's capital, but were equal to 51 percent of the company's voting shares, to the consortium for US$1.76 billion.(42) Due to restrictions imposed by the Foreign Investment Law, Carso Group has the majority control of the company with 10.4 percent of the shares, while Southwestern Bell and France Cable et Radio own 5 percent each.(43) A second stage of the Telmex privatization was implemented in mid-June 1991. The government sold "L" type shares, representing 16.5 percent of the company in foreign stock markets, for US$ 2.27 billion.(44) Telephone workers and the new controlling consortium also purchased Telmex shares during this offering.(45)

The sector has also been deeply restructured and liberalized. Value-added services are open to competition. Telmex must comply with certain regulations to avoid unfair competition in the provision of services.(46) Data services are provided under market conditions by Telepac (a state-owned company), Telmex, and various private companies. Some of these companies are taking advantage of technological innovations and the acceptance by LDCs of the "nonresidence" principle to provide data services from abroad.(47) Such are the cases of Overseas Telecommunications, Inc. (OTI) and Houston International Teleport (HIT Stars), which compete with Mexico City's private companies to provide international high speed data services through the Morelos satellite systems.

The government also allows the overlay of private networks for the provision of point-to-point communication. Going even further in the liberalization of the Mexican telecom market, the Salinas administration now grants permission to private network owners to resell services to third parties.

Wireless communications are also liberalized and, considering the inadequacies of the public network for the telecom needs of a rapidly growing economy, the Mexican government expects a burst of new services provided by private operators.(48) However, SCT still controls the granting of licences for the operation of cellular, radiotelephone, and paging systems. The country is divided in nine regions for the provision of cellular telephony. Despite the requirement of a minimum of US$1.5 million of capital and proven technical expertise, SCT received 106 applications that fulfilled all the requirements.(49)

Along with cellular telephony, paging has been liberalized. Seventeen new radio licences for public service, including several with nationwide coverage in the 900 Mhz, are starting operations. Finally, radio telephone permits have been granted for services in central Mexico and other regions of the country.

Satellites is one of the few areas that the government has kept under state control. In 1982 the Mexican Constitution was modified to include in its Art. 28 the explicit statement that satellite communication was a strategic tool, and, therefore, under exclusive state control. The satellite system is operated by SCT and provides telecommunication and broadcasting services to all the country.(50) Services are provided through two domestic satellites (Morelos I and II), and the government is planning to add a third satellite by 1993, to provide services to all of Latin America. Despite constitutional restrictions the Salinas government has carried out regulatory reforms to allow the installment and operations of private satellite communication. In this way, Telmex, private telecom companies, and large users will be able to own and operate earth stations for data transmission, rural telephony, and other services.(51)

In sum, neither a long tradition of strong nationalism and revolutionary pride, nor socially entrenched welfare policies and state interventionism, were an impediment for the corporatist Mexican state to fully reverse its telecom strategies moving towards widespread liberalization and privatization. Resistance to this "revolutionary" shift has not been absent. Yet, despite a period of political weakness, the Salinas administration was able to recover traditional state autonomy and presidential powers to carry on with the controversial sale of Telmex and opening of the sector. Contrary to the cases of Argentina and Thailand, the Mexican government paced and shaped the reform to meet most of the governments initial goals. Insulated state officials, a disciplined bureaucracy with a strong executive, and a recovering economy gave the Mexican president most of the political tools that were absent in the two previous cases.

Malaysia

A former British colony, Malaya acquired its independence in 1957, and established the Federation of Malaysia in 1963.(52) Organized as a constitutional monarchy, the head of the state, Yang di Pertuan Agong (the King), is elected for a period of five years by the conference of state rulers, consisting of the nine ruling sultans of peninsular Malaysia. The country has been governed since its independence by a multiracial coalition known as Barisan Nasional.(53) The current head of the government Prime Minister Datuk Seri Dr. Mahathir Mohamad, who is the country's fourth Prime Minister since 1957. Mahathir Mohamad is, at the same time, head of Umno (United Malays National Organization), the Malay party that had headed the governing coalition since independence.(54) Politics in the country is organized very much along ethnic lines. Malaysia's population is constituted by 55 percent Malays and other indigenous population, 34 percent Chinese, and 11 percent Indians.(55) Ethnic conflicts have dominated the country since the British left the peninsula, and until today, race remains the single most important aspect of politics.(56)

Malaysia displays striking similarities with Mexico, and sharp differences with Thailand and Argentina, in regard to the substantive distribution of power and openness of the system. Malaysia is a constitutional monarchy with a parliamentary system, while Mexico holds a presidential system; but both countries share key political features. Both nations are internationally recognized, at least in formal terms, as democracies. Yet, each has had only one political group in power since the current political regime took power: Barisan Nasional in Malaysia and the PRI in Mexico. Both are organized in such a way that interest groups, which otherwise would probably enter in conflict, are integrated into a broad coalition under the patronage of the party in Mexico and of the electoral front in Malaysia.(57) In both cases the opposition is very weak; and, even though both governing groups faced a hegemonic decline in the late 1980s, both recovered ground and are today in full control of the nation's political environment.

Just as does Mexico, Malaysia has a stable, highly professionalized state bureaucracy with clear demarcation of roles and hierarchies and with a strong concentration of power in the hands of the Prime Minister. The boundaries between the state, the government, and the party are an institutional fiction in Malaysia, as in the case of Mexico. Malaysia also has a long tradition of technically-trained administrative service, which have led scholars to consider Malaysia as an "administrative state"(58) that sets the political tone of the country.(59)

Clear authoritarian and hierarchical relations, strong concentration of power in the executive, discipline within the party system and within the state, and a politically dismembered society (in which demands are channeled through the specific power structures to which the state has granted representational legitimacy), places Malaysia, along with Mexico, as a state-corporatist society with a highly integrated political system.

Reflecting its colonial past, the political system of the country responded to principles of centralization and control. In a parallel fashion, the communication infrastructure of the peninsula developed in a way that allowed the British to monitor the economic, political, and social evolution of the colony.(60) After 1963 all functions were merged under the Regional Director of Telecommunications, under the control of the Minister of Works, Telecommunications, and Posts. In this way Malaysian telecommunications became operated by Department of Telecommunications (DOT), under the name of *Jabatan Telekom Malaysia* (JTM).

Since World War II the service grew cyclically, reaching growth rates of 16 percent per annum at some stage (1947-57), and dropping to 8.5 percent in others (1960-70). From 1970 to 1987, there was a rapid expansion of basic telephone services and the introduction of new value added services. The telephone-per-capita ratio has surged: in the early 1970s the country had 1 telephone per 100 people, by 1980 that figure rose to 2.9 per 100, and by the late 1980s the country had achieved a ratio of more than 10 telephones per 100 people. Throughout this period the company added a variety of technologies and services. In 1975 most crossbar exchanges were replaced by electronic exchanges, which led to the introduction of International Subscriber Dialing Service (ISD) in 1979. By the late 1980s, 80 percent of subscribers had access to ISD, granting them direct dialing to over 150 countries. Data services were introduced in 1984, when Malaysian Packet Switched Public Data Network (MAYPAC) and Malaysian Circuit Switched Public Data Network (MAYCIS) launched their operations.

Malaysia has displayed an impressive growth in services throughout the country. But as infrastructure and service grew so did the economy, and with it the demand for more and new services. By 1987 the number of customers on the waiting list for new services had grown to 365,000, from an initial 14,000 fifteen years earlier.(61) During the period 1976-84, revenues increased fourfold, while operating expenditures increased fivefold. By 1984 only 52.9 percent of the Department's expenditures were funded by genuine revenues.

This low performance of the Telecommunications Department in conjunction with the economic downturn of the early 1980s drove the government to new strategies for reform of the public sector.(62) In 1983 the government designed a plan for certain key SOEs. As in other LDCs, the public telephone company, Jabatan Telekom Malaysia, was the initial target.(63) In early 1984 the government made public its intention to privatize the company, and in March of the same year the proposal was formally approved by the cabinet. The announcement was met with resistance from telephone workers and other economic and political groups with vested interests in the sector.

During the years of JTM privatization the government battled on two fronts to keep its hegemonic position within the political mosaic of the country. In the arena of party politics, the government faced serious challenges to its policy guidelines and leadership. More specifically, in the telecommunications sector, government officials struggled with telephone workers to avoid major conflicts over the privatization of JTM.

Political opposition to top-level decisions has been generally futile within the Barisan coalition and even outside of it. Party discipline and scattered, weak opposition parties have characterized the Malaysian political scene since its independence. However, in the midst of the privatization process opposition grew within the party and outside of it.

In 1986 Dr. Mahathir Mohamad led Barisan Nasional to a sweeping victory in national elections, and renewed his Prime Ministership for another term. However, a few months later, he nearly lost the leadership of his own party (Unmo), in what it came to be the first-ever challenge to the party's leadership. An alliance between Tengku Razaleigh Hamzah, then trade and industry minister, and Datuk Musa Hitam, a former deputy president of Umno, put serious doubt Mahathir's leadership. Soon after, dissidents questioned the validity of the elections on juridical arguing that the operations of Unmo were illegal because 30 of its branches were improperly constituted.

Intra-party struggles were reinforced by new challenges from other parties, within and outside the Barisan Nasional coalition. One of the important issues that the privatization of SOEs revived was the official economic discrimination against Malaysia's Chinese population. Following the guidelines established by the NEP, the privatization program was conceived as a proper mechanism for the redistribution of wealth between the Chinese and Malay populations. In consequence, Malays had preferential access to the program, while Chinese were implicitly excluded from the reform. This and other economic and political issues caused deep resentment in the Chinese. During the 1986 elections, the Malaysian Chinese Association (MCA), the Chinese party within the Barisan Nasional and second largest in the coalition, lost considerable support. Simultaneously, the Democratic Action Party (DAP), another dominantly Chinese party, won 20.8 percent the votes, becoming the largest opposition party in the country. Further conflicts within the MCA, and growing loss of support from its constituents, resulted the party leader threatening the government with a possible MCA withdrawal from the coalition if the state maintained its discriminatory policies against the Chinese community.

In response to these challenges, Mahathir moved decisively and repressively. First, under the Internal Security Act, approximately 100 opponents were arrested, various demonstrations and political rallies were banned and three newspapers were closed. Second, the decision of the Court that Umno was operating illegally was displaced with the formation of a new party, the Umno Baru, from which opponents were excluded. Third, through constitutional amendment the jurisdiction and functions of the judiciary were reformed, making it more difficult for judges to take independent actions. Fourth, through political pressures of all sorts, the Supreme Court was dismantled, and a new one, acquiescent to the official line, was convened. Finally, several laws were amended to limit political freedom and strengthen the power of the executive. By early 1989 intra-party struggle had disappeared, opponents had formed new parties that were not a serious threat to the regime, and the Chinese rebellion was in clear decline. By the end of the same year, Umno Baru and its leaders were still in full control of the Malaysian political scene.

Some other groups within the state, such as JTM managers and government officials, had scant incentives to oppose the project. In Malaysia's highly professionalized and institutionalized state with very little space for dissent, resisting a decision from the top hierarchy of the state apparatus would have been a major professional and political mistake. Further, for most of the Malaysian state officials in telecom managerial positions, the transformation of the company into a private enterprise, where the state would maintain a majority of shares, did not imply a major threat to their careers. The stability of their jobs was not at risk. Besides, several of them would remain in the DOT, which would operate thereafter as a regulator of the sector.

Telecommunications workers were perhaps the only meaningful opposition to the project. Unlike management, most workers feared that they would lose their jobs when the company shifted its operations to more commercial principles. Others feared losing rights that they enjoyed as state employees. Nevertheless, the possibility of a powerful union resistance in Malaysia is very low. Unionism in the country, unlike Argentina or Thailand, is minimal or banned. The ability of the telephone workers to mobilize a meaningful revolt against the state was very limited. Further, the abundant surplus of labor market generally diminished the bargaining power of workers. These structural weaknesses of the labor sector were reinforced further by an official promise that telephone workers would be retained in the new company for a period of at least five years.(64) Worker's opposition was the last obstacle to the privatization of JTM. The government, with a tight control over the Malaysian political system, was able to dismantle the rising opposition and inhibit any further challenges to the official program.

In August of 1985, with a weakened political opposition, a tamed work force, and a loyal state bureaucracy, the president was able to pass in Parliament, the Telecommunications (Amendment) Bill 1985 and the Telecommunications Services (Successor Company) Bill 1985, which offered the legal framework for the transformation of the sector.(65) After two years of organizational and financial reforms the process was completed. On January 1, 1987, the new company, Syarikat Telekom Malaysia, Berhad (STM), was officially registered as a private enterprise under the 1965 Companies' Act. However, this was only the first step towards privatization. The emergence of Syarikat Telekom Malaysia, a company in which the government still retained 100 percent ownership, was only an incorporation stage that prepared the company for future public floatation of shares in the international stock market.(66)

In November 1990, STM was listed in the Kuala Lumpur Stock Exchange, and 13 percent of the company's shares were sold to the public.(67) After the public floatation of shares, the state reduced even further its participation in the company by selling shares to STM employees and several Malay (bumiputra) institutions. Although these shares were not government shares, but rather new shares to increase the company's capital base, the state control of the company shrank to 81 percent of STM capital.(68) Since its corporatization the company has reversed its historical deficit by turning impressive profits, which have been enhanced with the recent listing of the business in the stock exchange.(69)

The corporatization of state-owned telecom services and later partial privatization of the company was probably the most important of several measures that the Malay government adopted to upgrade the sector in its attempt to catch up with the booming national economy. Along with the corporatization and privatization of the SOE, a wide liberalization program has been implemented since the mid-1980s.(70)

In the realm of data services the main operators are MAYPAC and MAYCIS. Both are operated by STM were introduced in 1984. Along with these services the government granted permission for the leasing of private lines to provide business with timesharing services, offering in this way cheaper and more efficient routes.(71) Value-added services are also provided by private companies like Komtel, which is owned by Sapura Holdings Group, a major Malaysian telecommunications holding. Besides being one of the thirty-two companies that provide paging services in fifteen cities, Komtel offers, mainly in Kuala Lumpur, value-added services such as wake-up, message check, and appointment reminder. More recently, other services such as domestic and international messaging has become available. Skytel, a joint venture of Mobile Telecommunications Technologies offer access to alphanumeric messaging, voice mail, and international messaging.

Wireless communications has also been liberalized. Paging services are provided throughout the country by various private companies. The government has granted thirty-two licences to companies that operate locally in different areas of the country. And competition in paging has been recently introduced throughout the country by granting Hong Kong's Hutchison Telecom a licence to operate nationwide a radio paging service. The interesting pattern in the liberalization of paging services is that JTM is not allowed to enter that segment of the market. Regarding cellular telephony, there are 12 private mobile radio systems in operation, and 13 companies will be granted licences for the provision of CT2 systems. STM is also actively participating in the segment of cellular telecommunications through Automatic Telephone Using Radio (ATUR), which was launched nationwide in 1985, becoming the first of its kind in the region. After a few years of holding a monopoly on the service, ATUR now competes with Cellular Communications (Celcom), a telecom company owned by Fleet Group, a financial consortium related to the governing party Umno.

The successful liberalization of various telecom services and the privatization of the formerly state-owned Jabatan Telekom Malaysia was not a foregone conclusion in Malaysia. The government has confronted a variety of political, economic, social, and institutional obstacles in its attempt to reform the sector. Despite labor and political party opposition, ethnic frictions based on discriminatory economic policies, legal obstacles, and economic difficulties in the sector itself, the Malay government has completed the first stages of its privatization program and continues to open the market to competitive entry of third parties. As in the case of Mexico, the history of the "successful" implementation of reforms in the country can be explained by the autonomy of the state apparatus from domestic and international constituents and heavy concentration of power in the executive branch.

V.- Conclusion

Telecom reform recently surged throughout the world at a astonishing pace. More striking even is the fact that the phenomenon has spread in a global basis at the same historical time, regardless of political boundaries, economic structures, or dominant ideologies. However, these sweeping changes have not taken the same patterns in all nations. Even those countries that share some basic socio-economic features have diverged sharply in the way they have reorganized the provision of telecom services. Based on the cases of Argentina, Thailand, Mexico, and Malaysia, this study attempts to explain why LDCs, with shared reform goals, have differed in their policy outcomes.

Based on the assessment of various theoretical frameworks and the available data from the cases, the study argued that the relative autonomy of the state and degree of power concentration within the state apparatus are key variables to understand policy variation among LDCs. More concretely, the central hypothesis is that countries with a highly autonomous states and strong concentration of power in the executive branch are more capable of privatizing their SOEs and liberalizing different segments of the telecom market than those nations in which these patterns are absent.

The evolution of the political system in Argentina, and its impact in the unfolding of telecom reform in the country, is one of the most illustrative cases supporting the central argument of the study. During the military period, a dispersion of power within the state apparatus blocked reform. Later, under democracy, the participatory nature of politics made it difficult for the government to achieve any major changes in the sector. Finally, during the Menem administration, an insulation of the state from domestic political pressures and a strong concentration of power in the executive granted the government the political space to maneuver towards a broad privatization program. Similar to the first stages of the Argentine story, Thailand had faced after the mid-1970s an opening of the political system and an increasing participation of diverse political coalitions. Despite committed efforts of previous governments to reform, the projects have failed due to resistance from various camps of the political arena.

Malaysia and Mexico stand sharp contrast to Argentina and Thailand. Both countries share a strong state-corporatist political system. Both countries moved towards reform in the past few years. And both countries have achieved most of their initial goals. In both cases, also, the state plays a central role in the articulation and integration of political forces, while at the same time displays a clear autonomy in the policy making process. Further, each nation portrays a strong concentration of power at the top of the executive branch. In both Malaysia and Mexico the history of telecom reform reveals close links between the evolution of the changes in the sector and the role of power concentration and autonomy in the crafting and realization of those changes.

At a second level, I argued that even though this analytical approach was quite powerful in explaining general reform trends in LDCs, it has problems in elucidating some "anomalies" in the dominant patterns of change, i.e., why Argentina has been able to privatize but not to liberalize, while Thailand has achieved the latter but not the former. Political and socio-economic data from the countries point to the fact that powerful flows in the domestic economy have relegated political will to the background of the reform scene. In Thailand, pressures from a booming economy broke tight political resistance to the transformation of the sector. In Argentina, the needs of a decadent economy pushed the government to surrender liberalization on behalf of a "successful" privatization of the state-owned telephone company.

In brief, the examination of telecom reform in Asia and Latin America shows that politics and the distribution of power in a society is a key element in the restructuring of telecommunications in the developing world. Moreover, this analytical exercise has led us to the not very encouraging conclusion that, in LDCs, free market and participatory politics do not go hand in hand. On the contrary, economic liberalization seems to build, at least in its early stages, in political suppression. Finally, the paradox of this premise is that, when applied to the economic liberalization of the public sector, dismantling the state calls for the presence of a strong and independent state.

Notes

[*] Regulatory reform in the telecom sector of LDCs is a very dynamic phenomenon, and, therefore, highly prone to permanent changes and transformations. This paper attempts to explain crucial reforms in the studied countries between 1984 and 1990. Events thereafter are not included in the analysis, although they are occasionally used as examples.

[1] Stephen Krasner, *Structural Conflict: The Third World Against Global Liberalism* (Berkeley: University of California Press, 1985).

[2] Grounded in the degree of political openness, this work parallels, and at the same time contradicts, a recent study on telecom reform in the European Community. Based on reform processes in England, France, and Germany, Raymond Duch reaches the conclusion that participatory political systems are more prone to achieve reform than those based on corporatist political structures. The answer to this puzzle may lie in a crucial difference between developed and developing countries: the source of pressures for reform. While industrialized nations have reformed, mainly, in response to the needs and pressures of large business consumers, changes in LDCs are, largely, a reflection of government's response to fiscal and economic constraints. See Raymond Duch, *Privatizing the Economy: Telecommunications Policy in Comparative Perspective* (Ann Arbor: The University of Michigan Press, 1991).

[3] Theda Skocpol, "Emerging Agendas and Recurrent Strategies in Historical Sociology," in Skocpol (ed.) *Vision and Method in Historical Sociology*, 375.

[4] See, for example, Theda Skocpol (ed.), *Vision and Method in Historical Sociology* (Cambridge: Cambridge University Press, 1984); Theda Skocpol and Margaret Somers, "The Uses of Comparative History in Macrosocial Inquiry," *Comparative Studies in Society and History* , n° 22 (1980); Charles Tilly, *Big Structures, Large Processes, Huge Comparisons* (New York: Russell Sage Foundation, 1984); Neil Smelser, *Comparative Methods in the Social Sciences* (Englewood Cliffs: Prentice Hall, 1976). A variety of seminal social science studies have applied this research methodology, of which the most outstanding are Theda Skocpol's, *States and Social Revolutions: A Comparative Analysis of France, Russia, and China* (Cambridge: Cambridge University Press, 1979); Barrington Moore's, *Social Origins of Dictatorship and Democracy* (Boston: Beacon Press, 1966).

[5] Cited in Gabriel Szekely, "Mexico's Challenge: Developing a New International Economic Strategy," in ed., *Changing Networks: Mexico's Telecommunications Options*, Peter F. Cowhey, Jonathan D. Aronson, and Gabriel Szekely, (La Jolla: Center for US-Mexican Studies, 1989), 81.

[6] Thailand is the only of the four countries that did not used telecom as leading case for state reform. The Thai government started its privatization attempts with electricity and ports.

[7] For studies of recent telecom transformations in industrialized nations see, Alan Stone, *Wrong Number: The Break Up of AT&T* (New York: Basic Books, 1989); Robert B. Horwitz, *The Irony of Regulatory Reform: The Deregulation of American Telecommunications* (New York: Oxford University Press, 1989); Jill Hills, *Deregulating Telecoms: Competition and Control in the United States, Japan, and Britain* (Westport: Quorum Books, 1986); Peter Cowhey and Jonathan Aronson, *When Countries Talk: International Trade in Telecommunications Services* (Lexington: Ballinger, 1988); Ray Duch, *Privatizing the Economy.*

[8] See, for example, Richard Rose, *Do Parties Make a Difference?* (Chatham: Chatham House, 1984); and Douglas Hibbs, "Political Parties and Macroeconomic Policy," *American Political Science Review*, 71 (December 1977).

[9] See Emmanuel Adler, *The Power of Ideology: The Quest for Technological Autonomy in Argentina and Brazil* (Berkeley: University of California Press, 1987); Peter A. Hall, ed., *The Political Power of Economic Ideas: Keynesianism Across Nations* (Princeton: Princeton University Press, 1989); and William Drake and Kalypso Nicolaidis, "Ideas, Interest, and Institutionalization: 'Trade in Service' and the Uruguay Round," *International Organization*, 46, 1 (Winter 1992).

[10] Stephen Haggard, *Pathways from the Periphery: The Politics of Growth in the Newly Industrializing Countries* (Ithaca: Cornell University Press, 1990) , 34.

[11] Peter Cowhey, "The Political Economy of Telecommunications Reform in Developing Countries."

[12] See for example, Peter Gourevitch, *Politics in Hard Times: Comparative Responses to International Economic Crisis* (Ithaca: Cornell University Press, 1986); Peter Katzenstein, *Between Power and Plenty: Foreign Economic Policies of Advanced Industrial States* (Madison: University of Wisconsin Press, 1978).

[13] Some of the most relevant works on state literature are Peter Evans, Dietrich Rueschemeyer, and Theda Skocpol, *Bringing the State Back In* (Cambridge: Cambridge University Press, 1985); J. P. Nettl "The State as a Conceptual Variable," *World Politics*, vol. 20 (1968).

[14] I have labeled "state-corporatism" those corporatist arrangements found in LDCs because they portrait a crucial difference to traditional corporatist systems in industrialized countries. While in developed countries corporatism functions mainly at the societal level, in LDCs their very existence and functioning depends, generally, on the sponsorship and management of state elites.

[15] This mode of country categorization is an ideal type, a theoretical construction, that helps us to organize the otherwise complex and sometimes chaotic data of political organization. Therefore, no country fits "perfectly" in these categories. Most cases will present a mix of both; however, in most cases one type of political organization will predominate over the other.

[16] See Philippe Schmitter and Gerahard Luhmbruch, eds., *Trends Toward Corporatist Intermediation* (Beverly Hills: Sage Publications, 1979), 13.

[17] Raymond Duch, *Privatizing the Economy*, 106.

[18] Stephan Haggard, *Pathways from the Periphery*, 43.

[19] For Mexico, see Peter Smith, *Labyrinths of Power* (Princeton: Princeton University Press, 1979). For Malaysia see, Mavis Puthucheary, "The Administrative Elite," in Zakaria Haji Ahmad *Government and Politics of Malaysia* (New York: Oxford University Press, 1987).

[20] For Thailand see, Jinpyo Yoon, *Formation and Transformation of the Modern State: A Comparative Study of the Nature and Role of the State in Indonesia, Thailand and Vietnam*, (Ann Arbor: UMI Dissertation Information Services, 1990). For Argentina, Carlos Waisman, "Argentina's Revolution from Above," in ed., *The New Democracy in Argentina*, Edward C. Epstein (New York: Praeger, 1992).

[21] For Thailand, Jynpyo Yoon, op. cit., and Kevin Hewison, *Power and Politics in Thailand*, (Manila: JCAP, 1989). For studies of the Argentine state see, for example, Oscar Oszlak, *La Reforma del Estado en la Argentina*, (Buenos Aires: Centro de Estudios de Estado y Sociedad, 1990).

[22] The provision of basic services still constitutes around 90% of the sector's investments, operations, and revenues in most LDCs. See Ernst

Becher, *Restructuring of Telecommunications in Developing Countries: An Empirical Investigation with ITU's Role in Perspective* (Geneva: International Telecommunications Union, 1991).

23 For a broader study of the Alfonsin period, see Cynthia Baur, "Rethinking Privatization, Liberalization, and Deregulation: The Case of Argentine Telecommunications," unpublished manuscript, University of California-San Diego, La Jolla, California, 1991.

24 Haggard, *Pathways from the Periphery*, 44; Gourevitch, *Politics in Hard Times*, 22.

25 Law Nº 23.696, Art. 9/11.

26 Debt papers were bought by the bidders in the secondary market at a highly discounted price (11 cents on the dollar), but taken by the Argentine government at their face value (i.e., 1 dollar each).

27 Entel was sold for US$214 million in cash (US$114 million for the south, and US$100 for the northern region), US$380 million in notes (US$203 million for the southern region, and US$177 million for the north), and US$5.028 billion in debt papers (Telecom paid US$2.308 billion, and Telefónica US$2.720 billion). Yet, if we take the value of the debt papers in the secondary market at the time of the sale (which was approximately 11 cents on the dollar), the price paid for the company drops to US$1.5 billion.

28 Further analysis of Entel's privatization can be found in Alejandra Herrera with Ben A. Petrazzini, "The Privatization of Telecommunications Services: The Case of Argentina," *Columbia Journal of World Business*, forthcoming 1992.

29 Decree 731/89, September 12, 1989.

30 Decree 731/89, Art. 10-1.

31 Decree 62/90, art. 9.11. The provision of cellular telephony is operated in the Buenos Aires area by the new private company, integrated by Telefonica and Telecom (Startel) and Movicom, a consortium constituted by: BellSouth (31 percent), Motorola (25 percent), Citicorp (8 percent), and two local companies—Socma (16 percent) and BGH (20 percent). National data transmition is provided by Impsat, Satelnet, and recently Alcatel. Two other companies (Keydata and Tecsel) hold licenses to operate but are presently out of the market.

32 David A. Wilson, *Politics in Thailand* (Ithaca: Cornell University Press, 1962), and Fred W. Riggs, *Thailand: The Modernization of a Bureaucratic Polity* (Honolulu: East-West Center, 1966).

33 David Morell and Chai-Anan Samudavanija, *Political Conflict in Thailand: Reform, Reaction, Revolution* (Cambridge: Oelgeschalager Gunn & Main Publishers, 1981), and Ross Prizzia, *Thailand in Transition: The Role of Oppositional Forces* (Honolulu: University of Hawaii Press, 1985).

34 Taiwan, for example, has 375 telephone lines per 1000 people, while South Korea has 304, Singapore 370, Hong Kong 424 and Malaysia 140.

35 For growth rate, customers waiting list and other data see, Paul Handley, "Progress by Numbers," *Far Eastern Economic Review* (23 March 1989):83. For waiting period and instalation charges see Mark A. Hukill and Meheroo Jussawalla, "Telecommunications Policies and Markets in the ASEAN Countries," *Columbia Journal of World Business* (Spring 1989):51.

36 By mid-1989, Thai workers in the private sector were making approximately US$3 a day (the lowest salary in Southeast Asia, after Indonesia).

37 *The Financial Times*, March 26, 1990.

38 *Business Wire Inc.*, May 15, 1986.

39 For an excellent introduction to Mexican politics see Wayne A. Cornelius and Ann L. Craig, *Politics in Mexico: An Introduction and Overview* (La Jolla, Calif: Center for US-Mexican Studies, Uuiversity of California-San Diego, 1988).

40 Steve Dubb, "Modernization and Union Politics in Teléfonos de Mexico," unpublished manuscript, University of California-San Diego, La Jolla, California, 1991.

41 The two parties that posed serious threats to the PRI were the Partido de Acción Nacional (PAN) and the Partido Revolucionario Democratico (PRD).

42 The amount received by the Mexican government for Telmex went far beyond anybody's expectations. Yet, one should keep in mind that the Telmex sale was enhanced by bundling in the same deal most of the 24 subsidiaries mentioned above.

43 Telecommunications is a sector in which foreigners are allowed to own up to 49 percent of the controlling shares of any Mexican company. See Mexico, Secretariat for Commerce and Industrial Development, *Legal Framework for Direct Foreign Investment in Mexico* (Mexico, D.F., 1990).

44 Mexico sold 1.745 million "L" type shares, which were offered in stock markets all over the world in the form of American Depository Shares (ADS), and cost US$27.25 for each ADS (each ADS contains 20 "L" type shares). "L" type shares is another new element that the financial reform of Telmex brought about. These new shares are nonvoting shares, and they are valued 2.5 times less than the traditional "A" Telmex shares.

45 The telephone union, using a credit of US$325 million from the Mexican government, bought 187 million type "A" shares through Nacional Financiera (Nafin), which constitutes 4.4 percent of Telmex's capital.

46 Such as separate subsidiaries with separate accounts, network development for easy interconnection and the sharing of network information, etc.

47 Traditionally, market access was linked to the commercial principles of "rights of establisment" and "commercial presence;" today, with the emergence of high-tech telematic networks (telecommunications and informatics), companies are able to provide services from abroad. "Nonestablished" companies do not need to invest in the local economy to provide services in the local market, and the only impediment they face is acquiring a license to plug into the national public network. See Russel Pipe, *Telecommunications Services: Considerations for Developing Countries in Uruguay Round Negotiations* report prepared for UNCTAD (Amsterdam, May 1989), and Karl P. Sauvant, *International Transactions in Services: The Politics of Transborder Data Flows* (Boulder, Colo.: Westview Press, 1986).

48 The explosive diffusion of wireless communication in LDCs to bypass the deteriorated public network will reinvigorate traditional domestic and international struggles on the proprietary rights and allocations of radio frequency spectrum. For implications of recent increase in the provision of wire-less telecom services see "Airwave Wars," *BusinessWeek* (July 23, 1990). For an elaborate historical analysis of the international politics of radio spectrum allocation and the role of LDCs see, James Savage, *The Politics of International Telecommunications Regulation* (Boulder: Westview Press, 1989), chap. 2.

49 One of the companies is Intelcel, a subsidiary of Telmex; the other one is IUSACEL.

50 The system has 44 transponders that make possible the operation of 361 telephone circuits, 230 telex circuits, satellite telephone communication with 43 countries, telex communication with 17 countries and two video channels. Source: Pisciotta and Fischer, "Mexico".

51 Generally this services are operated through the modern technology of Very Small Aperture Terminals (VSAT). Some companies such as Princeton Consulting Inc. and Satellite Applications Engineering Corp. have already applied for government licenses to install satellite mobile systems. From Ciudad Juarez, Sersa/Geocom, Inc. offers a satellite-based telecommunications service throughout the northern border area of Mexico.

52 The Federation was constituted by Peninsular Malaya, Sabah, Sarawak, and Singapore. In 1965 Singapore left the Federation and became an independent country.

53 Barisan Nasional translates as National Front. The main parties in the coalition are the United Malays National Organization (Umno), the Malaysian Chinese Association (MCA), the Malaysian Indian Congress (MIC), the Gerakan Party, and the Party Pesaka Bumiputera Bersatu (PBB).

54 For studies on Malaysia's political system see, Zakaria Haji Ahmad, ed., *Government and Politics of Malaysia* , and Chandra Muzaffar, *Challenges and Choices in Malaysian Politics and Society* (Penang: Aliran Kesedaran Negara, 1989).

55 Although the Chinese population constitute a minority in the country, it has been in control of business and trade for decades. On the contrary, the Malays (or Bhumiputra--"the sons of the soil") has been traditionally the largest, yet less afluent group in Malaysia. With the purpose of finding a balance in the distribution of wealth among different ethnic groups, the government instituted in 1971 (after ethnically driven national revolts) a National Economic Policy (NEP). The main goal of the program is to increase in a considerable proportion (30 per cent) the stake of the Malay population in the country's equity share.

56 Unequal income distribution between Chinese and Malays have been a key issue in racial friction.

57 While Barisan Nasional integrates conflictive ethnic groups and dissolves racial tension, the PRI integrates different professional and income groups and dissolves economic-based tensions.

58 An administrative state is, in the words of Esman, one in which 'the state is the dominant institution in society, guiding and controlling more than it responds to societal pressures, and administrative (bureaucratic) institutions, personnel, values, and styles are more important than political and participative organs in determining the behavior of the state and thus the course of public affairs.' Milton J. Esman, *Administration and Development in Malaysia: Institution Building and Reform in a Plural Society* (Ithaca: Cornell University Press, 1972): 72, cited in Mavis Puthucheary, "The Administrative Elite".

59 For a study of state bureaucracy in Malaysia see, Mavis Puthucheary, "The Administrative Elite," in Zakari Haji Ahmad, *Government and Politics of Malaysia* .

60 This section relays heavily on the work of Fong Chan Onn, "The Malaysian Telecommunications Services Industry: Development, Perspective and Prospects," *Columbia Journal of World Business* (Spring 1989).

61 As a proportion of subscribers, the amount of backlogged requests surge from 7.8 percent in 1970 to 32.3 percent in 1987.

62 The international economic recession of the early 1980s had a strong impact in the fall of raw material prices coming from LDCs. Malaysia was particularly affected by these downward trend in the international economy.

63 Economic Planning Unit, *Guidelines on Privatization* (Kuala Lumpur: Prime Minister Department, 1985).

64 The government also offered retirement to those who were willing to take the deal. In this way, almost 400 of the 28,724 company's employees dropped out of JTM. Daud bin Isahak, "Meeting the Challenges of

Privatizatior in Malaysia," in *Restructuring and Managing the Telecommunications Sector*, ed., Bjorn Wellenius, Peter A. Stern, Timothy E. Nulty, and Richard D. Stern (Washington D.C.: The World Bank, 1990).

65 The Telecommunications (Amendment) Act of 1985 restructured Jabatan Telekom Malaysia as a state regulatory agency, while the Telecommunications Service (Successor Company) Act of 1985 regulated the operations of the new company: Syarikat Telekom Malaysia.

66 STM operates under a twenty-year licence issued by the Minister of Works, Telecommunications, and Posts. The fact that STM operates under a government licence implies that the state has kept the prerogative of reviewing the companies' monopoly in the provision of basic services. Toh Kin Woon, "The Liberalization and Privatization of Telecommunications: The Malaysian Experience," in *Privatization and Deregulation in ASEAN and the EC: Making Markets More Effective*, eds., Jacques Pleknans and Norbert Wagner (Singapore: ISEAS, 1990).

67 Some of the factors that delayed the public floatation of STM shares are related to managerial and financial issues. The company had to adjust its operations to the logic of private markets, and restructure its accounting system to meet the requirements of the Malaysia's Capital Issues Committee (CIC). But more important, STM, according to regulations of the CIC, had to show a record of continuous profit during three years to be able to list its shares in the Kuala Lumpur Stock Exchange. Toh Kin Woon, "The Liberalization and Privatization of Telecommunications: The Malaysian Experience", 73.

68 Fong Chan Onn, "Malaysia," in *Pacific Basin Telecommunications: An Evolutionary Approach*, eds., Eli M. Noam, Seisuke Komatsuzaki, and Douglas A. Conn (New York: Oxford University Press, 1992)

69 The company announced a 36-fold increase in net income for 1988. By 1991 the company was earning US$ 333 million, which represented a sharp increase over the US$203 in profits of the previous year. By 1992 the company is expecting to raise its income to US$360. The value of STM shares has climbed steadily from the US$1.80 at which it was issued to US$4.25 in late June of 1991. See Michael Westlake "Ringing the Changes," *Far Eastern Economic Review* (July 1989): 66; and Nick Ingelbrecht, "Privatisation Doubles Profits," *Asian Business* (September 1991): 13.

70 Much of the data on the competitive provision of services is drawn from Fong Chan Onn, "Malaysia,"*Pacific Basin Telecommunications: An Evolutionary Approach*; and William Ambrose, Paul Hennemeyer, and Jean-Paul Chapon, *Privatizing Telecommunications Systems* (Washington D.C.: International Finance Corporation, 1990).

71 Li Shui-hua, "Telecommunications Opportunities," *East Asian Executive Report* (April 15, 1986).

International Telecommunications Is Shifting Paradigms: How Will It Affect Your Business?

By Gregory C. Staple*

ABSTRACT

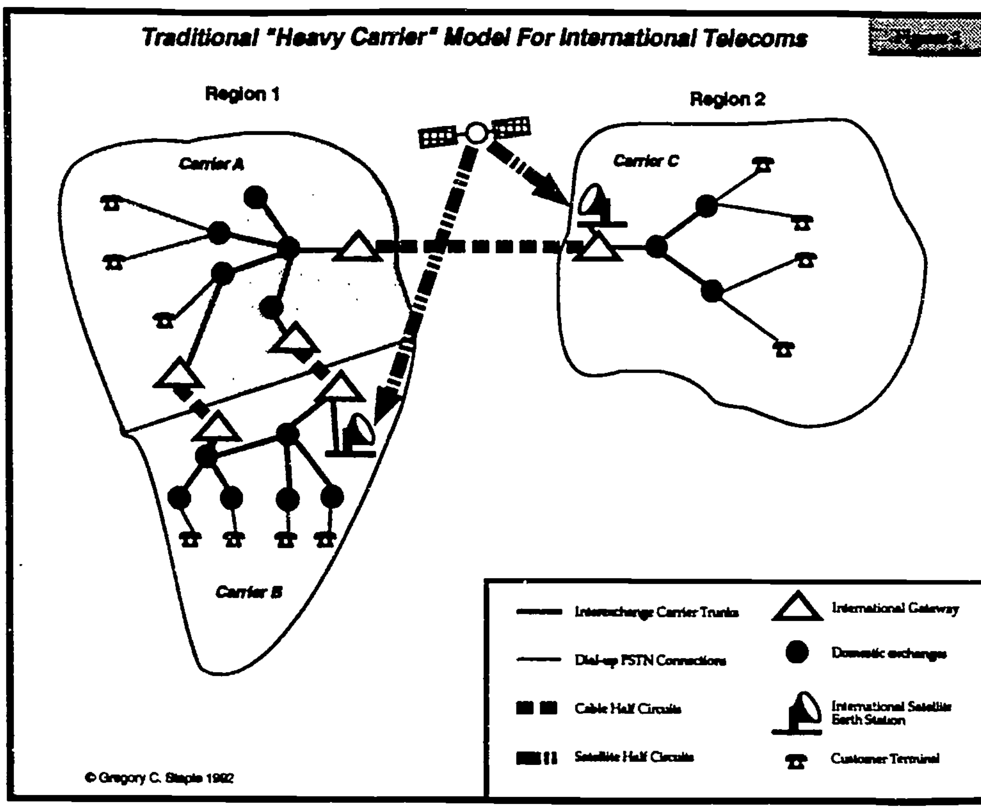
There is a new paradigm for international telecommunications services. The old paradigm is characterized by monopolistic, facilities-based "Heavy Carriers" which interconnect half-circuits and compensate each other through a 50/50 division of accounting rates. The new paradigm is being pioneered by "Light Carriers", including cellular mobile and satellite carriers, which resell, repackage or reprogram the offerings of Heavy Carriers to provide lower priced end-to-end service to users on a multinational basis. This essay (1) surveys the technological and regulatory changes driving the paradigm shift and (2) shows how it is changing the options open to government and industry. For as intelligent network services, credit card payment plans and IDD become ubiquitous, the Light Carrier paradigm will make alternative (ie, foreign) telephone services available in every country, notwithstanding local regulatory preferences.

The business of providing international telecommunications is going through a paradigm shift.

The new paradigm makes global competition for cross-border traffic a reality. As such, it will soon affect the competitive position of almost every national carrier, whether large or small, based in Asia or the Americas, with extensive international facilities or none. At stake is a $45 billion *world* market for services which will continue growing at 10% to 15% annually during the 1990s.[1]

The current service paradigm for international telecoms is characterized by nationalistic, monopolistic, hardware intensive carriers. These facilities-based or "Heavy Carriers" must interconnect their respective half-circuits to provide end-to-end international service. Each carrier is essentially sovereign on its own soil and sets the charges for originating foreign calls in its home country.

Starting in the 1980s, technology and market liberalization began to challenge this service paradigm. Advances in micro-electronics, fiber optics and network software, on the one hand, and the entry of competing carriers, on the other, have brought forward a new paradigm for end-to-end global service. The paradigm is being pioneered by a novel type of "Light Carrier".



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The Light Carrier provides international service by reselling, rerouting, repackaging or reprogramming the offerings of Heavy Carriers. Primarily software based, the Light Carrier is a telephone company in name only. It is driven by services and applications, not facilities, and it may not own a single trans-oceanic cable or satellite circuit.

The Heavy Carrier's services are sold in one country. The Light Carrier's market is global. Wherever located, the Light Carrier offers subscribers direct access to network dial tones of the world's lowest priced service providers <u>via</u> "800" (free phone) numbers, private lines or automated call-back equipment. Least cost global routing is the goal. For the Light Carrier there are no national monopolies and a customer's home country does not dictate call charges or the choice of carrier.

Figures 1 and 2 provide a network schematic, in abbreviated form, for the two competing paradigms described above.

<u>Implications</u>

There are no truly global Light Carriers today. The new service paradigm sketched above is just that -- a generic pattern or an archetype. But like other innovations driven forward by technology and market demand the Light Carrier idea is gaining momentum.

Much of the paradigm's appeal is its "one world" vision. Technologically, there already is one global network. Worldwide direct international dialing to at least 200 states and territories is now commonplace. The connection is nearly instantaneous and most telephone callers neither know (nor care) whether the transmission is digital or analogue, is routed by cable or satellite, is handled by one carrier or a dozen, so long as the network works. And the price is reasonable.

But therein lies the rub. For many users, the price of international telecommunications is plainly out of line with the falling cost of long distance transmission and switching technologies. The gap between the promise of a universally accessible and inexpensive global telecoms platform and the current service paradigm, rooted as it is in national carriers and monopoly charging practices, has led to growing economic and political tensions.

The dominant Heavy Carriers have sought to diffuse these tensions through a series of modest tariff reductions.[2] They have also made an unprecedented commitment to adopt more cost-based charges (accounting rates) for interconnecting each other's half circuits.[3] At the same time, many Heavy Carriers have begun to "lighten up" their own service strategies or have committed themselves to developing a mix of "Light" and "Heavy" service options. See generally Part IV below.

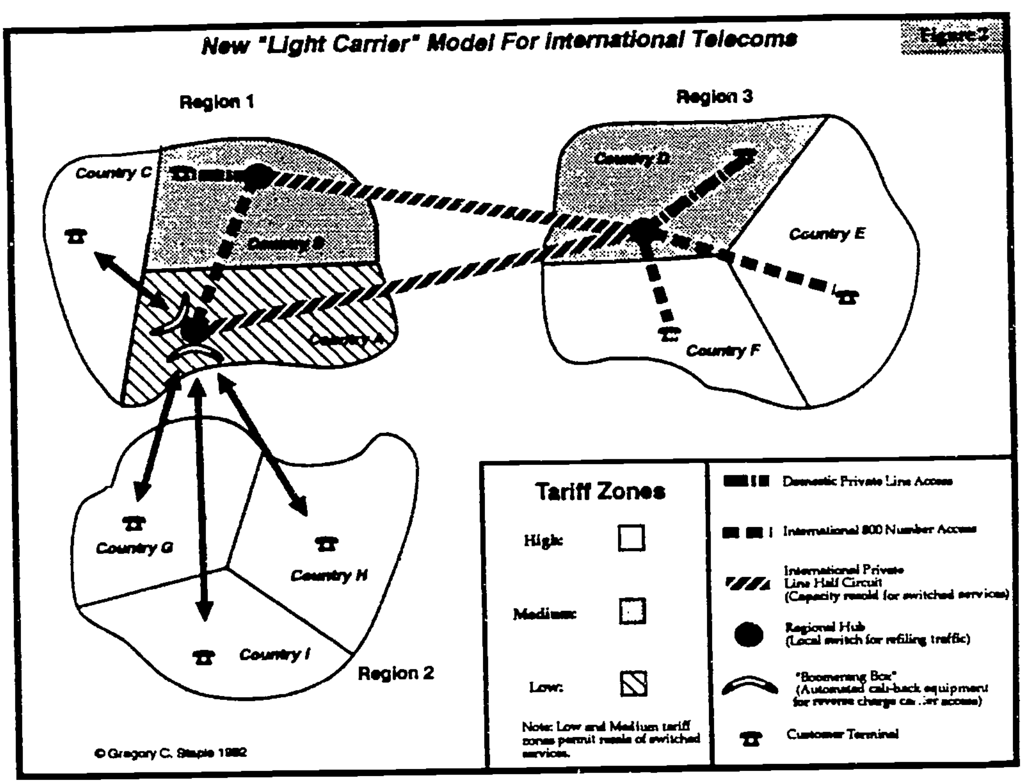
These responses appear prudent. If the Light Carrier model proves viable, it could shift billions of dollars in annual revenues from national telephone companies to new multinational service providers. As importantly, Light Carriers might offer an alternative entry vehicle for companies from middle and low income countries which, until now, have not been able to aspire to the type of global presence which many European and North American carriers recently have won.

The remainder of this article looks more closely at the issues raised by this paradigm shift. The next section, Part I, provides a fuller description of the current international service model and the pricing and traffic routing rules supporting it. Part II profiles the new paradigm and some of the regulatory questions affecting its future.

Part III examines several of the Light Carriers which have begun to exploit the new paradigm. Part IV focuses on the counter-strategies of major Heavy Carriers to sell their dial-tones on a multinational basis. Part V offers some final thoughts on the importance of the new service paradigm for carriers and countries alike.

I. The Current Model For International Services

Foreign telecommunications today can be characterized as a joint venture among independent national monopolies (or oligopolies). The venture is supported by: (a) a facilities regime based upon carrier



ownership of half-circuits in international cable and satellite facilities and (b) a financial regime which compensates or "settles" carriers for interconnecting their half-circuits and corresponding domestic networks through a 50/50 division of an agreed "accounting rate."

These two regimes -- half-circuits and 50/50 settlements -- are complementary. Any proposal to depart from the current facilities regime inevitably impacts the settlements regime.

A. The Facilities Regime

The "half-circuit" regime for international facilities has its origins in the monopoly structure of the telecommunications industry. It also reflects national security concerns regarding alien ownership of the "domestic" portion of international cable and satellite facilities.

A half-circuit typically extends from an international gateway (cable head end) in one country to a notional midpoint (the halfway point) in a cable or a geostationary satellite. Because two matching half-circuits must be interconnected to provide end-to-end service, a whole circuit cannot be established absent the consent of each national carrier and/or government. Even where competition exists, therefore, the regime makes it physically impossible for a carrier from Country A to pick up and land traffic in Country B without a carrier from that country supplying facilities (and vice versa).

The half circuit regime has considerable appeal for carriers. It encourages cost sharing and broad multilateral ownership of facilities without jeopardizing exclusive national rights. Further, intercontinental cables and satellites have significant scale economies. The bigger the facility and the more the costs are shared, the harder it may be for an alternative facility to be competitive. Ratebase regulated carriers arguably have an additional incentive to invest in such large capital-intensive facilities.

The current facilities regime also can readily accommodate intra-modal (satellite/cable) competition. International satellite communication requires an uplink in one country and a downlink in another. Equivalent half-circuits (radio channels) consequently may be separately assigned to each country.

The general application of the half-circuit regime and its entrenched institutional status often suggests that the regime is mandated by international law. This is not the case. With certain exceptions, for satellite communications (see below), the regime's legal force is largely a reflection of carrier contracts and national regulatory preferences, not international treaties.

Of importance in this regard are the new International Telecommunication Regulations (ITR) adopted in 1989 by the then 160 members of the International Telecommunications Union (ITU).[4] The ITR, which prefigure the current paradigm shift, reflect a compromise. They provide that countries shall cooperate in establishing international facilities; that international routes shall be determined by mutual agreement; that such routes shall not be unilaterally changed; and that carriers shall be compensated for interconnecting their services by way of accounting rates consistent with the Recommendations of the CCITT (International Telegraph and Telephone Consultative Committee), the ITU's standards body.[5]

At the same time, the ITR expressly state that countries may enter into "special arrangements" (ie, alternative agreements) on telecommunications matters which do not concern the ITU's members in general. Further, countries may allow non-carriers to enter into such arrangements.[6] Consequently, the ITR are arguably broad enough, some might say were intended, to accommodate various facilities and services models; they reaffirm the status quo without prejudging the future.

The impact of the ITR thus far has been limited. They have yet to be ratified by many countries, including the United States (at November 1, 1992) and few "special arrangements" have been negotiated. Moreover, as noted, the ITR do not require any country to depart from the status quo with respect to the ownership of international satellite or cable facilities. Any new arrangements must be worked out on a case-by-case basis in connection with a particular international satellite or cable facility.

In the case of satellites, the main challenge to the half-circuit convention has been posed by private satellite operators based in the U.S. -- eg, Pan American Satellite (PAS), Columbia Communication and Orion. If uplinks and downlinks can be built (or leased) in two or more countries, private satellites can offer users end-to-end international service. In contrast, the carrier owned multinational satellite organizations (Intelsat, Inmarsat, Eutelsat), which by treaty monopolize most public international telecommunications, can only furnish half-circuits to users. And Intelsat et al. do so indirectly, via national carriers which generally may not supply competing uplinks or downlinks on each other's territory.[7]

There are no analogous treaties governing the provision of international telecom cables. This has made it somewhat easier to plan and construct "private" telecommunications cables, such as PTAT, the trans-Atlantic cable completed in 1989. But, to date, neither private cables or satellites have led to a break from the industry's half-circuit convention. Private circuits have been leased primarily to carriers for public service and national regulators have barred carriers from acquiring whole circuits so as to preserve the exclusive rights of local operators.

The current facilities regime thus has proven resistant to change, private facilities notwithstanding. Even so, at least a half dozen countries are beginning to rethink the benefits of the status quo.[8] The concerns are similar? Are national economies being hurt by limiting investment in international cable or satellite facilities solely to carriers and their proxies?

Should third parties (non-carriers) have direct access to circuits provided by Intelsat and its sister organizations? What about whole circuits (ie, authorizing competitive uplinks and downlinks)? Further, where third party investment in international cables and satellites is precluded, should users be granted unrestricted leaseholds? If so, on what terms may international leased lines be interconnected with the public switched telephone network (PSTN)?

The answers given to these questions in the years ahead will directly affect the future of any new service paradigm. See Part II below.

B. The Financial Regime

The network model described above -- sovereign carriers interconnecting at a midpoint -- is supported by a unique two-tier rate regime for international service. There is a wholesale rate for carriers and a retail rate for customers.

The wholesale rate is known as the accounting rate. It determines how much a carrier must pay its foreign correspondent for taking a call from the mid-point of an international circuit (or border crossing point) and terminating it. Accounting rates are negotiated bilaterally and are typically stated in $US or Special Drawing Rights (SDRs) per minute of service. (The value of the SDR reflects a "basket" of major currencies; at 1 November 1992, 1 SDR = $1.40).

Carriers divide the accounting rate by one half to determine what each is due. That amount is known as the settlement rate. Settlements between carriers are based on net traffic balances. Separate accounting rates exist for different services (eg, telephone, telex, packet switched data). Transit rates are also negotiated for indirectly routed traffic that uses the facilities of other carriers.

An example may help to clarify these rules. Consider, for instance, calls between the U.S. and the U.K. that are routed via AT&T and BT. AT&T's accounting rate with BT for peak period telephone service is currently .54 SDR ($.76) per minute. AT&T thus owes BT .27 SDR ($.38) per minute for each outbound call. During a given accounting period, if AT&T sends more minutes to BT than it receives, AT&T

would owe .27 SDR x (the number of outbound minutes - inbound minutes) to BT.

Telephone users do not pay accounting rates for international services. They pay retail or tariff rates. These retail charges are set by each national carrier, subject to domestic regulation.
The settlement rate (the payment per minute to the foreign carrier) generally places a floor under the carrier's retail charge on a given route. However, some carriers may price their services below the settlement cost per minute because the lost revenue is more than offset by revenue from return traffic on the same route. Retail charges may also vary depending upon the time of day when the call is initiated, the aggregate level of demand and taxes.

In theory, accounting rates and public collection charges are linked because they are both cost-based; CCITT Recommendations have long required that. But there is strong evidence that this cost nexus (and hence the linkage) has broken down. Costs have fallen. Reductions in accounting rates and collection charges have varied greatly from country-to-country.

In addition, because each of the world's approximately 200 national telephone companies typically negotiates a different settlement rate -- in private -- with each of its 199 foreign correspondents, price discrimination has arisen between routes having very similar costs. The extent of this discrimination is hard to gauge because few accounting rates have been made public. It appears, however, that many national telecom carriers have behaved like an airport authority which charges airplanes a different landing fee based primarily on their country of origin rather than the landing facilities required.[9]

Some examples may be instructive. So far as accounting rates are concerned, a European carrier may pay a U.S. carrier a settlement ranging from approximately $.27 to $1.00 for landing a minute of traffic from Europe which traverse essentially the same international facilities.[10] More disturbingly perhaps, the public collection charge for an international call between Europe and the U.S. may vary by 200% or more depending upon where it is originated.[11]

Similarly, within Europe, there are still large differences betwen tariffs on the same routes. A 1991 survey by the Union of European Consumers (BEUC) found that the minimum charge for a call from Bonn to Dublin cost 2.12 ECU and 3.11 ECU in the reverse direction; the minimum charge for a call from London to Madrid (using Mercury) cost 2.27 ECU as compared with 3.32 ECU from Madrid to London.[12] (At 1 November 1992, 1 ECU = $1.27)

It is this disparity between the cost of international service, on the one hand, and the level of accounting rates and collection charges, on the other hand, which has provided the immediate impetus for the growth of a Light Carrier service industry. Arbitrage can be profitable. Yet, the ability of Light Carriers to prosper in the long term is likely to depend on more fundamental changes in network technologies and regulation. We turn to these interrelated issues next.

II. The New Service Paradigm

Communications satellites and cable systems need know no boundaries. Governments are defined by the boundaries they keep. Part I of this essay showed how the current paradigm for international service seeks to accommodate this tension between technology and politics by giving governments and their surrogates (national carriers) the upper hand.

The emerging Light Carrier service paradigm argues for a new balance. It would give a greater role to markets in determining entry and pricing policies for international services so that users can benefit more fully from the boundary-less global electronic network.

A. Technology: Fiber Optics and Intelligent Networks

Since the 1970s, order of magnitude improvements in telecom transmission and switching technologies have radically changed the facilities-based constraints on international telephony. As recently as 1975, the most modern trans-oceanic cables had a capacity of less than 10,000 voice paths at a cost of $25,000 or more per path. The generation of trans- oceanic fiber optic cables installed in the 1990s will offer 600,000 or more voice paths with each path costing $2,500 or less.[13] The proliferation of very large capacity transmission facilities like these plainly calls into question the rationale for the pricing and access rules adopted in an environment where transmission capacity was relatively scarce.

The story is much the same when it comes to telecom switching systems. Since the 1950s, approximately every three years the cost of processing electronic bits has halved and the trend is a continuing one. Likewise, every three years the number of transistors which can be squeezed onto a single computer chip quadruples with four million set chips the current norm.[14] These developments have made it economical for both carriers and users to build a vastly greater level of intelligence into switching, network control and terminal facilities.

The rise of digital "intelligent networks" and the rapidly growing base of "smart" terminals directly affect the current service paradigm. At the center of the "intelligent network" is a new common-channel signaling system knows as Signaling System 7 (SS7). A digital network employing SS7 has one channel for transmitting routing, billing and service information and another channel for transmitting a user's message.

Where common-channel signaling is unavailable, telephone networks use in-band signaling which sends the coded instructions necessary to set up a calling path through a network of switches and transmission links over the same communications path used by the message itself. This link-by-link call setup process is slow and often needlessly consumes capacity for calls that are never completed. In-band signaling also requires that data on network numbering be stored (and continually updated) at every switching center in the network.

With common-channel signaling, call routing and billing instructions are sent over a dedicated channel to all switching points in the network simultaneously from the same Service Control Point (SCP). The SCP is in effect a large computer where all numbering, call processing and customer credit information are stored. SS7 thus allows a network to analyze and route calls selectively through networks owned by different operators while at the same time providing the information necessary for the proper billing of those calls.[15]

The billing and data base functions supported by SS7 and related products also facilitate a wide variety of value added services, third party payment plans and interconnection arrangements for independent service providers. Beyond that, the multinational deployment of SS7 and fiber optic transmission facilities can be synergistic.

Large users require a mix of transmission capacity to handle their needs for networked voice, data and video communications. The capacity and routing required for each service may be different and may also vary from day-to-day. Networks must be able to sustain communication rates that range from tens of bits to millions of bits per second; from a few keyboard character strokes to the real time exchange of large data bases and full motion computer-based images.

Traditional analog transmission and switching systems usually could not handle these changing needs. Circuit capacity was limited and was dedicated to a particular function; connections were often hard-wired; and the possible transmission paths through the switch were bounded by the physically created electro-mechanical connections which could be made.

In contrast, software controlled digital switches have almost infinite flexibility. Switching is a function of the software program. The instructions can be changed and adapted to accommodate new routes. Switches can also be used to partition the bandwidth assigned to a particular user (or carrier) thereby making more efficient use of high capacity transmission facilities.

These network signaling and switching capabilities have been complemented by a new generation of "smart" terminal equipment. This has further decentralized (and, in part, privatized) carriers' historical monopoly over switching and call routing. Private Automatic Branch Exchanges (PABXs) are programmed to select the least cost international route; facsimile machines and voice mail systems use store and forward technology to time shift transmissions and to convert basic services to enhanced ones; software entrepreneurs design automated call-back devices ("boomerang boxes") to facilitate call arbitrage.

In sum, plentiful transmission capacity, "smart terminals" and "intelligent networks" make it increasingly possible to separate the ownership of transmission and switching facilities from the ownership of the service provider, and hence to promote competition on a whole new scale. Whether or not these possibilities are realized depends largely on how regulators respond.

B. Regulation: Making Technology Available To Users

Over the last decade, the public interest burden generally has shifted from those who believe countries are best served by competing long distance telecommunications to those who believe that there should be a sole supplier. Competitive long distance transmission networks for voice telephony have now been licensed in several nations, including some where the base of exchange lines is quite limited (New Zealand, the Philippines). And, other countries are considering a like course.

However, this essay argues that the technologies described above are making the licensing of a second or third carrier less and less important in determining the scope for services competition. Increasingly what matters, especially for international services, is the scope for third parties to use existing facilities -- to have direct access to gateway earth stations and satellite circuits; to lease international cable capacity in bulk; and to interconnect leased facilities (satellite or cable) with the public switched telephone network (PSTN). *Moreover, as discussed as Part III, as credit card payment schemes and international direct dialing become ubiquitous, a range of (ie, competing) foreign telephone services will be available in every country, notwithstanding the policy of the national regulator regarding competing facilities licenses or resale.*

Assuming for the present that regulators are sovereign, or nearly so, however, what steps should they take to make the benefits of today's global electronic network more widely available? How much liberalization is in the public interest and how should it be accomplished? Should liberalization aim to repeal carriers' historical monopoly over international facilities so as to promote competition on a whole circuit (end-to-end) basis as exists, for example, in the airline industry? Or should competition be introduced in a form which preserves the industry's current structure?

Do national security, trade or foreign policy considerations make competition for international services a special case? Or are the same economic and consumer arguments which favor competition for long distance services domestically of equal application to international services?

Not surprisingly, governments have differed in their answers to these questions. But, there are some common elements.

As an initial step toward satisfying user demands, several governments have tried to ensure that international service is more cost based by requiring carriers to unbundle (tariff separately) their facilities (eg, earth stations, satellite circuits, terrestrial tails). The U.S., Australia and various European states have also permitted international satellite services to be supplied competitively, thus allowing national carriers and users more flexibility in configuring their networks.

Second, governments have begun to allow non- carriers to have an ownership interest in international facilities. As noted earlier, ownership of public international satellite facilities is generally limited by treaty to government signatories or their designates. But the ownership of undersea cable circuits is typically decided by contract and, in principle, ownership units -- known as Indefeasible Rights of Use (IRUs) -- may be held by carriers, users or independent investors. Even though these IRUs are only for half-circuits (ie, must be matched with a foreign IRU to provide end-to-end service), the greater the range of facilities owners, the greater the scope for services competition.

In the United States, the FCC recently went one step further in liberalizing access to international cables. In June, 1992, the agency ruled that henceforth companies holding cable IRUs would be permitted to transfer their interests to other parties at a market price instead of at cost (ie, net-book value), which often made any transfer unprofitable.[16] Although this decision only affects U.S. cable half-circuits, other governments may follow suit, thus creating an international market for IRUs and greatly facilitating access to these bottleneck transmission facilities by new service providers.

Third, and probably of most significance, governments have progressively liberalized the terms upon which international private lines (IPLs) -- cable or satellite capacity which is dedicated to a single user -- may be resold and interconnected with the PSTN. IPLs offer large volume users an end-to-end circuit at a much lower cost per call than the public network because IPLs are priced at a flat monthly rate by each national carrier providing one-half of the through circuit. An IPL thus may be economic if it is used as little as three or four hours a day.

IPLs have long offered the potential for corporate users (or their network managers) to bypass the established carriers in picking up and landing international traffic. Until recently, however, a variety of international and national rules haver prevented customers from using IPLs to transform themselves into carriers. Of primary importance internationally were the CCITT's D-1 series of Recommendations. Since at least the 1940s, the CCITT Recommendations, which most countries considered binding, prohibited users from connecting an international leased circuit with the PSTN at both ends or from freely reselling capacity to third parties.[17] But, in 1991, after years of contentious debate the CCITT voted to liberalize the D-1 Recommendations. The new D-1 series basically lets each country decide for itself whether international circuits can be subleased or interconnected to the PSTN at one or both ends.[18]

The unrestricted resale of IPLs, often called international simple resale (ISR) is crucial to the development of the new Light Carrier service paradigm for new and old carriers alike. This is so because ISR enables a company to offer end-to-end services without having to invest in expensive cable or satellite facilities, but also because it will give established carriers the opportunity via leased lines, to bypass their traditional correspondent relationships. It is this latter possibility, the provision of relatively inexpensive end-to-end service by a single "national" carrier, that is responsible for much of the excitement and the caution with which international resale has been treated.

Since the CCITT's action, a number of countries -- Canada, the U.S., the U.K., Australia, Sweden and New Zealand -- have agreed to ISR in principle. Competition law may lead to similar initiatives within other members of the European Economic Communities (EEC). Yet implementation of ISR is likely to proceed slowly. At this writing (November 1992) ISR has been finally authorized only between the U.S. and Canada and between the U.K., on the one hand, and Canada, Australia and Sweden, on the other.[19]

In each country reciprocity is the watch word for ISR. Unless a reasonably equivalent freedom to resell IPLs is available at the foreign end of the circuit, ISR will not be approved. Moreover, reciprocity may well be judged on commercial terms; forma' regulatory equivalence may be insufficient.[20]

Beyond that, ISR does not automatically mean more competition. That depends upon the rules for interconnecting international resellers with the switched network. It is a two step process. To be fully competitive, resellers need transmission capacity plus reasonable access to the dominant carriers' higher level switching and database functions -- that is, to the intelligent network. Unless a reseller's service offerings can interwork with the network database of the main carrier, its ability to offer innovative routing, billing and service features may be comparatively limited.

The need for competitive access to these network services is not unique to international resellers. The issue is already being considered by regulators in the context of domestic proceedings concerning Open Network Access (ONA) and Open Network Provision (ONP). ISR merely adds a further dimension to this regulatory equation.

In addition, ISR also forces regulators to consider how a new system of domestic interconnection agreements can coexist with the current settlements regime. International carriers are now paid a negotiated "settlement" rate per minute for landing foreign traffic. As noted above, if ISR is legal, a foreign carrier could opt to land its traffic on its own IPL and negotiate a separate agreement for domestic carriage with the most competitive service provider available.[21] The impact of this type of international carrier bypass has yet to be thought through by regulators.

III. The Emergence Of The Light Carrier

A. Managed Networks

The largest Light Carriers are currently companies which manage the cross-border private line and data processing requirements of major multinational businesses. Leading players -- Electronic Data Systems (EDS), Computer Sciences Corporation (CSC), General Electric Service Company (GEIS) -- account for several billion dollars in annual revenues.

These outsourcing vendors (so named because their clients have contracted-out business to them) usually own limited transmission and switching facilities. The outsourcing vendor is a specialist at bundling and unbundling the tariffed offerings of other carriers; configuring networks; optimizing routing; and integrating widely dispersed intra-corporate networks having different operating standards.

The network which GEIS manages for GE alone covers 1800 locations in over 35 countries. In 1990, it accounted for over 750 million minutes of switched traffic including more than 20 million minutes of international traffic.[22] But, despite their size, most outsourcing vendors see themselves as customers rather than competitors of the international telcos. That could change.

So long as IPLs could not be resold and interconnected freely with the switched network, the line between private and public networks was fairly clear. Outsourcing companies operated on the private side; carriers operated on the public side. When these restrictions end, the clients and traffic bases of the outsourcing companies might be leveraged to launch a broader business. The technical and operational skills of some outsourcing vendors rivals that of many smaller carriers. So too does their international reach.

B. Value Added Carriers

A second group of Light Carriers may evolve from the growing range of companies now providing international value added or enhanced services. The value added carriers overlap, in part, wi: network management companies such as EDS and GEIS. They can be distinguished insofar as services are offered to the general public. Typical value added service offerings include E-mail, enhanced fax, voice mail and on-line computer services.

The 1991 market for international value added services, broadly construed, was approximately $2 billion. BT Tymenet and Sprint Net each had about 25% of the market; Infonet (an MCI, France Telecom, DBP Telekom led-consortium) and AT&T's Istel (U.K.) accounted for approximately 8% each; network managers (IBM, GEIS) accounting for much of the remaining market.[23]

Services offered by these value added carriers are generally bounded by the degree of service competition in the least liberal market (ie, international VAN agreements only include services which have been liberalized in both countries.)[24] As this boundary line changes, so too will the business of these companies.

Most value added carriers will probably continue to service the niche markets they have developed. Others will use the value added business as a stepping stone to the market for basic services and, like AT&T/Istel in Europe, will construct alternative network platforms for the future.[25] In that way, these carriers may straddle both worlds -- by deploying a facilities-based (Heavy) or non-facilities based (Light) strategy depending upon local market conditions.

C. International Resellers

Historical price differences between the wholesale (private line) and retail (public switched) tariffs for international services have long suggested that a profitable business might be built by reselling the wholesale service to individual customers below prevailing retail rates. This potential profit has been responsible for much of the attention ISR has received.[26]

In the long run, however, tariff arbitrage, may not be so important to Light Carriers as the opportunity for network access which ISR offers. With limited exception, as described in Part II, the "bottleneck" transmission facilities of the global network -- the trans-oceanic cables and satellites -- can not be owned by non-carriers. For third parties to be able to buy an unrestricted leasehold interest in these facilities thus represents a major departure from the old order.

Simply put, ISR opens up the possibility for a new kind of hub and spoke network architecture based on international private line bridges between the lowest priced carriers in a region. For North America, the hub is likely to be the U.S. (or Canada, on certain routes); for Europe, the U.K.; for Asia, Japan or Hong Kong or possibly Australia. Each of the hubs of this triangular network would have "spokes" to other markets in the region via "800" numbers, private lines or automated call back devices. See Figure 2.

ISR is also important to the evolution of the Light Carrier model because resale may provide a means for smaller carriers and carriers from developing countries to establish a global presence. A national carrier wishing to send or receive traffic from a foreign country now must buy its own cable or satellite circuits or rely upon other carriers and pay the associated transit charges. If ISR and third-country hubbing arrangements become more widely available, third country carriers may be able to increase greatly their global connectivity while reducing transit charges.

There are over 200 countries and principalities which have telephone service. Full global connectivity thus requires a country to make arrangements for handling traffic on at least 199 different bilateral routes. Yet, even in a satellite age, the dictates of geography can make direct interconnection impossible (eg, because the two countries are not within the same satellite footprint). Indirect routing, via one or more third country carriers, is thus the rule.

Except in Western Europe, transit traffic was once a relative small part of the global traffic flow. But in the last two decades, trade, investment, tourism and emigration have broadened most countries' foreign traffic streams. This has created new demands for global connectivity. In this environment, the growing market for innovative third country transit services could eventually stimulate ISR as much as the retail demand for cheap global telephone calls.

D. "Boomerang Boxes": Automated Call-Back Services

The country-by-country adoption of international direct dialing (IDD) has been singularly important in boosting foreign calling. IDD largely privatizes the call set-up process by shifting control from telephone company operators to users. By enabling users to make "call-me-back" arrangements anonymous, IDD also gave users control over a call's origination point -- a matter of some significance when the price for a given route may vary by 100 or 200% depending on where the call begins.

Enter International Discount Telecommunications (IDT), one of the most publicized telecom "start-up" companies of the 1990s.[27] IDT is the archetypical Light Carrier; it has no transmission facilities in the U.S. or any other country and very little other hardware. IDT's business is based on the fact that, on many routes, U.S. international outbound calls cost the user substantially less than calls in the other direction.

For a monthly line fee, IDT sells foreign subscribers a U.S. telephone number associated with a dedicated port on an IDT call conferencing switch, which works like a boomerang. The subscriber calls the U.S. number and hangs up after the phone rings. IDT's switch is programmed to dial-back from the U.S. to the subscriber's overseas telephone and, when the phone is answered, conference in a separate U.S. telephone line. The foreign caller then has a U.S. dial tone and can use the line to complete a call in the U.S. or any other country at U.S. rates.

IDT's model is not unique. Several other companies (Viatel; Credit Card Calling Systems; Gateway USA; Metromedia) reportedly provide similar "boomerang box" services. Moreover, in theory, the IDT model can be used to provide a public line bridge between any two markets having significant differences in their foreign call tariffs.

The public line telecom bridges between countries offered by IDT complement the private line bridges now used by other Light Carriers. In terms of the larger paradigm, these two kinds of bridges are the spokes of the Light Carrier network; they route subscriber's traffic to and from the carrier's low-cost regional hubs. The regional hubs, in turn, are linked via resold private lines. Again, see Figure 2.

IV. The Heavy Carrier Response: From Virtual Networks To Credit Cards

One should not assume that Light Carriers will win the race to exploit the new international facilities and pricing model described above. The established carriers are also trying to adapt the model to their own needs. The last part of this essay profiles some of their initiatives.

A. Virtual Private Networks

International Virtual Private Networks (VPNs) are one of the Heavy Carriers' primary responses to the new economic and technological realities of the 1990s.[28]

A VPN is a network within a network; it is "logically" separate rather than physically so. The VPN relies upon the software built into the digital switches and billing facilities of the public network to give customers the unlimited point-to-point service and calling options ordinarily associated with private links.

Users access the VPN via a domestic private line to the switch of a participating local carrier. The user can then adopt a seven digit global dialing plan to obtain two-way connections between its home office and various overseas sites, suppliers and customers. The rates for VPN are higher than private line services but are significantly less than public tariffs.

In the United States and, to a lesser extent in the U.K., VPNs have attracted a growing number of corporate users. AT&T and other major carriers have sought to build on this demand by extending their VPN offerings overseas and, in so doing, to migrate the traffic of some of their largest international private line customers back to the public switched network.

Why can global VPN carriers afford to undercut their international tariffs for such large traffic streams which although "virtually" private are also "virtually" public? The answer is that international VPNs are public services in terms of the international settlement process. AT&T and its global VPN partners have simply agreed to settle accounts for VPN designated traffic at a discounted accounting rate, allowing some of the savings to be passed on to customers.

VPNs are also a compromise in one other important respect. The service preserves the sovereignty of each carrier's network; traffic is handed over at a midpoint because each carrier merely furnishes the other a virtual private link; no physical facilities are actually leased to the foreign carrier or to the end-user.

The VPN is thus an acceptable and, in many ways, an ingenious vehicle for bridging the two service paradigms. VPNs do not require new international facilities; they make available network intelligence to the user; move carriers down the road toward global pricing; place additional downward pressure on switched accounting rates and offer a valuable service. Their attractions should not be underestimated.

B. Calling Card Programs

Alternative billing and call set-up services provide another popular way for major carriers to extend their networks to foreign countries without actually doing so.

International calls have traditionally been billed to the terminal where the call originates and, for obvious reasons, national carriers normally do not extend credit to transient foreign customers. Hence, with the first telephone call home, many foreigners learn that the "global village" is in reality a crazy-quilt of national telephone companies which operate on the pay-as-you go principle in the local currency and under local tariffs.

In 1989, the CCITT adopted a set of new Recommendations (E. 118) to widen the use of telephone credit cards which could change these quaint national practices forever.[29] Some of the options which these new Recommendations will foster include the following:

1. Reciprocal recognition of carrier calling cards.

Telephone company credit cards today are company-specific. They can be used only to charge calls over the issuing company's network or for home-country direct services. The new E. 118 Recommendations look to reciprocal recognition of national calling cards. Full implementation of this Recommendation, which requires countries to issue new cards and user identification numbers, is not expected until at least 1994. But several carriers have already started service trials so that card holders can bill both domestic and international calls in foreign countries to their local calling cards. (eg, a France Telecom calling card will be accepted by AT&T in California).

2. Credit card payment plans.

The new CCITT Recommendation also contemplate the widespread use of bank credit cards for international telephone service, subject to agreement with local carriers. In 1990, Visa and Mastercard both began to explore these options. The largest Visaphone and Masterphone programs rely upon agreements with U.S. carriers (MCI, Sprint). U.S. and foreign customers of these companies can use their Visa/Master cards to make domestic and international calls -- including home-country direct and third-country calls -- from almost any "foreign" state (eg, an MCI customer can use a Visa card to call from

Greece to the U.S. or from Greece to England). BT will launch a similar program for the four million U.K. Visacard holders in 1993.[30]

These credit card programs compete with carrier calling cards. For the consumer, however, the result is much the same -- competition. If your home country's international rates for a given route seem too high, your credit card could give you the option of "originating" a call on the network of any lower priced foreign carrier which will honor it.

3. Third country calling programs.

To complement their calling card and credit card programs, U.S. carriers also have begun to pioneer third-country calling programs. AT&T and MCI have been the most aggressive. These programs take the carriers' popular home-country direct programs one step further by enabling a customer to use her calling card in Country A to call Country B by first calling the U.S. and having the U.S. carrier complete the call to Country B. AT&T's advertisements put it this way: "Germany to Hong Kong. Bolivia to Egypt. India to Israel. These kinds of phone calls haven't always been easy to make. ... Now with an AT&T card, they can be. AT&T World Connect Service It's Got The Whole World Talking".[31]

Other carriers and regulators are talking too. One reason is that the U.S. based third-country calling programs have the potential for undermining traditional call routing and settlement patterns. As noted earlier, the 1989 International Telecommunications Regulations arguably bar carriers from unilaterally changing call routing agreements by, for example, hubbing traffic through a nearby third country to reduce the cost of outbound settlements. Some carriers take the view that third country call plans which route bilateral traffic (Italy - Argentina) via the U.S. (substituting a U.S. - Argentina settlement rate for the Italy - Argentina rate), have the same impact and hence should be barred absent the consent of all the countries involved, which U.S. carriers say they have secured.

Such complaints notwithstanding, the billing mechanisms for these and other calling card services have been carefully integrated into the established accounting rate system. Third country direct and credit card calls originated overseas are treated as outgoing calls from the card holder's home country for settlement purposes. A home-country direct call from Italy to the U.S. thus leads to settlements being paid by a U.S. carrier to Italcable for "landing" the call.

The widespread acceptance of calling cards and bank cards for international telephone service could be dramatic. As these cards proliferate, the tens of millions of telephone users who live in a "high price" foreign call zones will, via country-direct or equivalent international "800" numbers, have direct access to the dial tones of the carriers in "low priced" zones to complete their international calls.

The global base of Visa cards in 1991 exceeded 280 million, more than double the estimated base of telephone calling cards. By "monetizing" this card base for telephone service, Visa and its participating telcos arguably have the financial power to substitute their international facilities and price platforms for those of their smaller rivals. Still this strategy has its risks.

The entry barriers are modest. Competition may develop from any low cost carrier which can strike a deal with a reliable financial partner to process the bills of its foreign credit card customers. And, if a national carrier is willing to honor one company's credit cards, regulators will almost certainly require it to accept the credit cards of its competitors.

Cardphone programs also risk transforming credit card issues into potential resale competitors. Visa International has been careful to avoid doing business with resale carriers and to preserve its reputation as a global business owned by local card issuers. But as the Visaphone program grows in size, the incentives to take a more direct stake in the telecom business itself could prove irresistible for some of the company's affiliates.

C. Outsourcing Ventures

As the prospect of ISR draws closer and the network management business continues to enjoy steady growth, several major carriers have begun to look more closely at getting into these businesses too. Doing so might mean competing against customers or long-time correspondents. Yet it might forestall additional competition as well as providing a new Light Carrier option for the future.

Syncordia is perhaps the best known "Light Carrier" hedge to date. Based in Atlanta and majority owned by BT, Syncordia was founded in 1991 to provide global telecom services to major multinationals. The company has candidly described itself as a "reseller." It's goal: To provide "end-to-end virtual networks for intra-corporate communications...integrating both voice and data," between the world's major business centers.[32]

At this writing, Syncordia is still in a start-up stage. It has not been authorized to engage in ISR in any major market. Nor has it been able to bring in the French, German and Japanese partners it initially contemplated.

Less visible than Syncordia is the ad hoc effort of Cable & Wireless to tie together affiliates in the U.S. (CWCI), H.K. (HK Telecom International), the U.K. (Mercury), Japan (IDC), the Philippines (Eastern Telecom) and Australia (Optus). The C&W companies already offer a Global VPN service in competition with BT, AT&T and KDD. But although the C&W group has a physical network capable of providing end-to-end service among the Far East, North America and Europe, the individual C&W companies appear to have interconnected their national networks at arms-length. That is, C&W group traffic is picked up and delivered under the same settlement terms as are offered to non-affiliated carriers. National regulators have required no less.

The big question is whether ISR will change that. If Mercury and other C&W affiliates must resell their own facilities, will C&W also develop a pan-national resale product, outside the current VPN category to compete with the likes of Syncordia?

D. Wireless Services

The potential for trans-national wireless carriers, satellite linked or otherwise, deserves separate attention. As yet, cross-border cellular radio services are still in their infancy. However, thanks to the pioneering efforts of Bell South, Cable & Wireless and Inmarsat, among others, within a very short time, innovative financial and legal arrangements for international wireless telephony may show the way forward for terrestrial networks.

Bell South, for example, recently launched end-to-end international roaming for South American cellular customers in other American markets. Cellular roaming is also possible now between Hong Kong and neighboring Guangdong province in China. The 1993 European Commission Green Paper on mobile communications is also expected to break new ground on the provision of cross-border mobile services within the Community. Although many cellular carriers are owned by of affiliated with Heavy Carriers, most operators realize that because cellular services have not grown up in the accounting rate, half-circuit world of terrestrial carriers, new financial arrangements for end-to-end service might be created.

The deregulation of end-to-end international service is also being brought forward by Inmarsat's ambitious plan, known as Project 21, to offer a range of affordable personal mobile communications services, including a hand-held satellite phone service, in the late 1990s. Inmarsat, collectively owned by over 60 private and public telecoms operators, has long provided international telecoms services via dedicated satellites to the world's shipping fleets. In recent years, Inmarsat has also offered telecoms service to the international airline community -- an initiative which has already transformed numerous trans-oceanic jumbo jets into stateless telecoms carriers for those on board.

Inmarsat's aeronautical program has been complemented by the introduction of progressively smaller and more versatile mobile satellite terminals. In 1991, Inmarsat introduced the Inmarsat-C, a data messaging service which uses a briefcase size terminal to transmit telex and E-mail information via satellite. The Inmarsat-M terminal, the worlds' first portable mobile satellite phone, began service in 1992. And, in 1995 or 1996, if Inmarsat's owners can agree on the new generation of satellites required, Inmarsat will roll out the Inmarsat-P terminal, a hand-held satellite mobile phone with global coverage which will also double as a cellular radio phone where cellular coverage is available.[33]

As with Intelsat, the current range of Inmarsat mobile services are all provided via Heavy Carriers and traditional accounting rate charges or their equivalent apply. Moreover, ship to shore and air to ground international satellite services are typically more expensive than alternative shore to shore links. But as these costs fall and the public becomes aware that mobile phones with global reach have now arrived the old pricing arrangements are likely to break down.[34]

V. Conclusions

This essay has argued that the international telecom service business is shifting paradigms. The old paradigm -- nationalistic, monopolistic, hardware intensive, tied to half-circuits -- supported the rise of the Heavy Carrier. The new paradigm -- multi-national, competitive, software driven, offering end-to-end service -- is being pioneered by the Light Carrier.[35]

This paradigm shift has been anticipated by other observers. In 1986, for example, Peter Huber noted that as switching costs fell relative to transmission costs, competition among private and public switches would increase and the pyramid-like architecture of the telecommunication network would become more geodesic.[36] In a similar vein, Eli Noam later suggested that the evolving domestic network might be best described as a "network of networks," public and private.[37] The changing structure of the international network reflects these trends.

The thesis of this essay is not that Light Carriers will soon displace Heavy Carriers or that facilities ownership is no longer important. To the contrary. A facilities-based competitor will almost always be better positioned to mount a more lasting competitive challenge where transmission expenses constitute a significant portion of the end-to-end service cost.

By comparison, the profitability of a Light Carriers will depend upon the size of the resale margin provided for in the price of leased facilities and may be at risk whenever the underlying Heavy Carrier reduces these margins. For that reason alone, a Light Carrier strategy based solely upon arbitrage opportunities and which does not offer customers additional value, in terms of access, billing, service options or otherwise, may not be sustainable over the long run.

The evolution of the international service industry is thus likely to be marked by a combination of Light Carrier and Heavy Carrier strategies. (See Figure 3.) Light Carriers will seek to gain better control over their long run costs by contracting forward for bulk transmission capacity and by entering into joint ventures with facilities-based carriers. They will also seek to pare down their use of more costly transmission facilities by using creative hubbing, routing and billing arrangements (ie, by investing in switching rather than transmission capacity at the margin).

Conversely, Heavy Carriers will attempt to meet the Light Carrier challenge in the 1990s by leasing instead of owning capacity and by offering their own brand of global service. Beyond that, a Heavy Carrier buy-out of the more successful Light Carriers can not be ruled out.

Figure 3

"HEAVY CARRIERS" (facilities based)	"LIGHT CARRIERS" (resellers; value added carriers; software-based networks)	"HYBRID CARRIERS" (affiliated or owned by facilities-based carriers)
AT&T [largest international carrier; facilities limited primarily to U.S.]	**Electronic Data Systems (EDS)** [private line/data processing network manager]	**Syncordia** [BT owned outsourcing vendor; private line reseller]
BT [dominant U.K. carrier; few facilities outside U.K.]	**International Discount Telecommunication (IDT); Viatel** [automated international call-back services]	**Infonet/BT Tymenet** [value-added service providers]
C&W [multinational carrier with facilities in over 30 countries]	**Fonorola Corp.; ACC Corp.** [international private line resellers]	**INMARSAT** [carrier owned satellite consortium offering end-to-end international service for mobile users; local PSTN connection required]
INTELSAT [carrier owned satellite consortium offering half-circuits to national carriers]	**Visa International** [VisaPhone program will make Visa a global calling card and potential service reseller]	**Bell South** [national cellular provider; international roaming between North and South American franchises]

How rapidly and how far Light Carriers will be able to go in establishing themselves and in securing a sustainable operating structure for the future will depend largely upon the regulatory environment which these carriers face in the principal European, American and Asian markets. Regulation (not technology) is crucial. A progressive evolution of the market for international telecom services simply will not occur absent a further commitment to liberalization in these key regions.

The last two years has seen a number of encouraging steps both nationally (eg, regarding resale) and internationally (eg, regarding the flexible use of satellite systems). But much remains to be done if the market is to have access to the best which both the Light Carrier and Heavy Carrier paradigm can provide.

The paradigm shift described in this essay also poses a fundamental question for carriers about their future strategy and organization. This is especially true for smaller carriers which are just beginning to play an international role, whether in Central Europe or South East Asia. Is a carrier's strategy for international service based on the regulatory and technological platform of the 1960s or the 1990s? Is the model AT&T or EDS? BT or Syncordia? France Telecom or Sovintel? IBM or Novell and Dell Computers?

We probably don't know yet what the most successful type of Light Carrier will be. As suggested earlier, some will be new entrepreneurial efforts, following on from network integrators. Some may come from the multi-national ventures of cellular telephone companies. And others may be software driven start-up ventures. In fact, the chances are that the "Apple Computer" company of the Light Carrier industry has not yet been incorporated. What is clear though is that the old paradigm is no longer the only model available and in twenty years time may not even be the dominant one.

(1). For a country-by-country review of the market for international switched telephone traffic, see G. Staple (Ed.), TeleGeography 1992 (International Institute of Communications, London, 1992).

(2). Over the last 18 months, British Telecom, DBP Telekom (Germany) and France Telecom have all reduced their in international call charges 10-25%, with the greatest reductions occurring on inter-continental routes.

(3). See e.g. the new D. 140 Recommendations on Accounting Rate Principles For International Telephone Services, proposed in June 1992 by Study Group III of the International Telegraph and Telephone Consultative Committee (CCITT) and adopted in October 1992 by member administrations of the International Telecommunications Union (ITU). They provide inter alia that "administration should seek to achieve cost-oriented accounting rates in an expeditious manner, recognizing that this may need to be implemented on a scheduled basis [i.e., "over a period normally of one to five years"] where the level of reduction required is significant."

(4). International Telecommunication Regulations (ITU, Geneva 1989), Articles 1.1, 3.1, 3.3, 6.2 and Appendix 1, Sections 1.1 and 1.4. See also Convention Of The International Telecommunication Union (ITU, Geneva 1990), Articles 29 and 30.

(5). See "General Tariff Principles Charging And Accounting in International Telecommunications Services" CCITT Blue Book, Vol. II, Fascicle II.1, Recommendation D.150 (ITU, Geneva, 1989).

(6). See International Telecommunication Regulations, op cit, note 4, at Article 9.3.

(7). See eg, Agreement Relating to the International Telecommunication Satellite Organization (Intelsat) 28 U.S.T. 3813, T.I.A.S. No. 7532, Article XIV, and the companion Intelsat Operating Agreement. For further discussion of these restrictions, see Green Paper on a common approach in the field of satellite communications in the European Community (COM(90)490 final, 20.11.90), pp. 31-32; 100-104.

(8). For example, the European Commission (EC) satellite Green Paper, op cit, note 7, proposes to abolish the exclusive rights of carriers within the Community as regards the provision of international satellite uplinks and downlinks and to provide users unrestricted access to international space segment capacity. Interconnection with the public switched telephone network (PSTN), however, may be restricted by member states. In 1984 the U.S. determined that separate (non-Intelsat) international satellite systems were in the public interest and in 1991 committed itself to the complete elimination of the restrictions on the interconnection of such systems with the PSTN by January 1997. In June 1992 the Intelsat Board of Governors took a significant step toward implementing the U.S. agenda by agreeing routinely to approve the use of up to 1250 64 kilobit per second circuits per separate satellite system for services interconnected with the PSTN. See Telecommunications Reports, December 2, 1991, pp. 14-17 and June 22, 1992, p. 30. Australia and the United Kingdom have also liberalized the provision of international satellite earth station and space segment capacity. In Germany, as of May, 1992, the Ministry for Post and Telecommunications, has stated that satellite network operators and service providers may shop for satellite capacity from any member of Eutelsat, Intelsat or Inmarsat, not only DPB Telekom. See Communications Law Newsletter (Denton International, London) Issue 10, September 1992, p. 2.

(9). See generally Organization For Economic Co-Operation And Development (OECD), Working Party On Telecommunication and Information Services Policies (TISP) "International Telecommunication Tariffs: Charging Practices And Procedures," DSTI/ICCP/TISP(91)2, 18 April 1991, and "Pricing Principles And International Telecommunications," DSTI/ICCP/TISP(91)3, 18 April 1991, prepared for the 13-14 May 1991 OECD Meeting of the Ad Hoc Group of Experts on International Telecommunications Charging Practices and Procedures. See also "Analysis of Telephone Accounting Rates," DSTI/ICCP/TISP(92)3, 27 April 1992.

(10). See eg, "U.S. Telephone Accounting Rates with OECD Countries (March, 1992)," FCC, Industry Analysis Division (Washington, D.C. 1992).

(11). See eg, "Peak Rate International Telephone Calls Between OECD Member Countries (December 1991)" (OECD, Paris, 1992).

(12). See "Telephone Services. In the EEC." (Bureau Européen des Unions de Consummateus (BEUC), Brussels, September 1991).

(13). See eg, G. Staple (Ed.), TeleGeography 1992 op cit, note 1, at p. 65.

(14). See eg, L. G. Tesler, "Networked Computing in the 1990s" Scientific American, Vol. 265, No. 3, September 1991, pp.86-93. See also G. Gilder, Microcosm The Quantum Revolution In Economics And Technology, (Simon & Schuster, N.Y. 1989).

(15). An overview of SS7 and "intelligent networks" is provided by the FCC's Notice of Inquiry, In the Matter of Intelligent Networks, CC Docket No. 91-346, FCC 91-383, released December 6, 1991. As discussed therein, the services offered by a network employing SS7 depend largely on the software functions embedded in network Service Control Points (SCPs). Third parties desiring to offer competitive options thus require access to these SCPs or the ability to operate independent call-control software (non-network SCPs) in conjunction with the SCPs of the main carriers. See also The NTIA Infrastructure Report Telecommunications in the Age of Information, NTIA Special Publication 91-26, (U.S. Department of Commerce, Washington D.C. 1991) pp. 109-119 and Competition and Choice: Telecommunications Policy for the 1990s A Consultative Document, (U.K. Department of Trade and Industry, London, 1990), pp. 20-23.

(16). Report and Order, CC Docket No. 87-45, FCC 92-286, released July 22, 1982.

(17). See CCITT Blue Book, op cit, note 5, Recommendation D. 2.

(18). See Revised CCITT Recommendation D. 1, "General Principles for the Lease of International (Continental and Intercontinental) Private Telecommunications Circuits and Networks," Section 3.1.1 and 4.1. (ITU, Geneva, May 1991).

(19). See Memorandum Opinion, Order and Certification (In re Applications of fONOROLA Corporation and EMI Communications Corporation) FCC 92-464, released November 4, 1992; "New Competition Aims To Cut Cost Of Phone Calls To Australia, Canada and Sweden," Press Notice, Department of Trade and Industry, U.K., 25 September 1992.

(20). In the U.S., Federal Communications Commission (FCC) rules require any party seeking authority for ISR to show that "equivalent resale opportunities exist between the U.S. and [the target] country." 57 Federal Register 646, 647 (January 8, 1992). In the U.K., the Department of Trade and Industry (DTI) has stated that there must be "broad comparability... in any licensing or authorization procedures attaching to the provision of such [international resale] services in the overseas country." Competition and Choice: Telecommunications Policy for the 1990s Cm 1460 (HMSO, London, 1991), p. 15.

(21). Bruce Stanford, Vice President, Correspondent Relations, BT North America, put it this way:

"The advent of international resale signals the commencement of potentially significant changes to the existing structure of the traditional relationship between international telephony carriers ... Contracts for incoming and outgoing traffic may underlie the future correspondent relationship ... A wholesale market will emerge where existing PTOs become suppliers to non facilities based resellers. Existing carriers will operate at both end of international circuits, bypassing existing cooperative business arrangements, and offering resale based products in niche markets." B. Bruce Stanford, "International Resale Presentation", TeleStrategies Conference, East Rutherford, New Jersey, April 14, 1992.

(22). S. M. Welland, "Networks Of The Future And Their Application In The General Electric Company To Serve The Vision Of The 1990's", presentation to FCC "Networks Of The Future" meeting, Washington D.C., May 1, 1991.

(23). K. Lynch, "Global Services Showdown," Communications Week International, 11 May 1992, p.22.

(24). For background See e.g., "International Value-Added Network Services - An Introduction," National Telecommunications and Information Administration Publication TM-90-256, (U.S. Department of Commerce, Washington D.C., 1990).

(25). See eg, E. Messmer, "AT&T storms Europe in data net offensive," Network World, March 16, 1992, p.1. For further background on AT&T's European strategy see, P. Fuhrman "An unlikely trustbuster," Forbes, February 18, 1991, pp. 100-104.

(26). See eg, B. Crockett, "The Resale Struggle Begins," Global Networks, Vol. 1 No. 2, Summer 1991, pp.17-22.

(27). See eg, A. Ramirez, "Reversing Rates For Overseas Callers," The New York Times, January 9, 1992, p.D1.; "Rome to Bonn Via New Jersey," BusinessWeek, April 13, 1992, pp.84-85.

(28). For a comprehensive review of global VPN offerings, see "The TeleChoice Report on International Virtual Networks," 3 vols. (TeleChoice, Montclair, New Jersey, 1991).

(29). See "Telephone Network And ISDN - Operation, Numbering, Routing And Mobile Service," CCITT Blue Book Volume II, Fascicle II.2, Recommendation E.118 (ITU, Geneva, 1989).

(30). "Visa plans phone service," Financial Times, May 6, 1992, p.11. Total Visaphone billings in 1991 reportedly exceeded $70 million and are projected to rise to over $300 million in 1994.

(31). "Introducing AT&T World Connect Service..." The New York Times, May 1, 1992, p. D18.

(32). "Comments" of Syncordia Corporation before the FCC, File No. ITC-92-066, January 27, 1992, pp.1-3. For additional background on Syncordia see "Global Services Showdown," op cit, note 23.

(33). See e.g., Olof Lundberg "The Evolution of Global Personal Communications," Official Handbook InFotel Lanka '92 (Colombo, Sri Lanka, 1992).

(34). There are signs that a non accounting rate price for Inmarsat mobile services is already developing. For example, in Singapore, users of the Inmarsat-C portable data terminal only pay the flat satellite charges associated with the service which do not vary by country. Further, users are not charged for the local PSTN interconnection. S. Kumar, "Inmarsat-C users need pay only satellite charges for use of LES," Business Times [Singapore], February 2, 1991, p. 3.

(35). A similar competitive divide exists in the semiconductor industry between "heavy" companies, such as Intel, which own fabrication plants ("fabs") to manufacture the microprocessors which they design and "light" companies, such as Chips & Technologies and Advanced Micro Devices (AMD), which contract manufacturing to independent foundaries. "Whether it was [Jerry] Sanders [CEO of AMD] or T.J. Rodgers [the founder of Cypress computers] who said it first, the phrase 'real men have fabs' has become part of the folklore of Silicon Valley. Real chip companies make things. They don't sit around drawing clever designs and then turn them over to someone else to manufacture." But, continues one well known Silicon Valley analyst, a "persuasive counter argument has been made that real men have fabs, but rich men don't. With the cost of a fabrication facility hitting the half-billion dollar mark, start ups [are] better off concentrating on profitable chip designs ... [And] fabless companies are loved by Wall Street." K. Wieger, "The Empire Strikes Back," Upside, June 1992, Vol. 4, No. 6, p. 39.

(36). The Geodesic Network 1987 Report on Competition in the Telephone Industry ["The Huber Report"] (US Government Printing Office, Washington D.C., 1987).

(37). E. M. Noam, "The Public Telecommunications Network: A Concept In Transition," Journal of Communications, Winter 1987, pp. 40-58.

Study on
The Measurement of Economic Benefits of Telecom. Project
in The Developing Countries
- Proposing New Method -

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1. ABSTRACT

It is said that an efficient utilization of 'Telecommunication' becomes one of key success factors to achieve rapid economic developments. However, no clear method to clarify 'why it is so' has been proposed yet. This paper propose one of new measurement method by paying our attentions for user's daily activities more carefully, and then, we can find the following major effect of telecommunications development, i)Cost Saving Effect, and ii)Network Expansion Effect.

2. Introduction

This paper is prepared based on the fields survey in Nepal, conducted by the ECONOMIC BENEFITS STUDY TEAM organized by the Ministry of Posts and Telecommunications in Japan in 1991. The survey city/town were selected Katmandu, Pokhara, Nepalgunji, Tulshipur where telephone service was supplied without any constraint, and Syangja, Bandipur, Damauli, Kusuma, Baglung where telephone service was very recently supplied only to the Government office, and PCO (Public Call Office) in 1988.

The primary objectives which we selected the different type of cities, where the simplified type of telecommunication service was newly equipped, were to compare its differences of its impacts on social/business activities by the introduction of telephone service, very easily.

Since the Telecom project is a profit-oriented venture, the basic objectives of financial appraisal is to provide decision makers with the information needed by them to judge the financial viability of a specific project they may wish to proceed. Thus, the purpose of the financial analysis is to determine whether the proposed investment would generate a stream of future income sufficient to meet the minimum financial return requirements of the investor (service provider) in a time frame acceptable to him. The financial viability of the project does not given an accurate indication of a project's net impact on a country's economy. The economic rate of return measure determines the economic merit of the project from country's viewpoint. An acceptable project should increase national income. Income by itself does not create welfare but leads to the consumption of goods and services which can serve as a proxy for increased welfare.

However, in the past, the telecom economist could not provide an proper investment criteria to the decision maker to guarantee fruitful investment results.

In general, there are three different opinions to decide the size of the telecom. investment according to the role/functions of telecom in the society. First opinion is that Telecom. investment size should be reduced as much as possible since its benefits will be arisen to only the certain class in the society like an privileged classes, and its investment tends to concentrate on large cites. On the other hand, there are few measurable benefits. Thus, negative benefits will become large enough to support less investment priority given to Telecom sector. Second opinion is that Telecom sector should be developed in line with the market needs. Third opinion is that Telecom investment should be more accelerated than other sectors, since the benefits of modern technology will bring large enough to effect on the various human activities effectively.

To find an answer of the above discussions, we should provide an proper study framework of benefits measurement, and accumulated data to describe the role of Telecom in social infrastructure, business, and people's daily life quantitatively.

The cost and benefits to be incurred by the project implementation shall be classified as follows:

	Cost	Benefits
User	Subscription Fees Monthly Rental Fees Call Charges	Economic Benefits
Service Provider	Investment Costs Maintenance Costs Operation Costs Taxes	Financial Revenue Subsidy from the Government
Society & Government	Subsidy Investment Cost	Taxes from the and Users Increases in GDP

The economic benefits can be measured by paying our attentions for the aspects of either the users benefits , the society's income such GDP, or the Government taxes increment due to the company's profit increases with Telecommunication development.

Consumer surplus analysis is a convenient method to measure user's benefits by analyzing the user's willingness to pay for the telecommunication services. If we assume that the rational individual, household, office workers, and official workers shall behave to lower the amount of payment for the services than the benefits receiving from the services, the differences from the received benefits and the payment for the charges is called 'Consumer Surplus'.

According to the book titled "Telecommunications and Economic Development" published by World Bank, there are three measurement method for Consumer surplus, that is, i)Price Change Method, ii)Best Alternative Method, iii)Expenditure Method. The price change method is to analyze the change of the consumption (traffic volume) on the price (tariff) change. If the demand is sufficiently fulfilled by the supply every year, we can find the real meeting point on the demand curve. However, we can also measure the partial volume of consumer surplus on the supply curve. The best alternative method is to analyze the cost comparisons among the available media. The expenditure method is to analyze the actual expenditures incurred in the process of communication activities.

However, this approach still does not explain us how to aggregate total benefits for telecommunication developments, and does explain only one aspect at one moment since this is not discussed communication structure/behavior, and its real cause results relationship with economic activity.

3. Proposed Method of Measurement

Telecommunication is one of the communication media which can make available to communicate at direct dial line (at distant areas at once). Telephone is one of the telecommunication media and widely accepted as a both-ways personal communication media.

Information has been widely recognized as a fourth element of production following after capital, labor, and land. Its efficient utilization becomes one of key success factors to hold a dominant position in competition. Media are means of exchanging information. Its value should depend on the value of information, and usage cost. The advancement of the media itself increase the value of information through the sales or income increase. The sophisticated media can functions to deepen information contents, and expand number of nodes to networking society more closely. Impact on the telecommunication can be classified largely into the network (expansion) effect, and the efficiency improvement on the communication behavior through the transition of the media use (the cost saving effect).

<u>Network Effect</u> is that expanding communication nodes can be attained by Telecom projects, which means the increment of the accessibility to social services, business services, and etc, which we have not been able to communicate in the past. This effect include the 'Value Acceleration Effect' or 'Value Linkage Effect'. These effect can be measured with 'Time Value' only if we can clarify information flow from daily activities.

<u>Cost Saving Effect</u> is that more efficient utilization of media for the present communication matrix will be achieved through the media choice mechanism. This will results in the saving of communication expenses realized by the internalization of trading cost. We should measure this effect by the amount of cost savings if sales amount is the same as that 'Without the project' and by the increment of profits if communication expenses is the same as that 'Without the project'.

In short, the cause-effect relationship between economic activity and communication activity are summarized as follows;

```
Activity Level      Effects   Measurement Model
__________________  _______   _________________
Economic Activity
   ↓       ↑
Information Activity
   |       ↑          Network─┬ Generation Model
   |       ←────      Effects └ Communication
   ↓       |                    Traffic Model
Communication Activity
   |       ↑←────     Cost ─── Media Choice Model
   ↓       |          Saving
Telecommunication     Effect
```

Information activity will be increased larger than economic activity since, in general, the economy will shift toward "information society" as the development is proceeded. An Increases of information activity will expand communication activity in its frequency, contents, and nodes. In its process, an efficient communication media such as telecommunication will be deployed more due to technology development. On the other hand, the advancement of telecommunication technology will bring backward to more efficient communication activity through the coordination of media deployment (media choice). As the results of it, economic activity will be increased.

In the past 20 years, Japan experienced that the volume of foreign movement flow increased 14 times larger in human trip, 18 times in goods, 44 times in information through telecommunication media. In particular, both human trip and information flow seems to be increased larger in movement frequencies than distance. The increment rate of telecommunication expenses in total household expenses increased 4% in 1987 from 1% in 1970, though others including travel expense was 1 to 2%. Role of telecommunications was changed a lot for both business and residential users.

Telecom projects promote the development of the media in volume and functions, which will change information activities. These changes can be assessed by the changed volume of the sales, or profits increase, as direct economic benefits, caused with Telecom projects through the production activities changes such as goods production and money flow.

The following shows the conceptual flow to measure benefits.

Daily Activities
↓
Clarifying Information Activity
↓ Nodes ↓ Communication Volume
↓ Present Communication Matrix ← Telecom Project

Changes in Information Activities
(Efficiency in Behavior, saving time, elimination of distance)
↓ Changes in Information Contents ↓ Changes in Nodes ↓ Changes in Information Volume
↓ Changes in Communication Matrix
↓ Changes in Daily Activities ↓ Changes in Production
↓ Reduction in Intermediate Goods & Service ↓ New Products ↓ New Markets
↓ Increase in Sales
↓ Increase in Profit

We begin to define the beneficiary area/people and collect data worthwhile to be assessed for forecasting the future economic benefits. Then, we should build a model showing the following figure, which are composed of Communication Generation Model, Communication Distribution Model, and Media Choice Model (Modal Split Model).

Defining Beneficiary Area/Person
↓
Zoning Area → Media Facility Survey
↓ Area-wise Data Sample Data Media Provider
Finding Patterns of Communication in Volume & Contents | Finding Media Choice Mechanism | Finding Distribution Patterns
Defining Unit Value of Communication | Present Communication Matrix
Generation Model | Media Choice Model | Distribution Model
→ Future Unit Value of Communication | Future Communication Matrix
↓
Expected Benefits

At first, the many sample data concerning each individual and office shall be collected by inquiries or questionnaire survey to prepare the present communication patterns by different categories, which shows the generation and distribution patterns of communication. Then, we will build the three various kinds of information activities. Next, we will build the three models by combining the area data with the traffic data to forecast the benefits.

4. Model Building Results

(1) Traffic Generation Model

As a results of the survey, the following Telephone Traffic Generation Model was formulated.

$$\log(T/Pop) = 28.035 + \underset{(2.69)}{1.284*\log(RGDP/Pop)} - \underset{(-4.34)}{14.896*\log(P)} - \underset{(5.79)}{2.54*(Sup.Dummy)}$$

$$R^2 = 0.93, \text{ (T-value)}$$

here,

T/Pop :No. of Outgoing Traffic at PCO in 1991 per 100 District Working Population

RGDP/Pop:Estimated District GDP per Working Population

P :Average Call Charge per minute for All Available Call Destinations

Sup.Dummy:1 for the city/town where the supply of telephone is restricted. 0 for no-restriction.

This model shows that when district GDP per working population increase by 1%, annual telephone traffic per 100 working population increase by 1.284%. Thus, the city/town has higher GDP, higher traffic will be generated. Since call charge has a negative correlation with the traffic, 1% reduction of average call charge can bring to 14.896% increase of traffic volume. It is noticeable that the variable P is the average call charge for all available destinations, though the price (call Charge) effect seems to be great. The negative value of the supply dummy means a lower traffic frequency where the supply of telephone is restricted.

(2) Traffic Distribution Model

As the same method applied in the above, the following traffic distribution model is obtained.

$$\log(Tij) = -24.845 - \underset{(11.7)}{2.979*\log(P)} + \underset{(6.7)}{2.183*\log(Popj)} + \underset{(2.8)}{1.028*\log(RGDPi)} - \underset{(4.1)}{1.797*(Sup.Dummy)} - \underset{(1.4)}{0.643*(Bandipur)} - \underset{(2.2)}{1.004*(Damauli)}$$

$$R^2 = 0.72$$

here,

T :No. of Outgoing Call from the i-area to the j-area at PCO in 1991

P .Call charges per minute from the i-area to the j-area.

Popj:Working population in the j-area(zone).

RGDPi:The i-district's GDP

Sup.Dummy:1 for with supply constraint, 0 for without supply constraint

Bandipur, Damauli is 1 for area dummy, 0 for not.

This model shows that traffic frequency increase

2.18% and 1.03% when zone population of call destination increases 1%, and district's GDP increases 1%, respectively. Since call charge has a negative correlation, 1% increases of call charge will decrease 2.98% of traffic frequency. The negative value of supply dummy means a lower traffic frequency in the case with supply constraint.

(3) Traffic Generation Model from Questionnaire Data

Traffic generation models are formulated from questionnaire data for Baglung and Kusuma towns in the following.

For Baglung

$$\log(T)=1.26-0.58*\log(P)+0.16*\log(S)+0.26*\log(Y)$$
$$(8.2) \qquad (2.9) \qquad (3.9)$$
$$-\ 0.075*\log(D) + 0.29*\text{Dummy}$$
$$(-1.5) \qquad (2.0)$$
$$R^2 = 0.72$$

For Kusma

$$\log(T)=4.69-0.75*\log(P)+0.018*\log(S)*\log(Y)$$
$$(9.0) \qquad (3.8)$$
$$-0.48*\log(D)$$
$$(3.9)$$
$$R^2 = 0.86$$

here,
T:No. of traffic per month
P:The ratio of call charges expenses and number of traffic per month
S:User's sales amount per month
Y:User's monthly income
D:Distance in km from user's place to PCO office
D:1 for those who engage in trade business, 0 for others

These models show that traffic increases by 0.16%, and 0.26% when sales amount, and income increase 1%, respectively in Baglung, while traffic increase 0.018% when either sales or income increases 1% in Kusma. Thus, those who have higher sales amount or income, tends to generate higher telephone call frequency. This justify the assumptions of that traffic call frequency for business, and private purpose have positive correlations with sales amount and income, respectively. Since call charge has a negative correlation with the traffic, 1% reduction of call charge can bring to 0.58% for Baglung and 0.75% for Kusma increase of traffic frequency. In addition, the variable D has a negative correlation with traffic frequency for both towns. Thus, 1% reduction of this figure will bring to 0.075% increase for Baglung and 0.48% for Kusma. The positive value of the trade business dummy means a higher traffic frequency for trade business people than others in Baglung. It is noticeable that a negative value of the distance variable for both formulas means the evidence of " the supply constraint" analyzed in the previous sections. That is, a distance is a kind of cost incurred to user's in the negative form for traffic frequency, and the thing happened by the supply constraint result a traveling forced to user for telephone call. Consumer's surplus are calculated as under. The figures are averaged for the relevant sample users.

Both analysis shows the same results that the value of Baglung obtained higher than that of Kusma. Both trade and agricultural people stay far away from PCO on average, and thus, spend more total expenses in Baglung. Thus, since Kusma is located between the second largest city, Pokhala and isolated hilly town, Baglung, and major transit point of goods and mountain traveler (trekker), distance is not greater, and surplus amount is less than that of Baglung, which correspond to the value of coefficient, -0.58 and -0.75 in P and -0.075 and -0.48 in D obtained from both formulas. Since both coefficient in Kusma is greater than that in Baglung, users in Kusma is more elastic to prices (costs). This means that Kusma is more advanced town and has other alternative communication media than Baglung.

(4) Traffic Distribution Model from Questionnaire Data

Traffic distribution models for Baglung and Kusma are formulated from questionnaire data in the followings. Questionnaire data were classified into six categories such as international call, capital call, zone center (province capital) call, district capital call, other village call, and local call. Thus, the share (%) model of traffic frequency is formulated in the following logit type model.

$$\log(P/(1-P)) = a + bS$$

here,
P:Probability (Share) of traffic frequency for each destination
S:Sales amount

This model shows that the size of sales amount explains the share of traffic frequency.

In Baglung, traffic frequency shares for all destination will increase as sales amount increases, though their coefficient vary and is greatest in the share for regional center (i.e.,Pokala) destination, and least in the share for capital destination (i.e.,Katmandu). This result is correspond to the interview survey. In kusma, the formulated results shows that correlation coefficient is low except that for international destination. Two shares for regional center and district capital have negative correlations. Theses results correspond to such Kusma's characteristics as trekkers' transit point, and many mercenary in foreign countries to go to work.

(5) Media Choice (Modal Split) Model from Questionnaire Data

Modal split models in transport traffic estimation will be classified into for forecasting, i)applying the present modal shares obtained from a field survey, ii)estimating a modal split formula with such generalized cost variables as tariff charges, or travel time differences.

Media choice models for Baglung and Kusma are as under. These model also formulated in a logit type. Media are classified into 'travel by himself', 'postal service', and 'others such sending messenger from this questionnaire data. Data were obtained by giving questions to user "When telephone service had not been available, what present percentage of telephone calls would have been replaced: travel to call destination, use the postal service instead, use other alternative means (e.g.,messengers), not make contact at all".

$$\log(P/(1-P)) = a + bX1 + cX2 + dX3 + eX4 + Dummy$$

here,

P:Probability (share) of media use in frequency without telephone service.
X1:Share of call destination to capital, greater communication needs to capital
X2:Share of call destination to district capital, greater communication needs to district capital
X3:Share of 'negotiation' call content, greater complicated communication needs
X4:User's cost differences obtained by dividing call charge expenses with media use expenses per time
Dummy:Profession/sector, trade people dummy or agricultural people dummy

Baglung

	a	b	c	d	e	Dummy Trade	Dummy Agriculture	R^2
Travel	-2.51	-3.91	-	2.96	13.88	-		0.50
		(2.9)		(2.2)	(3.0)			
Post	-0.56	-0.74	-2.6	1.59	0.02	-	-0.36	0.48
		(3.0)	(1.6)	(1.1)	(1.0)		(-1.0)	
Other	-0.43	-4.4	4.4	-0.9	3.1	0.16		0.79
		(4.2)	(6.4)	(4.0)	(1.3)	(1.0)		

Kusma

	a	X1	X2	X3	X4	Dummy Trade	Dummy Agriculture	R^2
Travel	-1.5	-	-	-	0.30	-	1.95	0.42
					(0.8)		(2.4)	
Post	-0.12	-0.11	0.44	-	-	-	2.78	0.84
		(4.9)	(6.4)				(3.1)	
Other	-54.7	-1.2	3.56	-	13.9	52.5	34.61	0.99
		(2.3)	(1.8)		(2.8)	(2.0)	(1.5)	

In Baglung, those who select higher share in 'travel by himself' means of communication instead of telephone service, tends to have a less communication need for the capital destination, and requires more complicated call contents such as 'negotiation'. The positive value of cost differences shows a lower share when travel cost is increased. Those who select higher share in 'postal service' means, tends to have a higher communication needs to countryside since both the variables of capital and district capital's value show negative sign, and a higher complicated call content. Those who select higher share in 'other means', tends to have more communication needs for district capital, and a less complicated call contents.

In Kusma, the share in 'travel by himself' has only the cost difference variable, while the share in 'postal service' has no relation with the cost difference variable, and a positive relation with call destination to district capital. Those who select higher share in 'other means', tends to have more communication needs for district capital.

The above evidences proved from the models are summarized as under.

Alternative Possibility of Telephone Call in Baglung

Item	Travel	Post	Other
Destination	Near City	Country	Near City
Contents	Complicated	Complicated	Simple
Profession		Lower in Agriculture	Higher in Trade
Cost Difference	Large	Less	Medium

5. Notes for Application of Proposed Method

(1) Difference Between Generation Model and Distribution Model

The estimated results should be applied according to the following way. If the nodes are classified such A, B, C, D as follows, the generation model is to estimate the total node's values such nodes A's total;100%, and the distribution model is to estimate each share among each nodes's total value, like share value between A and B;3%, between A and C;5%.

Nodes	A	B	C	D	E	Total(%)
A	2	3	5	6	7	100
B						
C						
D						
.						
.						
Total						G. Total

(2) Differences of Models built-up from Statistical Data and Questionnaire Data

Since, in general, statistical data provided from common careers are aggregated as a regional data, questionnaire survey should be conducted to collect individual traffic data. Regional data do not tell us exact communication behavior at micro viewpoint. Once we understand it, a cross check of both traffic data are needed for Model Building.

(3) Media Choice Model

The reasons why Katmandu businessmen choose each media for communication were summarized from questionnaire data as follows;

For Telephone

Media	Easy	Hurry	Convenient	Quick Responses	Total
Telephone	2	2	25	3	32
Telephone Total	3	3	27	3	36

For Trip

Media	Courtesy	Complicated	Total
Trip	2	3	5

For Mail or Messenger

Media	Material	Need to Send	Cheap	Not Hurry	Total
Total	3	2	13	3	21

Among total 62 samples businessmen, 32 was deployed subscribed telephone, 20 mail, and 5 trip. Main reasons for telephone is "convenient, "complicated" for trip, and "cheap" for mail. Thus, if "convenience" reasons can be measured by time like access time/distance to media, both media can be compared with cost differences since time can be converted to the monetary term like hourly wages. Thus, we should find factors/reasons to choose media for sample people by questionnaire survey as much as possible.

Media choice model assumed that there exist plural media, and several factors to deploy an certain media. Communication media have not only substitutional relation but supplementary relation. That is, to exchange information, there are many cases when several media needs to deploy at one communication, and there are some media which utilize as a supplementary functions to make communication more effective.

Though many supplementary combinations among media are considered, we, this time, assume the following three cases; i)telephone call and human trip movement, for example, asking by telephone an convenient time/place to visit, ii)telephone call and goods movement, for example, instructing by telephone call for the shipment of goods, and iii) independent telephone call, in other words, no generation human trip/good movement coincidentally. The questionnaire data are summarized as follows;

Media	Human Trip	Goods Movement	Human &Goods	Nothing	Total
Telephone	17	2	4	9	31
Telephone	1				1
Total	27	6	17	10	60

Subscribed telephone call, sharing 45% (27 to 60) of total samples, generate human trip movement 55% (17 to 31), and supplementary relation's call shares as large as 71%. On the other hand, independent telephone call , that is, substitutional relation's call shares only 29%. Thus, telephone is to be deployed mainly to make human/goods movement more effective. Since substitution and supplementary relation are coexisted, it is difficult to find an actual degree how far telephone call contribute to make communication efficient.

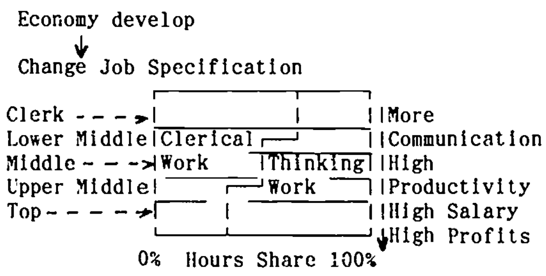
6. Further Development of the Proposed Method

For understanding the relation between economic activity and communication activity, we should further research i) the relation between business working hours and its production, ii) the relation between business working hours and communication, since communication and economic activity is not directly correlated with each other. This relation can be defined only through working hours.

Human activity is limited to 24 hours a day, and spend its time more for business to produce nation's wealth. If we classify working hours into in detail, Japan experienced that telephone call hours increases, instead of the reduction of trip out office hour for communication, which indicates the substitutional effect of telephone call among communication media (cost saving effect). And we may imagine that the reduced time for communication should be utilized more for productive activity.

As economy develop toward "information society", the share of tertiary sector increase in GDP as well as working populatior. , and at the same time, office workers will shift their working hours from "direct work" hours to "thinking (brain) work" hours, or communication hours.

Therefore, if we succeed to find proper cause-effect relationship between an change of working hours and communication level such as an change of nodes, contents, and frequencies, we can apply its results to national/regional level from corporate level very easily since it is easy task to clarify the relationship between office working hours and corporate profit level, and then, the relationship between corporate activity results and its industrial GDP by referring the past experiences of developed countries.



Important thing is how to define average figures of communication level for each categorized workers by classifying into section, status, industry category through the following model building.

Communication Level = f(work hours, etc)

The first model from questionnaire data in Katmandu office worker was built as follows;

$$\log(T)=-1.116+1.183*\log(Ch)+1.026*\log(CWh)+0.4096*\log(TWh)$$
$$\qquad(1.64)\qquad(2.23)\qquad(0.83)$$
$R^2=0.5$

here,
T :Telephone Call Frequencies per Month
Ch :Communication Hours Share(%) per Day
CWh:Clerical Work Hours Share(%) per Day
TWh:Thinking Work Hours Share(%) per Day

This model shows that when Ch increases by 1%, monthly telephone call increases by 1.18%. 1% increase of CWh will increases 1.03%. Increases of TWh will increase only 0.41%. Thus, Communication hours share is most sensitive to telephone call.

Questionnaire survey sheet were designed to ask "Your status in the office" and "Your section". The results of the model formation according to them are as under;

For office worker in the "administration section",

$$\log(T)=-8.392+2.989*\log(Ch)+1.241*\log(CWh)$$
$$\qquad(3.59)\qquad(2.55)$$
$R^2=0.56$

For office worker in the status of "administrative staff",

$$\log(T)=-8.863+2.762*\log(Ch)+1.503*\log(CWh)$$
$$\qquad(3.59)\qquad(2.64)$$
$R^2=0.71$

In the second model, 1% increase of Ch will increase 2.99% of T, which is the largest value among three models. This indicate that administrative section has the largest sensitive value to telephone call since it include management staff, who obtained both the largest communication hours and telephone call frequencies than other workers.

The monthly frequencies per worker to utilize each media by worker's status in office are summarized as follows.

Media	Management	Specialist	Administration	Other	Average
Telephone	433	155	151	107	201
Telephone				50	50
Receiving				50	50
Average	274	94	99	56	

We may imagine that management staff owned telephone to communicate outside office as their personal use, and administrative staff spend their time more for communication deploying with other media, from the fact that management staff use telephone most, and administrative staff use mail most, and other use someone's telephone including receiving.

The following fact is a clue to find measurable benefits of telecommunication. This is that telephone will deploy more frequently than other media for higher ranked workers who contribute their corporate's profits greater than other workers, and thus, higher hourly salaries (time value) will be paid.

The Software Export Industry of Developing Countries

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1. ABSTRACT

Successful missions have been undertaken for the export of software engineering services from developing countries to developed countries on behalf of the United Nations International Trade Centre UNCTAD/GATT (ITC), as part of a regional project of Technical co-operation, financed by the United Nations Development Programme, and executed by ITC. In particular telecommunications companies and systems integrators have a need to outsource to the developing countries for software.

2. INTRODUCTION

2.1 UN ITC REGIONAL PROJECT

A United Nations International Trade Centre (ITC) regional project on the development of trade and cooperation in tec nical consultancy services among ten developing countries in the Asian and Pacific region, namely Bangladesh, the People's Republic of China, India, Indonesia, Malaysia, Pakistan, the Philippines, Singapore, Sri Lanka and Thailand, was initiated at the beginning of November 1989. This was the first phase of a three-year project to assist developing countries to improve their foreign exchange earnings through expanded exports of technical consultancy services. The regional project was financed by the United Nations Development Programme (UNDP).

2.2 OVERVIEW

This paper covers the results of two ITC missions which came under the regional project; one mission was to sell Philippine software services and products to European and North American companies which included meetings at Telecom 91, and the second mission was to sell Sri Lankan software services and products to companies in Australia, Japan, the Philippines and Malaysia.

The responsibilities of the ITC will be explained and how it is jointly managed and funded by the General Agreement on Tariffs and Trade (GATT) and the United Nations Conference on Trade and Development (UNCTAD).

The contribution of the software industry and related industries in information technology to the positive balance of trade of the developing countries are discussed. Recommendations are made as to how to make the software export industry a success for developing countries. The focus will be on the philippines as an example.

3. THE INTERNATIONAL TRADE CENTRE (ITC)

It is a known fact that foreign trade is a necessity for economic growth in developing countries. Exporting provides the foreign exchange necessary to obtain essential basic needs for the population and for the development of the country such as capital goods and energy. It also offers the opportunity to raise the national output which in turn strengthens the economic well being of the country. Efficient importing is the necessary compliment to successful exporting. In addition if fundamental development and human needs are to be satisfied the scarce foreign trade earnings must be used to the best advantage of the country.

In order to achieve success in exporting and efficiency in importing special technical expertise is required that is often lacking in developing countries. The ITC has been put in place to provide the countries with necessary expertise. It was created by GATT in 1964 and since 1968 it has been jointly sponsored by GATT and UNCTAD. In 1973 the ITC was designated as the focal point in the United Nations system for technical cooperation with developing countries in export promotion.

3.1 MAIN FUNCTIONS

The ITC assists developing countries in establishing an effective national trade promotion strategy in line with the countries economic development goals. Creating and establishing national trade promotion agencies is another part of the ITC's technical cooperation program. In conjunction with the government it works to strengthen the role of the chambers of commerce and other business organizations.

The provision of market development services is another function of the ITC. These services are aimed at identifying new export opportunities, adapting products and services for sale abroad and promoting these offerings to the international market. One of the new opportunities that has been identified is the export of consultancy services which includes software.

A function of the ITC is to provide special services to back up the export marketing efforts which include export packaging, quality contro export financing, costing and pric g, trade information, publicity and trade fairs, commercial representation abroad, international physical distribution, legal aspects of foreign trade and joint marketing.

The ITC has the function of working with import management organizations to improve their import operations and techniques. Key to all of the main functions of the ITC is the provision of training programs that cover a broad range of export and import subjects. The main objective of the ITC's training activities is to make developing countries self sufficient in providing training in international marketing and trade promotion.

3.2 TECHNICAL COOPERATION PROJECTS

The ITC's technical cooperation projects cover developing countries at the national, regional and inter-regional levels. They are undertaken at the request of the governments concerned, administered from ITC headquarters in Geneva and implemented by ITC experts in conjunction with local officials. Projects most often take the form of an integrated national program, which includes a packaging of services to expand the country's exports and/or improve its import operation. Regional or inter-regional projects may deal with one or a combination of ITC services, depending upon the trade promotion requirements of the group of countries concerned.

ITC projects are coordinated with a number of organizations within and outside the UN. Close liaison is maintained with GATT and UNCTAD. Export market development activities are coordinated with the Food and Agriculture Organization of the UN (FAO) and the United Nations Industrial Development Organization (UNIDO) as required. Close contacts are maintained with UNDP which provides financing for a large portion of the ITC's projects and whose Resident Representatives serve as ITC official representatives in their countries of assignment.

3.3 FINANCING

ITC projects are financed by the UNDP, international financing institutions and voluntary contributions from individual countries. Voluntary contributions come in the form of either trust funds for projects in other countries or funds-in-trust provided by developing countries for projects in their own countries.

Financing from international organizations such as the World Bank which is primarily through its loans to developing countries and the European Community through subcontracting arrangements with the ITC is of increasing importance for the implementation of projects.

The regular budget of the ITC which covers the headquarters operations is contributed in equal parts by the UN and GATT. This budget includes general research and development.

3.4 ORGANIZATION, LEGAL STATUS AND POLICY MAKING

The ITC's secretariat is located in Geneva, Switzerland and is managed by an Executive Director who is responsible for 250 people at headquarters and more than 800 experts assigned to projects in developing countries.

The legal status of ITC is that of a "joint subsidiary organ" of GATT and the UN through UNCTAD. As such the ITC is a semi-autonomous organization within the UN family. The guidelines for technical cooperation are determined by the governing bodies of its two parent organizations the GATT Council and the Trade and Development Board of UNCTAD. Recommendations on the ITC's future work program are made to the two governing bodies known as the " Joint Advisory Group on the International Trade Centre UNCTAD/GATT" (JAG) by the ITC at its annual intergovernmental meeting. Representatives of member states of GATT and UNCTAD attend the annual meeting along with observers from other international organizations that work with the ITC.

4. THE PHILIPPINE MISSION

The first stage in the development of the project to assist in the exporting of technical consultancy services in software was a preparatory assistance phase involving an audit of those services that are available in the Asian and Pacific region which have the potential to be exported, and an identification of the best markets for these services. This phase culminated in a workshop held in Kuala Lumpur, Malaysia, in May 1990.

The objectives of the workshop, at which participants were drawn from four enterprises in each of the countries cooperating in the project which included the Philippines and Sri Lanka, were to:

1. Complete guidelines for a technical handbook on the exporting of technical consultancy services from the Asian and Pacific region;

2. Agree upon technical assistance activities to be undertaken within the framework of the existing project for the period mid-1990 to end 1991;

3. Prepare a draft follow-on project document for submission to UNDP for financing for the three-year period 1992 to 1994.

At the end of 1990 the decision was made by the UNDP and ITC to implement the project. In January of 1991 the regional project had been officially started with the establishment of an ITC regional office at UNDP premises in Kuala Lumpur, Malaysia. Since then, a number of activities were implemented to kick off the official Philippine Software Engineering Export Mission which took place between September 2nd and November 15th, 1991. The mission consisted of a delegation of one senior executive from each of two enterprises in the Philippines dealing in software engineering, Mr. Augusto C. Lagman a Director of Systems Resources Inc. and Mr. Zoilo Jesus M. De La Cruz III President of Infoserve, and an ITC contracted Senior Marketing Consultant and Coordinator.

4.1 TERMS OF REFERENCE

The mission's terms of reference were as follows:

- to carry out in-depth research to identify potential clients in the United States for the two Philippine software companies;
- to organize an export development mission of four weeks duration to the United States, Canada and Telecom 91 in Geneva, Switzerland and arranging business meetings with potential customers, trade associations and strategic partners;
- to initiate actions to fulfill the mission objectives which were to:
- sell Philippine software and software development,
- establish strategic partnerships &/or joint ventures,
- obtain orders and requests for proposals, quotes and information, and get on the bidders list;
- and to develop a follow-up action plan to the mission including a draft of a 5 year national software export industry plan to be approved by the Government, the ITC and the UNDP.

4.2 CONCLUSIONS

The conclusions of the mission were as follows:

- there is a major business opportunity in the export of software and software related products and services for the Philippines;

- there is significant business potential for outsourcing from the Philippines to the U.S. and Canada and in particular to systems integrators, telecommunications companies and software houses;

- there is significant business potential for strategic partnering, joint ventures and distribution agreements between Philippine and North American companies for the Asia/Pacific market;

- 90% of the forty plus companies,(most gross over $500 million) which met with the mission on a one on one basis have an immediate interest in pursuing a potential business relationship requiring specific follow up actions;

- a number of requests for proposals will be forthcoming and it is expected that at least two will be received within the year given appropriate follow up actions;

- it is expected that at least one distribution agreement will be signed for the ASEAN countries for the distribution of a line of software and related hardware products;

- at least four companies will visit the Philippine firms within the year with the objective to pursue a business relationship;

- other than North American companies are interested in possible outsourcing including two European companies and one company from Singapore;

- there is a strategic interest by most North American companies in expanding their business in Asia/Pacific in that a number have reorganized to focus on the market and are actively seeking partners in the region;

- a number of companies are interested in considering the Philippines as a base of operations for the region;

- there is a need for an immediate follow up action program by all interested parties, in particular by the two Philippine software companies;

- the Philippine software industry can become a significant contributor to reducing the country's foreign trade deficit in the future;

- the U.S. and Canada have a shortage of well qualified programmers and systems analysts and this situation is expected to continue where there will continue to be a need to outsource software to countries such as the Philippines;

- and the fact that the Philippines use English as its basic business language and understand North American culture and business practices is a definite advantage for the export of software engineering.

4.3. RECOMMENDATIONS

The major recommendations are as follows:

-there is a need for the immediate follow-up on the results of the Philippine mission in order not to lose the momentum to solidify business relationships together with funding and support from the ITC and UNDP;

- the next mission of the project in regard to Sri Lanka should be expanded to include the recommended follow-up activities to the Philippine mission;

- a presentation should be prepared based on the mission to serve as a basis for meetings with the Philippine Government, the UNDP and the ITC;

- complete a Sales and Marketing plan for the two firms to cover the North American opportunities;

- obtain approval and budget to write an overall business plan to include both the North American opportunity and the strategic partnering and distribution business for Asia/Pacific;

- use the results of the mission and the meetings in Manila to convince the Philippine Government to make the software industry a key strategic industry. Obtain financial support from all available sources to fulfill this strategic goal;

- and use this first mission of the regional project on the development of trade and cooperation in technical consultancy services among ten developing countries in the Asian and Pacific region as a foundation and guide.

4.4 ACTIVITIES AND WORK PROGRAM

The activities and work program of the mission which was initiated on September 2, 1991 with a planned completion date of November 15 consisted of a number of major tasks that included the following:

- arranging for over forty meetings with key executives from major corporations, organizations and governments;
- preparing an overall Sales and Marketing plan outline;
- preparing a list of the top U.S. systems integrators with their executive contact points;
- assessment of both SRI and Infoserve operations in the Philippines to insure they had the capabilities and resources to fulfill the mission;
- arrangements to attend three trade shows which were Telecom 91, Infoworld and COMDEX;
- preliminary plans and discussions as to how to organize to address the North American market;
- and following up on contacts made during the mission with appropriate actions.

To reiterate the objectives of everyone of the mission's meetings were the same as stated previously and can be summarized as follows:

- to sell Philippine software and software development services through outsourcing;
- and to establish strategic partnerships and joint ventures.

An example of the type of activities that occurred during the mission is given in the following two paragraphs.

The first phase of the trip was to attend Telecom 91 in Geneva, Switzerland which is well known to the telecommunications industry. This exposition and conference is sponsored by the International Telecommunications Union and is the largest of its kind. A Telecom occurs every four years and is attended by the world leaders in information technology and gave the mission access to a concentration of companies and executives.

Meetings were set up prior to Telecom 91 with Comsat and MCI. Other meetings were arranged during Telecom and included Ameritech, BBN, VMX, BellSouth, Alcatel, Ericsson, NYNEX, US West and US Sprint.

In addition brief discussions were held with HP, UNISYS, GE Information Systems, IBM, DEC and Northern Telecom in order to obtain the name of the executive contact points that would be interested in outsourcing software.
The following is a sample list of the companies and organizations that met with the mission in North America:

IBM	Data General
Stratus	Dun and Bradstreet
DEC	BBN
Nabisco	Harris Adacom
EDS	Hogan Systems
Lone Star Gas	B.C. Telephone
SHL Systemhouse	Apple
Tandem	Pacific Telecom Council
State of Hawaii	
GTE Hawaiian Tel.	

5. THE SRI LANKAN MISSION

The Sri Lankan mission had as its purpose to sell software engineering services and products to countries in Asia and the Pacific with a focus on Australia and Japan. The mission consisted of one senior executive from each of two enterprises in Sri Lanka dealing in software engineering, Mr. Sunesh Samarasinghe, Director of Computer Systems Ltd. and Mr. Gamini Wickramasinghe, Managing Director of Informatics Ltd., and an ITC contract Senior Marketing Consultant and Coordinator.

5.1 TERMS OF REFERENCE

The mission's terms of reference follow those of the Philippines and were as follows:

- to carry out in-depth research to identify potential clients in Asia and the Pacific for the two Sri Lankan software companies and arrange a marketing mission to visit the firms and organizations selected;

- to organize an export development mission of four weeks duration to the Philippines, Japan, Australia and Malaysia and arranging business meetings with potential customers, trade associations and strategic partners;

- to initiate actions to fulfill the mission objectives which were to:

- sell Sri Lankan software and software development/services,

- establish the companies as regional software companies,

- establish strategic partnerships / joint ventures,

- obtain orders and requests for proposals, quotes and information,

- get on the bidders list,

- and distribute software and hardware products from other companies in the region into Sri Lanka;

- to develop a follow-up action plan to the mission;

- and to draft the four year national software export industry plans for Sri Lanka.

5.2 CONCLUSIONS

The conclusions of the mission were as follows:

- Sri Lanka has the capability and foundation for the establishment of a software outsourcing industry and the timing is right for doing business in Asia and the Pacific, however, immediate and continued education and training is required to meet this industries growing needs;

- there is a major business opportunity in software and software related products and services for Sri Lanka, the Philippines, Australia, Malaysia and Japan;

- there is significant business potential for outsourcing from Sri Lanka to Australia and in particular Japan;

- there is significant business potential for strategic partnering, joint ventures and distribution agreements between Sri Lanka and Japanese and Australian companies for the Asia/Pacific market;

- at least thirty of the forty plus companies which met with the mission on a one on one basis have an immediate interest in pursuing a potential business relationship requiring specific follow up actions;

- it is expected that at least two distribution agreements will be signed for a line of software and related hardware products;

- at least five companies will visit the Sri Lankan firms within the six months following the mission with the objective to pursue a business relationship;

- there is a strategic interest by many Japanese and Australian companies in expanding their business in Asia/Pacific and are actively seeking partners in the region.

- the Japanese and Australian companies are also seeking to expand their business in the U.S. and Europe through outsourcing software to countries such as the Philippines and Sri Lanka;

- Japanese companies require outsourcing in programming, applications programs, customized software and systems integration in order to penetrate foreign markets and are now aware of Sri Lanka and the Philippines;

- there is a need for an immediate follow up action program by all interested parties, in particular by the two Sri Lankan software companies;

- the Sri Lankan software industry can become a significant contributor to reducing the country's foreign trade deficit in the future;

- Australia and in particular Japan have a shortage of well qualified programmers and systems analysts and therefore there is and will continue to be be a need to outsource software to countries such as the Sri Lanka;

-the fact that the Sri Lankans use English as a basic business language and understand European culture and business practices is a definite advantage;

- Japan has a shortage of 500,000 programmers and systems analysts and it is expected that this shortage will increase to 1,000,000 by the year 2000, therefore this is an immediate market and various forms of Japanese financial assistance and training in this area is available for countries such as Sri Lanka;

- a number of products from the Philippines and Australia will be marketed in Sri Lanka and vice-versa;

- the skills and products in the Philippines and Sri Lanka can complement each other;

- in order to insure the software export industry is successful the national plans for Sri Lanka and the Philippines as drafted by the ITC need to be implemented;

- most organizations and companies have no knowledge of the ITC, this includes executives of the Australian Trade Commission and the Commercial Attaches of the U.S. Embassies in the Philippines and Japan;

5.3 RECOMMENDATIONS

The major recommendations were as follows:

-there is a need for the immediate follow-up on the results of the Sri Lankan mission in order not to lose the momentum to solidify business relationships;

-the ITC four year national plans for Sri Lanka and the Philippines need to be approved and implemented in 1992;

-complete a Sales and Marketing plan for the Sri Lankan software industry to cover the regional opportunities;

-as part of the national plans obtain approval and budget to write an overall Sri Lankan software industry business plan to include the North American, Asia/Pacific and European opportunities and the strategic partnering and distribution business for Asia/Pacific;

-use the results of the mission to convince the Sri Lankan Government to make the software industry a key strategic industry and obtain financial support from all available sources to fulfill this strategic goal;

-put a cohesive plan in place for the training and education of the necessary personnel required to meet the future needs of the Sri Lankan software industry and obtain the necessary financing;

-there is a need to strengthen the existing IT educational institutions in Sri Lanka and the Philippines;

-consideration should be given to a Asia/Pacific regional plan for software engineering to optimize on the complementary strengths of the individual countries;

-and a coordinated public relations plan and meeting program with the developed countries embassies and commercial attaches located in the underdeveloped and newly industrialized countries in Asia/Pacific should be undertaken.

5.4 ACTIVITIES AND WORK PROGRAM

The activities and work program of the mission which was initiated on November 15, 1991 with a planned completion date of March 15, 1992 consisted of a number of major tasks that included the following :

- arranging for over forty meetings with key executives from major corporations, organizations and governments;

- assessing CSL and Informatics operations in the Sri Lanka to insure they had the capabilities and resources to fulfill the mission;

- attending and conducting workshops at the 1992 Pacific Telecommunications Conference in Honolulu covering the ITC project and met with a number of Japanese and Australian companies to arrange for meetings in their respective countries during the mission;

- conducting two separate sub-missions, one for CSL to Australia Malaysia and the Philippines from February 3 to 15, 1992 and one for Informatics to the Philippines and Japan from February 19 to 28, 1992;

-preliminary plans and discussions as to how to organize to address the Australian market;

-preliminary plans and discussions as to how to organize and address the Japanese market;

- the following up on contacts that were made during the mission and taking the appropriate actions;

To reiterate the objectives of the Sri Lankan mission were the same as stated previously and can be summarized as follows:

-to sell Sri Lankan software and software development services through outsourcing.
-to establish strategic partnerships and joint ventures for the Asia/Pacific region.

The following is a sample list of the companies and organizations that met with the mission:

Westpac	McDonnel Douglas
KPMG Peat Marwick	Continuum
IBM Australia	Microsoft Institute
AIIA	OTC
Sime Darby	PIKOM
Infoserve	Software Brewers
SRI	SDP
Saztec	IBM Japan
NTT	KDD
Mitsubishi	NEC
JISA	Japan Valiant Co.

6. OVERALL RESULTS AND CONCLUSIONS (2)

The immediate results of the two successful missions were two dissemination seminars of the missions' activities one in Manila and the other in Colombo and three workshops associated with the project for technical consultancy and engineering services; two in Malaysia and one in Sri Lanka.

The dissemination seminar in the Philippines entitled, "Software Engineering Services," took place on 5 May, 1992 and the seminar in Sri Lanka entitled, "Dissemination Seminar on Technical Consultancy and Engineering Services Information Technology Sector," took place on 9 May, 1992.

6.1 RESULTS AND CONCLUSIONS FOR THE PHILIPPINES

The Philippine mission follow on activities and Dissemination Seminar results and conclusions were as follows:

- a Software Engineering Consortium was formed as a result of the mission, which was incorporated as SRI and already has eight member companies;

- the Seminar provided the forum for the official endorsement of the consortium by the Government and the announcement that the software industry is a key strategic industry;

-allowed the Government to reinforce its commitment to the National Plan for the development of the software export industry;

- assisted in laying the groundwork for the Government to provide interim funding for the software export industry prior to the financing of the National Plan;

-a number of the companies present at the Seminar will become new members of the consortium;

- the attendee companies at the Seminar are now aware of the opportunities for software export and a significant number are expected to participate in the development of this industry.

- the U.S. Embassy is expected to assist in obtaining visas for training software engineers in the U.S.;

- if the National Plan is not funded through the UN, alternate plans will have to be put in place by the Government;

-the consortium must work with the Government and educational institutions to insure a continuous supply of qualified programmers, systems analysts and scientists to fulfill the export market need;

-and the Philippine software industry is well positioned for the export market based on the steps it has taken to establish itself as a viable contender for that market and to that end the consortium has produced marketing literature for its services.

The major result of the Philippine mission are two contracts between Hogan Systems of Dallas, Texas and LC Software (LCS) a member of the Philippine consortium known as Systems Resources, Inc. Hogan is a supplier of banking systems software on IBM main frames or equivalent. The first contract is for LCS to represent Hogan in the Philippines and the second is for LCS to provide Hogan with software consultants. At this time the first group of consultants are in Dallas completing their training.

The consortium has completed its first cut at a plan to get into the North American market and has established the first phase of an independent representative network in the U.S. In addition it has completed its initial set of marketing literature including a "COMPARATIVE LABOR COST FOR COMPUTER PERSONNEL" chart shown in Figure 1. The chart compares programmers and systems analysts from the consortium known as SRI with those of eight developed countries. SRI programmers cost less than half those of the U.S. and systems analysts are two thirds the cost.

6.2 RESULTS AND CONCLUSIONS FOR SRI LANKA

The Sri Lankan mission follow on activities and Dissemination Seminar's results and conclusions were:

- that plans were made for the formation of an IT industry association with the support of the Government with the initial activities toward the formation were agreed to at the seminar;

- that full support of the new association was given by the Economic Development Board (EDB);

- that the EDB will act as the new IT association's focal point;

- that the EDB will make money available to support 50% of the finances required for software industry missions and exhibits;

- that the ITC will assist in funding of missions and exhibits to supplement the funds provided by the EDB;

- that there are limited resources in certain segments of the software industry and therefore the export market in those segments cannot be exploited;

- there is a definite need for a strong IT association.

- there is a need for an IT national directory since many of the software companies are not aware of each other;

- that the luxury tax on computers of 100% should be eliminated and computers not be considered a luxury for this a definite hindrance to the development of the Industry;

- that the usage of existing computer resources of the country be optimized, in particular those of the universities;

- that in order to address the export market a consortium similar to the Philippine model is required;

- the Seminar attendees are now well aware of the potential export market and the effort required to go after the market;

- and that the Sri Lankan software industry is engineering/technology driven and not market driven due in part to a lack of sales and marketing professionals.

7. RECOMMENDATIONS

7.1 RECOMMENDATIONS FOR THE PHILIPPINES

The major recommendations for the Philippines are as follows:

- complete a business plan for the consortium;

- complete a sales and marketing plan for the consortium;

- obtain the interim funding for the National Plan;

- distribute the leads resulting from the mission to North America to the consortium members;

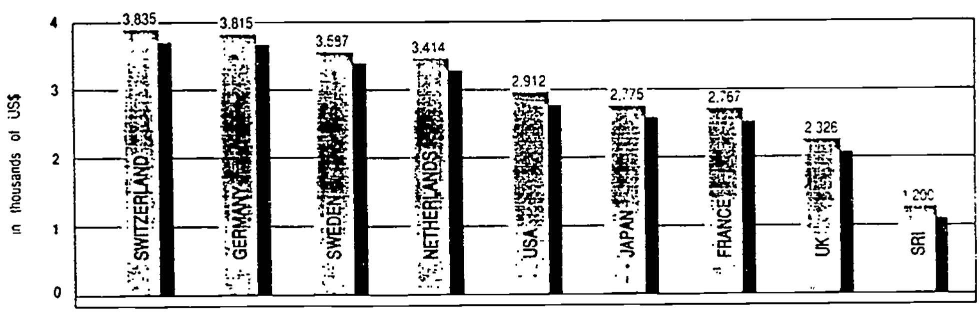
- work with the Government and educational institutions to insure that there is an adequate and qualified supply of engineers, scientists, systems analysts and programmers;

COMPARATIVE LABOR COST FOR COMPUTER PERSONNEL

SRI offers the mos cost-effective systems development solutions available.

Average Monthly Compensation
(Including fringes) in **US Dollars**

FOR PROGRAMMERS



FOR SYSTEMS ANALYSTS

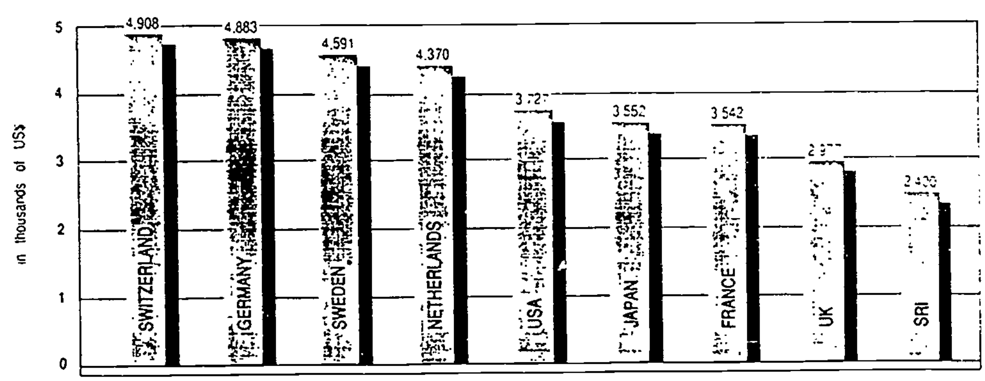


Figure 1

* as of May 1992

- work with the telecommunications carriers and regulators to insure the availability of high speed, reliable international and national telecommunications facilities;

- continue to develop project management techniques and project managers for international projects;

- establish quality control practices and procedures;

- develop techniques in management and quality to insure that schedules are met;

- work with the embassies of the U.S., Canada, Japan, Australia and the EEC countries to establish a method for approval for training visas and temporary work permits;

- work with Philippine Airlines and others to obtain the lowest rates for the consortium members and for the trainees;

- the consortium should be registered in the consultant data base of the Asian Development Bank and the World Bank;

- the consortium should bid for major national projects;

- the consortium should work with Philippine financial institutions to work out arrangements to support their bids for national projects within the Philippines and in other countries;

- and the electric utility needs to insure that there is backup power for the hardware used for outsourcing including air conditioning and lighting for the professionals and their support team. If the utility cannot provide backup then the consortium needs to provide a backup power system.

7.2 RECOMMENDATIONS FOR SRI LANKA

The major recommendations for Sri Lankan are as follows:

- immediate action to be taken by the EDB to contact the attendees of the Seminar in order to establish the new IT association;

- put a plan in place for follow-up missions to Australia and Japan and an initial mission to North America with funding from the EDB and the ITC;

- put a plan in place for international exhibits with funding from the EDB and ITC;

- implement the four year national plan;

- there is a need for the continued follow-up on the results of the Sri Lankan mission;

- complete a Sales and Marketing plan for the Sri Lankan software industry;

- as part of the national plan obtain approval and budget to write an overall Sri Lankan software industry business plan;

- put a cohesive plan in place for the training and education of the necessary personnel required to meet the future needs of the Sri Lankan software export industry and obtain the necessary financing, because at this time Sri Lanka only graduates 100 engineers per year as per information stated by one of the universities;

- there is a need to strengthen the existing IT educational institutions in Sri Lanka;

- international project management systems need to be developed that include quality control procedures and control of schedules;

- eliminate the luxury tax on computers and peripherals;

- work with the telecommunications service providers to insure the availability of of low cost, reliable and high speed national and international facilities;

- and work with the power utilities to insure the availability of uninterrupted power for the computer centers or find alternate means.

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(1) International Trade Centre. "Promoting Trade" Jan. 1990

(2) Lissandrello, G.J. "Programme to Promote an Export Result-oriented Support S'rategy for the Foreign Trade in Technical Consultancy Services from the Philippines to North America and from Sri Lanka to Selected Countries in Asia and the Pacific Dissemination Seminars" ITC Report, July 1992

Political Challenges to Globalisation of Public Telecommunications Operators

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1. ABSTRACT

Globalisation of the economy and the liberalisation of telecommunications have motivated major public telecommunications operators (PTOs) to extend their business activities in the international sphere. All the PTOs in major economies are becoming competitive with each another. This is creating various policy issues that are not covered by the framework of existing telecommunications policies.

2. INTRODUCTION

International investment by PTOs in telecommunications markets abroad has occurred only in the past few years, but its growth has been considerable. The major PTOs in OECD Member countries are becoming increasingly dynamic and outward-looking, regardless of their status (i.e. government-, privately- or mixed-owned). There were 25 cross-border acquisitions by PTOs and other telecommunications firms from 1988 to 1989, while there were only six in the previous year[1]. The amount of value per investment has rapidly increased since the end-1980s. In 1989 and 1990, PTOs invested more than half of the total investment that occurred between 1986 and 1990. This was true for both the number and value of investment.

This report focuses on impacts of extending PTOs activities in an international sphere beyond traditional transmission of voice and data on existing national telecommunications policies. The focus of analysis is placed on investment in services, not in equipment. This is because investment in the former has greater implications to national telecommunications policy than the latter.

Following the introduction in Section 1, factors that motivated PTOs to develop their business edge abroad are briefly discussed in Section 2. Section 3 examines various forms of globalisation followed by discussion of the applicability of existing policy instruments of telecommunications in Section 4. Policy issues that arise from policy vacancies are presented in Section 5 followed by concluding remarks in Section 6.

3. FACTORS THAT MOTIVATED PTO GLOBALISAION

Both internal and external factors have driven the global developments of PTOs.

(1) Globalisation of large firms

Globalisation of economic sectors has brought new market opportunities to PTOs. Communications networks are critical for management of multinational enterprises (MNEs). Cost effectiveness, reliability and enhanced communications functions to support specific requirement of their individual sectors are strongly required for their networks. In technical terms, NMEs have a high level of need for so-called "End-to-end systems" in telecommunications. A provider of such services should have enough experience in network planning, construction and operation, i.e. an expertise usually found amongst PTOs.

(2) Technology development

The technologies that are needed for global corporate network systems are increasingly becoming available on a commercial basis[2]. Synchronous Optical Network (SONET), Synchronous Digital Hierarchy (SDH) and Asynchronous Transfer Mode (ATM) are becoming widely used for a high bandwidth transmission system and will enhance interconnection between corporate networks built in different countries. Technologies that allow access to network intelligence are growing out of national networks to the global sphere.

(3) Competition in information systems services

PTOs are involved in an inter-sectorial competition. Large-scale corporate networks usually transmit both voice and data, such as the one generated by Computer Aided Design (CAD) systems. So-called "system integrators" provide specialised know-how to develop and manage such networks that may be sourced from a variety of firms, such as specialised firms (e.g. Electronics Data Systems Corp.), computer system vendors (e.g. IBM and DEC) and even subsidiaries of accounting firms (e.g. Andersen Consulting). PTOs are merely one of these competitors.

(4) Pressure from domestic markets

a. Less growth in the domestic market

The profit margin for basic telecommunications service is decreasing. The market growth is already saturated. While some new services are emerging, they are providing relatively smaller profit margins. Market liberalisation has given birth to an increasing level of competition, that is leading to price rebalancing and cost-based tariffs. Many of the OECD countries, however, prohibit PTOs to enter business areas

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that are not directly related to telecommunications. Because of the lack of new possibilities to increase revenues domestically, PTOs have turned eyes to new business opportunities abroad.

b. Preparation for possible competition in the home country

The provision of services in foreign markets provide opportunities for PTOs to improve skills (i.e. management and operation know-how) to prepare for the entry to new business areas in the home country that are likely to be opened to competition in the future. Some Regional Holding Companies (RHCs) in the US investing in CATV services in UK are examples of this case.

(5) Scale economies

PTOs may benefit from scale economies by operating globally. The costs of procurement, R&D for new technologies and the supply of financial resources are shared between domestic and foreign business activities. Intangible resources, such as management know-how in certain markets, may also be shared.

(6) The opening of new telecommunications markets in developing countries

Many countries in the world need access to foreign capital and operational know-how for the development of telecommunications infrastructure. The infrastructure is considered to be indispensable for economic development and is urgently needed in many countries in Asia, Latin America, the Central and East European Countries, the Baltic States and New Independent States of the ex-Soviet Union. These countries intend to facilitate the introduction of foreign capital through the sale of shares to international investors. The sale of the shares of PTOs in Mexico, Argentina, Venezuela, etc. to the North American and European PTOs illustrates this case. A similar plan is also being discussed in Hungary.

(7) Competition in international telecommunications services

Resale and shared use of leased circuits have become allowed by the changes to the CCITT D1 Recommendation made in 1991. This has stimulated competition in international telecommunications services, both in voice and value added services.

Excess capacity in international trunk-lines facilitated by fibre optic cable motivates PTOs to continue price competition to obtain more international traffic to fill the capacity. Pressure from regulators, such as OFTEL in the UK and FCC in the US, is increasing to require PTOs to restructure tariffs based on costs.

4. TWO DIMENSIONS OF GLOBALISATION

4.1 "OUTGOING" DIMENSION

Co-operation between common carriers was the major way of organisation for globalisation until recently, for example, joint account management (JAM) agreements. Under JAM, two PTOs in different countries mutually take care of the partner PTO's corporate customers that have branches in each other's country. In this system the customers may construct and maintain international corporate network systems only with the support of their home country's PTO.

The development of JAM agreements has lead to so-called "one-stop-shopping" (OSS). While JAM is a bilateral agreement merely for the customers of the countries concerned, OSS providers are no longer concerned about the customers' nationalities. These alliances are intended to serve MNEs that develop information networks via telecommunications infrastructure world-wide. Examples of providers of OSS are Eutelcom (FT and DBP Telekom, started in 1992), Syncordia (BT, started in 1991[3]) and Unisource (PTT Telecom in the Netherlands and Swedish Telecom, started in 1992). The emergence of OSS indicates that large PTOs are using their domestic networks to expand services to foreign customers.

The outgoing dimension of securing customers has grown rapidly since the end of the 1980s with an increase in the level of overseas investment by major OECD PTOs. Such investment is in the form of a joint venture (JV) with a firm in the host country, purchases of shares of existing telecommunications firms and mergers and acquisitions (M&A). Direct investment has an advantage for PTOs in that they become globally known (i.e. global presence) in a relatively short time and is a means of quickly entering the telecommunications market. Examples of large scale direct investment include the purchase of shares of the PTO in New Zealand (Telecom New Zealand) in 1990 by a consortium of Ameritech and Bell Atlantic (both from the US) and the purchase of 51 per cent of the shares of Mexican PTO, Telefonos de México (Telmex) by a consortium including South Western Bell and FT in 1991.

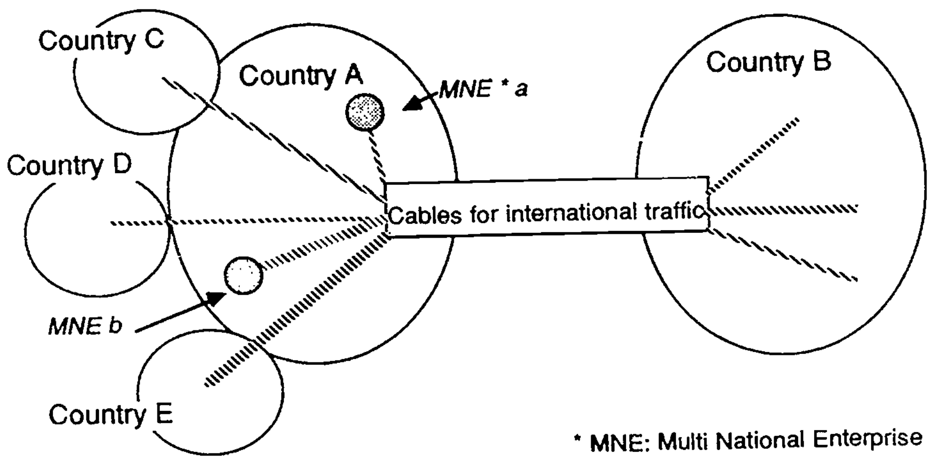
In some cases PTOs are installing telecommunications facilities abroad to ensure end-to-end operation of global corporate networks, notablly the installation of packet switches by BT in France and the US, and by FT in the UK.

4.2 "INCOMING" DIMENSION

A PTO may take advantage of international network users without going abroad. One way to do so is to invite the users of international corporate networks to locate their hubs in the PTO's home country. The PTO may obtain high profit from the increased international traffic. Another way is to transmit international toll calls that originate and terminate in other countries. For example in Figure 1, a PTO in country A has a cable for international traffic between countries A and B. The PTO obtains profit by providing toll call transmission service to international calls from countries C, D and E to country B through the cable. The location of the cables also give incentives for MNEs to locate their communications hubs in country A. The PTO in country A thus obtains markets for international traffic both from users in the domestic and foreign markets.

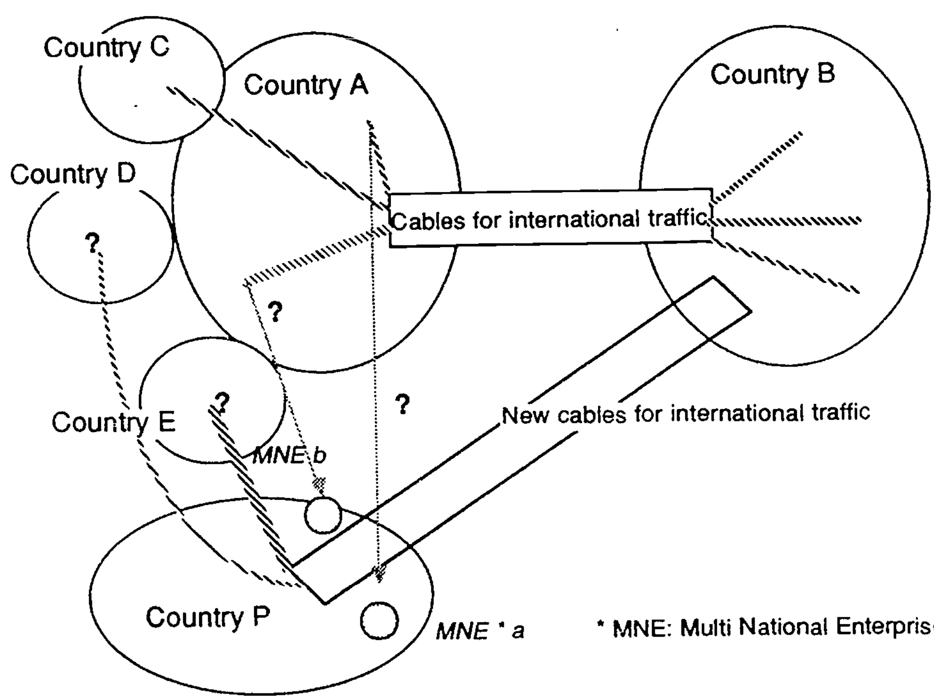
The "incoming" dimension creates potential competition between PTOs. In the former example above, a PTO may obtain a large source of revenue, if foreign firms locate their hubs in the PTO's country. Several PTOs will compete to obtain a hub of an international network of large users, since this provides new business opportunities[4]. In the latter example, if there is another country P that has its own cable to connect with country B, the countries A and P are in competition in trying to obtain traffic from the countries D and E. Some MNEs may locate their hubs in country P, rather than A, if it is more cost-efficient (Figure 2).

Figure 1
Current condition



* MNE: Multi National Enterprise

Figure 2
Potential competition between PTOs A and P



* MNE: Multi National Enterprise

5. HOW MUCH EXISTING TELECOMMUNICATIONS POLICIES COPE WITH NEW ISSUES?

5.1 REGULATORY CONDITIONS ON OUTGOING FOREIGN INVESTMENT

Most of the OECD Member countries do not have specific rules for its PTO investment abroad. Some Member countries have restrictions on outgoing investment by PTOs but these rules are vulnerable. In Germany, for example, the current law defines DBP Telekom as the Federal Administrative body and for this reason limits its activity within the boundary of the country. It is, however, expected that, after the amendment of the law, foreign investment by the PTO will become possible through its subsidiary[5].

5.2 REGULATORY CONDITIONS ON INCOMING FOREIGN INVESTMENT

Countries are more sensitive to in-coming direct investment by foreign PTOs in the domestic telecommunications market. Some seem to feel that they need some regulatory safeguards to maintain control of national PTOs, even if, at the same time, their national PTOs are active in investing abroad.

a. Foreign ownership

Regulation of foreign ownership of domestic PTOs is the most direct measure to limit inward foreign investment in telecommunications markets. The regulation (or deregulation) of foreign ownership of PTOs is currently under discussion in many OECD countries. New rules have been established in countries such as Australia and New Zealand. Foreign ownership restrictions on NTT and KDD in Japan were relaxed at the beginning of 1992.

Generally speaking, those countries whose PSTN operator(s) are legal corporate entities and joint stock companies need regulations on ownership. This applies, at present, to eight countries (Australia, Canada, Denmark, Finland, Japan, New Zealand, the UK and the US). The level of the percentage of shares that may be owned by foreigners differs widely, from no restriction (New Zealand and the UK) to 49 per cent maximum (Australia for the second carrier and Denmark).

The type of services provided by those PTOs fully or partly owned by foreigners differs from one country to another (Table 1). The restrictions are generally more strict on voice telephony services via fixed link networks than

Table 1 Restrictions of foreign ownership:
Matrix showing the principal PTO and its competitors in the domestic market
(as of October 1992)

Foreign ownership of the principal PTO		Foreign ownership of competitors to the principal PTO: Yes	Foreign ownership of competitors to the principal PTO: No
	Yes	Canada* Denmark* Finland* Japan* New Zealand* UK US* *: With some restrictions/exceptions.	Italy (SIP, Italcable) Portugal (CPRM) Spain
	No	Australia (PSTN, M, V) Belgium (V) France (M,V) Germany (M, V) Italy (V) The Netherlands (M-, V) Norway (M-) Sweden (PSTN, M, V)	Austria Iceland Ireland Italy (IRITEL, Telespazio) Luxembourg Portugal (Telecom Portugal, TLP) Switzerland Turkey

( ) -- Services open to competition.
PSTN: Public Switched Telecommunications Services Network
M: Mobile Services
M- : The second mobile operator not yet selected.
V: Value Added Netwotk services

Source: Compiled by the author from various sources.

those for mobile, satellite or value-added services. The ceiling on ownership is different between services in different countries. For example, France allows less than 20 per cent of foreign ownership in mobile and value added services, while Germany has no restriction.

b. Other measures for the control of PTOs

Some countries that have rules on foreign ownership have several other measures to ensure the minimum control of national PTOs. Governments in some countries own a special share that has veto power in decision-making for critically important issues. The "Golden share" held by the UK and the "Kiwi share" by New Zealand governments are examples of such cases. Restriction on nationality of the members of the Board of Directors is another measure of PTO control. There are yet other measures that in fact limit foreign ownership of PTO. Closure of the share to the investors currently undertaken by Optus Communications (Australia) and PTT Netherlands (the Netherlands) and general restrictions on foreign investment that may apply to telecommunications sector, such as the Exon-Florio provision in the 1988 Omnibus Trade Act (the US), are examples of other measures. In most countries, more than two measures are used for control.

6. POLICY ISSUES

6.1 NATIONAL INTERESTS

Pros and cons exist in national interests in PTO globalisation. Positive results such as increase in revenue from trade are expected from out-going investments. In-coming investment will bring some advantages, such as access to the capital for domestic PTOs and increased option to users due to competition from foreign-owned PTOs. National security and conservation of R&D capability are, in contrast, major reasons that justify limitation to in-coming investment.

Difficulty arise from the fact that many countries have contradictory interests, such as having an interest in making but not in receiving investments. A distinction between two groups of countries, i.e. those that invest in telecommunications market in foreign countries and those that receive investment from abroad, is not possible and unrealistic in the analysis of possible policy issues.

Asymmetry in existing regulations between OECD countries is likely to give birth to a set of policy issues relevant to all countries. National telecommunications policy, while originally developed to set rules for domestic matters, now has broader cross-border implications.

6.2 ISSUES

Several policy issues arise from the policy vacuum in existing telecommunications policy.

a. Competition issues

-- **Possibility of subsidised competition:**

Where do monopoly (or near-monopoly) PTOs obtain financial resources to invest abroad? Is there a possibility of "subsidised competition" when these PTOs compete with non-monopoly PTOs in the telecommunications market in third countries (i.e. those countries that receive investment)? How can one avoid "subsidised competition" most efficiently?

Viewed from the investing countries, can PTOs use profit from the home country to invest abroad, instead of sufficiently using profits to improve services and reduce tariffs to domestic users?

-- **A private firm owned by a foreign government:**

Would the purposes of privatisation be achieved if the new (major) owner of a PTO is a foreign PTO, either fully or partly owned by the foreign Government? Would it guarantee benefits of privatisation, such as improved management and quick response to customer needs, for the host country?

b. Trade issues

-- **Non discrimination in market access:**

Is the same level of accessibility to the market in the country concerned assured for both domestic and foreign PTOs? Are current regulatory systems opened to foreign-owned PTOs in terms of the availability of information needed to access national markets, such as network information and minimum customer data?

-- **Reciprocity**

Is it appropriate to apply a rule of reciprocity to investment in telecommunications? If so, to what degree should trade reciprocity rules be applied to foreign investment by PTOs?

-- **Liberalisation in telecommunications equipment interconnection:**

If new entrants are limited in their options in equipment, such conditions may work as a de facto entry barrier to the service market. Although it has been a fact that PTOs often had certain manufacturers who provided equipment almost exclusively to them, such practices will have to end. The policy of maintaining monopoly in telecommunications infrastructure may need to be reviewed in this context.

c. Other issues

-- **Beneficiaries of profit from the host country**

Viewed from the countries receiving investment, what mechanism is needed for the public to take the best advantage of profits from telecommunications markets in its own country?

Is there a need for a mechanism to prohibit the profits (some or all) from going abroad?

7. CONCLUSION

What is important is to investigate the right framework to analyse policy issues. Existing rules in telecommunications are only partly instrumental to handle market access issues. Policy vacuum in telecommunications is seen in handling questions such as:

-- What instrument, other than telecommunications policy, do we have to analyse possible issues?

-- What international rules do we need to handle policy issues associated with PTO globalisation?

All the PTOs are, either explicitly or implicitly, in a competitive situation under the globalising economy. Rules originally formulated for domestic markets are now factors of competitiveness for PTOs, that account for much of their revenue. Those rules, such as tariff levels, liberalisation and quality of telecommunications services, including both private and public networks, and availability of network information, are critical factors for corporate users for the planning and construction of their information networks. The formulation of telecommunications policy that takes into account a globalising economy will inevitably lead to further liberalisation of domestic telecommunications, if a country wishes to take advantage of globalisation.

Notes

1. Booz.Allen & Hamilton (1991), International Diversification Strategies for Telecommunications Service Companies, the UK.
2. Source: Uhlig, R.P. and Bartosewicz, J. (1992), The Evolution of Global Networks and Intelligent Networking, (a paper presented at the Eleventh International Conference on Computer Communication).
3. Its associating PTOs are yet to be obtained as of October 1992.
4. Such a type of competition is increasingly being seen between major European PTOs.
5. Information as of October 1992.

TIPS, TRICKS, AND TECHNIQUES FOR TROUBLE-FREE TELEWORK

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1. ABSTRACT

For all of the discussion about the benefits and value of telework (or telecommuting) in recent years, little of this discussion has been devoted to practical suggestions for actually implementing telework in an organization. Now that the telecommunications and IT tools are generally in place in many Pacific Rim countries to adequately support telework, this paper is offered to give some specific guidance about the "do's" and "don'ts" for successful telework.

2. INTRODUCTION

For many years, telework has been an interesting innovation around the world. In the last few years, however, it has become more popular and more widely accepted. Much of the telework in place already is of the work-at-home variety, although there is also growing use of satellite offices and "telework centers" as alternative work sites.

Many of these telework initiatives have resulted from "do-it-yourself" approaches in which employers have invented - or re-invented - the methods for managing these programs. This approach is admirable because it is the best kind of innovation, but it is also somewhat unsatisfactory because of the potential for wasted time and effort to discover the solutions to implementation problems that have been learned by others in other settings.

This paper will provide suggested solutions for some of these problems, and attempt to share some knowledge that has been obtained from more than ten years of implementation of telework programs around the world, in both private and public-sector organizations. Much of this experience comes from the work-at-home form of telework, and the special implications for satellite office or telework center settings will be noted.

The word "telework" has been used in many ways. For the purpose of this paper, it refers to salaried employees who normally work in a central or head office, but who instead work part of every work week in their homes or in a satellite office or "telework center." This paper will not refer to self-employed individuals, or to people doing work at home after the normal working hours, or to sales representatives or other employees who traditionally spend little time in a regular office setting.

Also, this paper will presume that the reader has already made the decision to implement telework in some form, and understands the basic concepts and benefits. Thus, there will be little or no discussion about the organizational or societal benefits of telework.(1)

3. WHAT JOBS ARE SUITED FOR TELEWORK?

There is a surprisingly wide range of jobs that can be done away from the traditional office setting. The history of telework suggests that most of these are in the data processing area - for example, programmers, systems engineers, data entry clerks, and technical documentation writers. While these are still quite common, we have seen growth in professional-level knowledge worker jobs (such as marketing research, financial analysis, engineering, and various government staff jobs) and in inbound call center jobs (such as airline or hotel reservations agents). Also, we are seeing a much wider range of uses of technology in telework; the much-publicized "electronic cottage" view of remote work (with extensive, and expensive, forms of technology) does not always represent the way that telework is practiced today.

Here are some guidelines for selecting jobs for telework. Keep in mind that these apply to all forms of telework, though the first point is more relevant to work at home:

A. Choose jobs that are <u>physically portable</u> - whatever the person needs to do the job can be taken from the office in a briefcase or a box, or can be accessed over the phone line. Thus, the person who must get up to take papers from a file cabinet several times each day would not be a good teleworker.

B. Choose jobs that have well-defined beginning and ending points - an important feature because it will be much easier for the manager to manage remotely when the assigned tasks are easily measured and defined. This doesn't mean that teleworking jobs must only be low-level jobs with unit measures of performance, e.g., fifteen forms processed every hour. We are trying to avoid jobs whose outcomes are so vague and hard to specify that the manager will find it almost impossible to be clear about what the remote worker is expected to do.

C. Choose jobs that require a minimum of unplanned face-to-face contact with co-workers or clients. Teleworkers typically spend at least one day in the central office each week, and during that time they can attend meetings as needed. While they are away from the office, they remain in contact as needed via telephone, voice mail, electronic mail, and (as prices continue to drop and availability increases), video.

There are many more jobs suited for telework than most people realize. Teleworkers are not at home (or in a satellite office) five days a week, and even when they are in one of those locations, they remain in contact with the office in many ways. Just as most organizations have survived very well when managers travel or attend meetings off-site, they can survive just as well when employees work away from the office. We are no longer in the Industrial Age, when everyone must be at the same work location at the same time ir order to be productive.

4. WHICH EMPLOYEES WILL BE THE BEST TELEWORKERS?

The answer to this question depends on which form of telework is involved. For satellite offices, there is virtually no difference from how people are selected to work in the central office. In some cases, organizations select these people based on their commuting times or distances from the central office; the longer the commute, the more likely the person is to be a teleworker.

No matter which remote location is selected, the objective is to select employees who have demonstrated the skills that show they can self-manage when away from the central location. Since they will be working much more on their own, it is important to choose employees who:

A. Can manage their own workload and schedules effectively;

B. Can recognize when they are (or are not) doing the job well, and are able to continue or change their work accordingly;

C. Are self-disciplined enough to begin and complete their work day without needing the manager standing around to provide direct supervision;

D. Have needs for socialization which are only moderate, so they will not feel isolated or alienated when working away from the office for part of the week.

As can be seen in the first three of these four items, this selection process generally means that the better employees are often chosen for teleworking. This is not a random selection process; in fact, quite the opposite is true. Most organizations quickly acknowledge that they are "cheating" when they set up telework programs; that is, they are carefully selecting teleworkers who are most likely to be successful, instead of taking a more random approach. This is done in an attempt to give the better (or best) workers a chance to do their jobs in a more flexible setting, and with much greater control over their own work processes.

In some ways, the characteristics of successful teleworkers are similar to those of successful entrepreneurs: a willingness to be held accountable for results, a desire to have higher degree of control over the work methods, and less desire for high levels of organizational socializing and politics. In short, they are concerned with the products, not the process, of the job.

5. WHAT KINDS OF MANAGERS CAN MANAGE FROM A DISTANCE?

To answer this question, we can begin by looking at the profile of successful remote managers who are not involved in teleworking. For example, the manager of a field sales organization or the principal of a school have to manage at a distance. Those who succeed at these and other forms of remote management have the following characteristics in common:

A. They believe that remote management is not only possible but even desirable, in some cases. They don't need to be looking over someone's shoulder to feel that they are doing their job as a manager.

B. They have above-average technical and managerial skills. These are needed because managing from a distance puts additional pressure on the manager. If he/she is not a good manager to begin with, the remote workers will not be productive.

C. They see their role as manager as being more of a coach than a boss. When remote workers are selected according to the criteria listed above, the manager needs to make sure that the workers have all the materials and information they need. The manager also must be available to solve problems and remove obstacles - but they do not need to be giving orders every moment and otherwise control the work methods instead of facilitating the work results.

Just as teleworking is not for every employee, managing (or accepting) telework is not for every manager. This is much more of an important issue for work-at-home than for satellite office work. Some managers cannot understand how a person could be productive when working at home - and others cannot understand how a person can be productive when working in a noisy, crowded office. We must allow these two kinds of managers to have the choice that suits them.

6. WHAT KINDS OF TRAINING ARE REQUIRED FOR MANAGERS OF TELEWORKERS?

To answer this question, we must look at the differences between work in the central office and telework. In the central office, managers have the opportunity (or, we might say, the luxury) of frequent, close contact with subordinates. This is sometimes known as "hallway management" - as the manager passes by the subordinates in the hallway, he or she asks, "How is the project going?" or "Have you completed that report yet?" This is a satisfactory management style but it is far from the best way to manage. This kind of "hallway management" has several drawbacks:

A. It depends on those chance encounters in the hallway (or other locations) for the vital communication to occur; if manager and subordinate don't happen to encounter each other, the risk is that the subordinate drifts away from the desired work path.

B. Very often, "hallway management" deals with determining progress toward the goal, rather than trying to be more specific about what the goal is in the first place.

C. By allowing these managerial encounters to happen by chance, instead of choice, the manager essentially abdicates on his/her responsibility to provide ongoing direction and performance feedback. This is, in the author's opinion, a serious failing.

The training for managers of teleworkers is intended to overcome these problems. The goal is to help managers understand their role in specifying:

Outcomes and setting goals: defining the <u>what</u> of the task;

Deadlines and interim benchmarks: defining the <u>when</u> of the task;

Acceptable quality guidelines: defining the <u>how well</u> of the task.

Note that there is nothing about these three aspects of supervision (i.e., what, when, and how well) that is different from what we should expect managers to be doing as a matter of routine in the office. The only difference is that effective supervision of teleworkers demands that managers be specific about these elements. Interestingly, we hear from managers of teleworkers that their process of being specific about these three elements for teleworkers "spills over" to their management of their workers in the office as well. This is an important (and unexpected) benefit of telework programs.

These three basic managerial skills are important for all forms of teleworking. There is the temptation to believe that since satellite offices or telework centers appear to be very similar to the traditional central offices, there is no difference in the role of the manager. This is generally not true, because supervisors of satellite office workers typically work in the central office, and in many ways are as distant from their subordinates as if they were working at home.

There are two additional training topics to be mentioned here. First, it is important for managers of teleworkers to take extra efforts to include the teleworkers in every aspect of office life, and to make sure they feel that they are full members of the organization.

For example, the manager must make sure that training programs, career opportunities, and access to company social events is equally available for teleworkers as for central-office workers.

Second, the manager has to pay special attention to the career goals of these remote workers. It is often said that one drawback of telework is the risk that because you are "out of sight" you are "out of mind,", or out of consideration, for desirable promotions and job transfers. Managers must be sure that teleworkers do not become "second-class citizens" in this regard. Two of the things the managers can do are:

A. Be sure that teleworkers are invited to and included in important corporate events, such as staff meetings and project review meetings. These are excellent opportunities for recognizing the accomplishments and contributions of remote workers who otherwise are not as visible to their co-workers and senior management.

B. Provide opportunities for the teleworkers to take on new responsibilities or projects that might otherwise be delegated to central-office workers. The problem here is that the manager might find it easier to delegate these tasks to people in the office simply because they are close at hand. It may take some extra effort to arrange to bring the teleworkers in so these projects can be assigned, but this effort will be rewarded because it results in a more competent staff overall.

7. WHAT TRAINING IS REQUIRED FOR THE TELEWORKERS THEMSELVES?

This depends on whether the teleworkers are working at home or in a satellite office or telework center. Since much of the telework now in place or being planned for the Pacific Rim region is not the at-home variety, this section will address the satellite office training.(2)

Here are some of the important training topics for teleworkers:

A.. ORGANIZATION SKILLS - Since teleworkers will be working much more independently (i.e., away from the direct supervision from and access to their manager), they will have to manage their time more effectively, learn to schedule their tasks effectively, and place more attention on staying on schedule. In essence, these teleworkers take on a more entrepreneurial attitude - working remotely is, in some ways, very similar to being your own boss.

B. COMMUNICATION SKILLS - Teleworkers begin to rely more on phone, fax, and electronic mail communications in place of face-to-face communications. This means they must consider the information needs of co-workers, they must write with more precision and clarity than is common in most verbal communications, and they must be very diligent in replying to these electronic messages. For example, fax and e-mail are very effective communications tools - but they are worthless if they are not read and responded to on a timely basis. This is why many organizations require teleworkers to promise they will check (and reply to) their e-mail messages twice in the morning and twice in the afternoon, for example. By doing so, the teleworkers can show they are doing their best to stay in contact with co-workers even if they are located somewhere else.

C. TECHNICAL SKILLS - Finally, it is important for teleworkers to be competent in the use of software, remote LAN access, and other technical "tools" that allow them to do their work. The difference between teleworkers and other workers in this regard is that teleworkers will not always have easy access to the technical experts in their departments who can provide answers and solve problems. Since the teleworkers are working more independently, they must be able to solve these problems on their own most of the time.

8. WHAT ARE THE IMPORTANT TECHNICAL PLANNING CONSIDERATIONS?

It is not possible in this paper to describe all the technical elements of telework, since every situation is different. Instead, the following general guidelines are offered:

A. PROVIDE FULL FUNCTIONALITY - Teleworkers who are used to having easy access to multiple systems in the office, and to working at high data transfer speeds (9600 bps or faster) will be frustrated if their remote work setting does not give them the same access. This is more of a problem for work-at-home than for satellite offices, in general. The author's belief is that it is better to avoid teleworking completely than to do it in a sub-standard fashion. That is, unless the company can provide the tools that allow the teleworkers to do the job in the same way as if they were in the central office, it might be better to forget about setting up these remote workers.

B. HAVE FEWER AND BETTER TELEWORKERS - Following the same thinking, it is better to have 20 teleworkers that are fully equipped to be productive, than to have 50 teleworkers who are required to use sub-standard technology. Very often this becomes a matter of budget priorities.

For example, consider the decision about the type of laptop PC to be given to teleworkers. The lower the price of the laptop (in general), the slower the processor speed, the worse the display quality, and the less comfortable the keyboard. Telework will not be as successful if the company chooses to purchase a lower-cost laptop that is harder and more frustrating to use. It is advisable to purchase fewer of the better models so that this smaller number of teleworkers will be fully successful - and then it will be easier to justify the expense of purchasing more of these better laptops for future teleworkers.

C. TAKE ADVANTAGE OF EMERGING TECHNOLOGIES - Telework programs are often the test sites for new software, ISDN applications, wireless communications, enhanced fax services, and other new hardware/software solutions. One common mistake with telework programs is to simply duplicate the technology solutions that are in use in the central office, instead of using telework as the opportunity to innovate and try new solutions.

Some of these new solutions, however, might be more attractive than they are truly valuable. For example, much has been written about the possible role of videoconferencing in telework. It is suggested that the ability to have video access will make remote work more practical. The author's opinion is that video does have a role in telework, but it is different from what many managers imagine. If video is used simply as a kind of long-distance supervision, it will not be effective and will be a waste of money. But if video is used to make it easier to conduct multi-location staff or project meetings, or to enable remote teleworkers to see a physical object that they could otherwise not see (such as a product coming off of a manufacturing line), then it will be useful.

The other issue with videoconferencing is the big difference in cost and bandwidth requirements between freeze-frame or slow-scan video, and full-motion, broadcast-quality video. We would like videoconferencing images to be just like what we see on our television sets at home, but this expectation is often unrealistic based on the budgetary realities of the 1990s.

9. HOW CAN AN ORGANIZATION EVALUATE ITS TELEWORK EFFORTS?

The answer to this question depends on the original objectives for telework. It is rare that these objectives are purely scientific in nature. If they were, organizations would randomly select teleworkers and give them little or no training. The results would be measured, and the "value" of telework would be determined.

In reality, most organizations are not interested in scientific experiments. They are in the business of increasing sales and profits, increasing productivity of knowledge workers, and reducing operating expenses. Telework must be assessed against these objectives.

The author suggests the following criteria for evaluating telework, though all will not apply in every situation. This list of seven items is meant to suggest the type of evaluation measures to consider:

A. ARE WORK QUALITY AND QUANTITY KEPT THE SAME? - This is a "break-even" philosophy, i.e., if quality and quantity of work are no less than before telework, it is sometimes assumed that telework is a success. This evaluation usually depends on the presence of other benefits, such as those listed below.

It has often been reported that employee productivity increases with telework programs - sometimes as much as 25% or more. The author has become somewhat skeptical about these claims, but only because of the difficulty of defining and measuring white-collar worker productivity. Without a doubt, most telework programs have produced increases in output; the problem is that the output of professionals does not always make it easy to find precise output measures.

In general, we look for a combination of measures that include level of output, quality, number of projects assigned at the same time, and progress against deadlines. These combine to form a more general measure of "employee effectiveness", and it is on this measure that we see great success in well-managed telework programs.

B. ARE OFFICE SPACE EXPENSES REDUCED? - This, of course, is one of the biggest attractions of telework. Depending on the mixture of work-at-home and satellite office telework, and on the number of days the teleworkers are away from the head office, the actual space savings will vary widely. Also, there will be no savings at all if the employer retains the teleworker's's desk or office space even if the person is working somewhere else. This is why many telework programs are starting to experiment with a shared-office concept in which few, if any, people have their own assigned work areas.

Depending on the local real estate market and vacancy rates, the ability to reduce the need for office space - or even to move to lower-cost office space in a satellite office - can be a very important reasons to use telework.

C. ARE CYCLE TIMES REDUCED? - If teleworkers are able to work with fewer interruptions and with greater concentration, it is possible that they can complete projects or assignments in shorter time. In today's downsized organizations, this lets management make better utilization of existing employees because teleworking employees can get the same job done in less time.

D. ARE VALUABLE EMPLOYEES RETAINED LONGER? Sometimes, employees find it difficult to continue in their jobs because of family or medical problems, because of very long commuting, or other reasons. In these cases, telework can be helpful if it allow the employee to continue working without having to come to the central office every day. As many Pacific Rim countries begin to face a shortage of qualified professionals, the need to retain current employees is becoming more evident. Therefore, telework can become popular because it helps employers avoid costly and disruptive employee turnover.

E. ARE NEW EMPLOYEES RECRUITED MORE EASILY? Similarly, employers who offer the telework option will find it easier to recruit new employees who find that option attractive. Even though telework is becoming more popular, it is not very widely used. Therefore, an employer who offers telework can have a competitive advantage when recruiting for new employees.

F. DO MANAGERS HAVE MORE TIME TO PLAN? One interesting aspect of telework is that it reduces the amount of time the manager needs to directly supervise the employees. When they are teleworking, these employees are, in effect, supervising themselves. The manager is still responsible for their performance, but does not have to spend as much time on the direct supervision. This should allow managers to have some additional time available for the other parts of their jobs that often are not done as well as can be. Specifically,, the manager now has time to do some longer-term planning, instead of having to concentrate only on the daily workload.

G. DOES CUSTOMER SERVICE IMPROVE? - Finally, we have seen cases where the telework option allows the organization to provide better customer service - and therefore increase sales. For example, sometimes telework is used to extend the hours of service for telephone-based jobs such as hotel or airline reservations, or accepting orders from customers. This happens because the teleworkers find it easier to work early in the morning or later in the evening, compared to the traditional business hours in the central office. These extended hours of service can result in higher satisfaction of customers who prefer to contact the company in the early morning or in the evening - something they perhaps could not do when all the employees were working during normal business hours in the central office.

10. DEALING WITH THE MANAGER'S RESISTANCE TO TELEWORK

It has been the author's experience that most resistance to telework is based on myths and misinformation. The idea of telework is, in some ways, very new and perhaps upsetting to many managers. The truth is that the basic concept of telework - allowing people to work away from the direct supervision of the manager - is not really very new. Consider, for example, sales representatives who work away from the office, or even jobs like truck drivers and repair technicians. In these cases, the manager does not supervise directly, by watching the work of the employee. This is the same with telework for knowledge-based jobs.

The most common source of resistance to telework is the manager who says, "How can I manage people if I can't see them here in the office?" We must remind this manager that just because we can *see* people, it does not mean we are *managing* them effectively. We also ask this manager, "How do you manage your people when you *can* see them in the office?" This manager will probably admit that he or she manages them according to the results that they produce - and this is exactly how teleworkers are managed also.

Another reason why managers resist telework is because they are afraid that everyone will want to do it. The truth is that everyone does *not* want to do it. Many people like to come to the office, and many people prefer the office (even with the commuting problems) instead of working at home or in a satellite office. Also, we remind the manager that he/she will be able to control who becomes a teleworker. Telework is not a benefit that everyone receives. It is only a specific kind of job assignment. Like all job assignments, some people are qualified for it and others are not. It is the manager's job - and his/her responsibility - to select only the correct people for telework.

The last major reason why managers resist telework is because they are afraid employees working at home or in a satellite office will not work very hard. They will be tempted by the television or other distractions at home, or they will spend all day socializing with co-workers in a satellite office. In telework experiences around the world, this has not been a problem *if* the manager makes it clear that permission for teleworking will be taken away if job performance goes down. Telework is a privilege, and as long as the employee shows that he/she is worthy of this privilege (by maintaining good work performance), then the privilege can continue.

11. SUMMARY

Telework is primarily a managerial challenge, not a technical one. The purpose of this paper is to respond to the need for managerial guidance that will be useful for successful telework. The Pacific Rim region has a tremendous amount of computer and communications technology available to support telework. This technology, together with appropriate management methods, will cause telework to grow in the region.

The "office" as we know it will not disappear. Telework does not mean that everyone will be working at home in blue jeans. Unfortunately, it does not mean that all the commuter problems and traffic congestion will disappear. Telework is only a tool - something that is one of many management methods to use in the business of the 1990's and beyond. We no longer need to have everyone come to one central location as we did at the time of the Industrial Revolution. The office is a good place to work, but it is no longer the only place, or even the best place, for today's knowledge workers to work.

(1) For more details on telework concepts as applied to the Pacific Rim, see the following papers in prior PTC proceedings:

"Contrasting Roles of Public Policy in Telework Development in the United States and Japan," by Gil Gordon, William Eagle, and Norihiro Katada (PTC 1991)

Telework Troubles, Traumas, and Triumphs: Confessions from Telework Planners Around the Pacific Rim," by Gil Gordon, Wendy Spinks, and Norihiro Katada (PTC 1992)

(2) Readers who would like more detailed information about training for teleworkers and their managers in work-at-home settings (or any other aspect of teleworking) are invited to contact the author at Gil Gordon Associates, 10 Donner Court, Monmouth Junction, NJ 08852 USA. Phone (908) 329-2266 or fax (908) 329-2703.

Global Teaming: Meeting the Challenge of Global Business with Help from Telecommunications and Information Technology – and a Lot of Management Savvy!

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ABSTRACT

Today's business environment is more challenging than ever before. Time is of the essence. Many products require the assimilation of multiple technologies and a wide variety of specialized skills and knowledge . These are unlikely to be found in one location or even within one company, The challenge for managers is to create flexible, adaptable organizations that can respond rapidly to shifting needs and take advantage of knowledge and skill wherever it is found: to create teams of teams that are multi-discipline, multinational, possibly multi-company, and which are geographically dispersed.

Let me quickly introduce myself. I am a Management Consultant employed by Digital Equipment Corporation working with customers and also with internal groups. Much of my past experience is of line management, a lot of it managing large, international, product development groups.

I'd like to start by posing three questions about how life in your company today compares with what it was 10 years ago:

- is the pace slower?
- are the management problems easier to solve?
- is the technology more simple and straightforward?

I'd be very surprised if anyone were able to answer those questions with a resounding "Yes!" In the computer industry, we face tough global competition and we have to make continuous dramatic improvements in product price and performance to stay in business. This requires the use of many different technologies, each of which is changing ever more quickly. The management problems we face are multi-dimensional. To continue to be competitive in this demanding environment, we have to react faster: - to fill a customer's order in hours or days, not quote a delivery date that is weeks or months ahead - to develop new products in months, not years, and so on. From my work as a Management consultant, I see that our customers in just about every industry are under similar pressure.

How then, do you both speed up your corporate reaction time and handle increased complexity? Not by demanding that everyone work harder! You have to do things differently. You have to re-design the process by which the work is done. Two of the fundamental changes we believe pay off are:

- to move from serial to parallel processes, that is, to work concurrently on what previously had been handled in separate phases, and
- to create cross-functional, cross-organizational teams.

In discussing these changes, I'm going to focus on product development, as that is what I am most familiar with, but it is only one of the processes we are re-designing - the whole supply chain is another.. In the old days, the engineers did the design and built a prototype and when they were satisfied they started talking to people in Manufacturing about how to build it and got some Marketing people to think about who might buy it, and when they were just about ready to put the product on the market they talked to the Services people about maintaining it. A product built in this serial fashion might not have been quite what customers wanted, was probably expensive and not very reliable, but it still sold. After it had been on the market a year or two and we had done some enhancements, we were probably close to having what customers really wanted. But that is not good enough today. To sell a product in today's competitive market, we have to get it right first time, with the features, the reliability and the price the customer knows they can command. This needs the combined knowledge of many technologists, marketing, manufacturing, sales and service people. They have to work as a team.

Getting people with such different perspectives to work together is hard enough, but it is made immensely more complicated because it is highly unlikely that they are all in one place. They probably aren't even on the same continent! To give you some specific examples:

- For Digital to design and build just one piece of a complex computer system, namely the central processor or CPU module, takes cooperation between the semiconductor design groups in Massachusetts and Israel, the manufacturing process design teams in Massachusetts and Scotland and the people who assemble and test modules in Ireland. To speed time to market the product and process designers work concurrently to simulate the operation of the chips in the system, including bringing up the operating software before they produce even a single chip in silicon. Further, as they design the chips, they build the test patterns that will later be used for verification and they build test structures into the chips to help with module testing.
- The International Systems Engineering group ensure that our software products are available in all the languages our customers speak - like Chinese, French, Arabic and these days, Russian. This group has people in 11 countries, speaking 16 languages and spread across 8 time zones. They work with the product developers, who themselves are spread around the world, and with the marketing groups in each country to identify what products are required. In the past, a product would be designed and introduced in the USA, without regard to the needs of the international community, so inevitably the

product had to be re-engineered before it could be introduced into Japan or Germany, say, and this could take a couple of years. As you might imagine, customers in those countries were not happy about this delay, especially if they were multinational corporations and wanted the same software to be available worldwide. The re-designed process allows a global team of engineers to work in parallel on the different language versions and bring them to market at the same time. Customers are happy and Digital's product development costs are much lower.

Why are these and other product development teams global? Because the competencies we need to be successful are spread around the globe. The technical experts, the research associates, the people with the market knowledge, the manufacturing capacity, and so on are not all to be found in one place.

Having recognized our dependency on cross-functional global teams, we set out to study how to make them successful. Our first discovery was that we could not find any books on how to do it! Digital seems to be very much on the leading edge. So we reviewed our own experience for lessons learned. I have time to mention only a few of them today.

Perhaps the most important lesson is that true **commitment to a common purpose** by all project members is absolutely essential - whether the project in question is a multi-year development project or a task lasting a few weeks. It cannot be overstated. It is hard in the best of conditions to keep a large, diverse team working productively. When they are in different places and from different cultures it is much harder. Having a common vision, clear goals and objectives is vital. We know that people are most committed to a vision or purpose which they helped to shape. Achieving broad scale participation in setting the vision, mission, objectives and so on may be more difficult for a dispersed organization, but it is vitally important. There is a lot of potential for rapid escalation of political infighting in distributed groups when they are not so aligned. Skimping the process of getting to agreement on purpose, or ignoring underlying differences around objectives is very dangerous. The more task-focused, the more concrete the goals in terms of what is to be delivered, by whom and when, the easier it will be for a distributed group to sustain commitment to a shared purpose.

As consultants, we have been able to help groups establish a shared vision and strategy using some efficient large-group meeting techniques. A common cause of failure in product development groups is being inwardly focused: being too technology driven and failing to test at an early stage whether there will be a demand for what they are making and paying too little attention to what is important to their potential customers. We strongly encourage groups to include in the vision/objective-setting stage representatives from all the affected parties - internal and external customers, related projects, people providing funds, people providing support services or doing sub-contract work - everyone they need to develop a sound strategy and to gain support for it. Bringing people back together periodically to refresh their commitment, to the goals and to working with each other, is also essential for lengthy projects.

Another critical success factor is selecting the **right kind of leader**, someone who is flexible and skilled enough to lead a dispersed, cross-organizational team with people of many nationalities, from multiple functional disciplines, working with many technologies and over whom he or she will at best have only shared authority. Team-building takes conscious effort in the dispersed team where circumstance makes it harder for that naturally to occur. A typical trap for the leader is to try to be the sole integrator, and it takes much skill to build a self-sustaining dispersed team. Leaders also have to create an environment that allows cultural differences to be a benefit rather than a problem. Multicultural teams can be among the most creative, if the different perspectives and experience of the members can be harnessed. But those very differences can make it hard for decisions to be made unless there is sensitivity to the diversity of assumptions across national cultures. Leaders also have a delicate balancing act to play between establishing a "group" style and adapting their management style to the norms of each culture. We have a number of programs under way to help educate and develop our managers for these kinds of assignments.

Suprisingly, we found that groups did not adequately take into account the problems of geographic separation when they decided who would do each piece of work. There is inherently less flexibility around reassigning work when people are dispersed, and the consequences of making changes are more significant, perhaps requiring key people to relocate or leaving a site with insufficient work for its people It is advisable to think through before finalizing assignments whether a proposed **division of labor** will make coordination too difficult or expensive. In consulting we use a graphical mapping technique to help groups work through some alternatives and literally see the consequences of various organizational choices.

Communication and information technology has an important role to play in support of integration. "Meetings" can take place without people being in the same place using phone, video, or computer-augmented real-time conferencing. Electronic mail, fax, bulletin boards and Notes-style computer conferences let people "talk" to each other when in different cities, countries and radically different time-zones. Electronic databases, combined with sophisticated information agents for search and retrieval, support knowledge sharing across the organization. Project management systems, electronic work-flow tools and virtual notebooks support project planning, coordination and administration. Tools that support the communication, coordination and collaboration needs of dispersed work teams are one of the primary growth areas in the computer software industry as are the devices that allow one to be almost any place and still connect to one's office environment. Another important learning is that introducing such technology without re-designing the work processes, and without the full cooperation of the target users, will probably fail. On the other hand, when those involved are able to participate in the design of how information will flow and in selecting the most useful tools, they will readily embrace new ways of working.

However, invaluable as such technology is, it is no substitute for face to face meetings to work through difficult issues. The electronic tools can help the group to do its routine work while separated, saving the precious time they spend together for more creative activities or for solving complex problems. We strongly believe that people need to spend time together at the beginning of the project to **build trust and establish the relationships** that will allow them later to work together, while apart. The amount of time needed for this can be dramatically reduced through carefully designed and facilitated events. We have also found that people do need to meet periodically or relationships deteriorate: distance breeds distrust and over-reliance on electronic communications can ferment it.

Managing dispersed groups is certainly challenging! one can't get away with muddling through — much more has to be done very deliberately. But it can be exciting and fun, and more important, the business payoff is there if it is done well. As management consultants, we are applying what we have learned from our own experience to help our customers redesign their business processes and to build global teams to enhance their market competitiveness.

BANDWIDTH ON DEMAND METERED SERVICE

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Abstract

Introduction of bandwidth on demand (BOD) metered services via satellite can provide advantages to satellite users and help spur the growth of private line communications. COMSAT World Systems (CWS) is planning to introduce a low-rate TDMA network to provide such services in 1993 in the Atlantic Ocean Region and in 1994 in the Pacific Ocean Region. Participants in these networks will have the ability to provide private line voice, data and videoconferencing services on a seamless, on-demand basis, and pay only for the space segment capacity used during actual transmission.

1.0 INTRODUCTION

Private line telecommunications customers are increasingly demanding flexible, custom-tailored networks designed to meet their unique requirements. These demands have resulted in the growing popularity of software-driven networks which often combine facilities into a seamless network providing on-demand capacity and metered "pay-as you-go" pricing. In order to bring the benefits of these services to international satellite users, COMSAT World Systems (CWS) is developing a Bandwidth on Demand (BOD) metered service offering which will allow flexible point-to-point and point-to-multipoint communications around the globe. This service will provide private-line users of the INTELSAT system with the ability to obtain satellite capacity on demand in increments of 64 kbps up to T-1 or E-1 circuits and pay only for the capacity used.

2.0 PROPOSED LOW-RATE TDMA BOD NETWORK

Currently, international satellite customers must acquire full-time private- line capacity and pay a flat rate regardless of actual usage. While part time and occasional use services are offered, generally they must be arranged in advance and are not truly "bandwidth on demand" type service offerings.

CWS' proposed BOD service will provide customers with on-demand capacity and give them the ability to "pay as they go" for communications space segment. The network will allow for dynamic reconfiguration of capacity so that customers will be able to communicate with several different overseas locations without installing separate "chains" of equipment for each telecommunications channel. Thus, for example, a customer in Los Angeles will be able to have private-line voice communications to Japan at 64 kbps, switch to data communications to Hong Kong at 256 kbps and then conduct a videoconference to Korea at T-1, all in rapid succession with instantaneous demand-assigned set-up for each communications channel. Intra-Pacific and Intra-American communications will also be supported.

The proposed network will be based upon low-rate TDMA technology being developed at COMSAT Laboratories. Transmission rates will range from one to eight Mbps on a burst by burst basis, giving large and small users the ability to communicate with each other in the same network. This network will operate with a decentralized hub, i.e. each terminal will have identical capabilities, including the capability to act as a reference terminal and to provide network management and billing support. The terminals will also allow for frequency and transponder hopping so that the network can be easily expanded.

3.0 IMPLEMENTATION SCHEDULE

Under CWS' current schedule for BOD service implementation, laboratory testing of the TDMA BOD terminal is slated for the second quarter of 1993. This will be followed by a field demonstration between the U.S. and two European countries in mid-1993. Service will be introduced in the Atlantic Ocean region in the fourth quarter of 1993, and in the Pacific Ocean region in 1994.

4.0 ADVANTAGES OF BOD NETWORK

Bandwidth on Demand, usage-sensitive pricing will allow users to determine for themselves whether they require full-time or on-demand services. Since users will pay for space segment only when "off-hook", their overall bill may be less. Also, many smaller users for whom a dedicated line is too expensive, will now be able to obtain private-line services on a more affordable "pay-as-you-go" basis.

The proposed BOD network will also increase the operational flexibility of the current IBS network by changing it from a fundamentally point-to-point network to a point-to-multipoint network. Unlike the current IBS network, which requires separate "chains" of equipment for each destination, users of the proposed BOD network will be able to communicate to any point within the network without need for additional modems, multiplexers or other costly equipment. CWS' analysis of earth station costs indicates that a low-rate TDMA user with as few as two destinations will save on earth station costs compared with a user with a traditional IBS earth station configuration. Thus, participants in the BOD network will have cost-effective, on-demand access to other participants in the network, greatly expanding their options.

This basic difference in architecture between the current IBS earth station configuration and the proposed low-rate TDMA configuration, is illustrated by the following block diagrams.

FIGURE 1

Typical IBS Networking

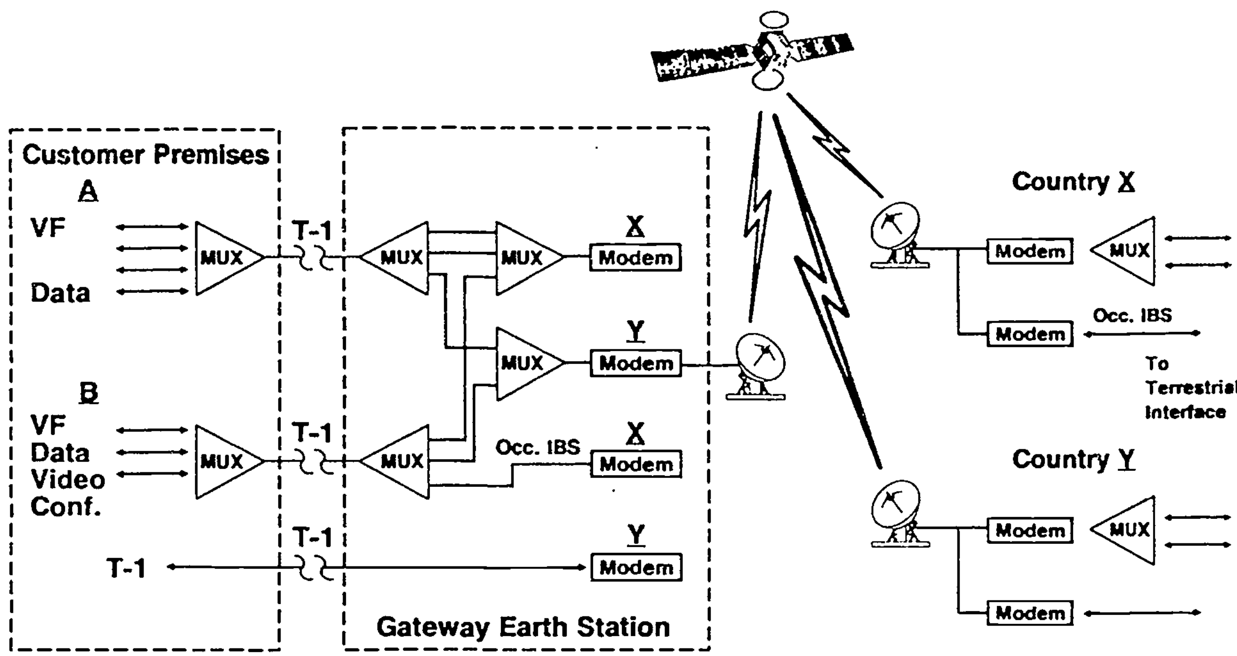
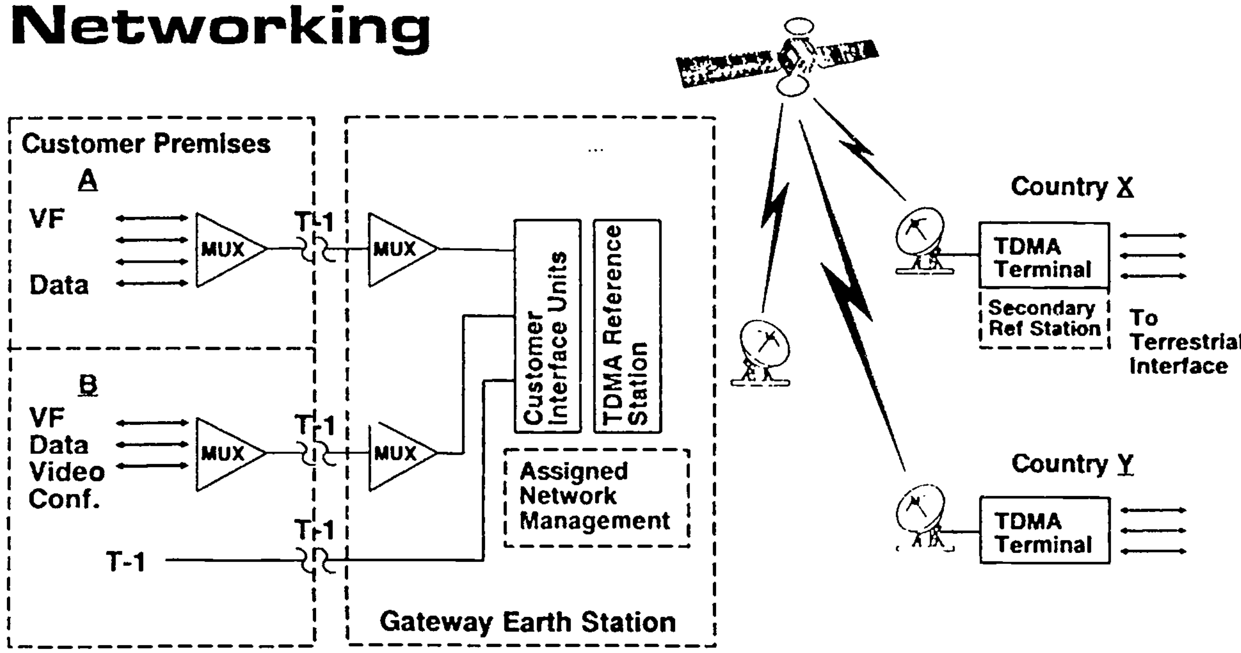


FIGURE 2

Proposed Bandwidth on Demand Networking



This architecture is designed to minimize equipment changes by either the end user or the gateway provider. In a gateway configuration, as is shown above, the customer premise equipment remains identical to that of current IBS equipment so that no additional investment by the customer is required. In a "rooftop-to-rooftop" configuration, the customer would, of course, require a TDMA terminal and the necessary radio frequency (RF) equipment. However, since the network will operate at relatively low rates and include burst by burst transmission and forward error correction (FEC) rate changes, the cost of the RF equipment can be minimized. Current cost projections for the equipment (excluding RF equipment) are approximately $150,000 for a fully redundant gateway terminal and approximately $35,000 for a non-redundant "rooftop" model.

Another advantage of the proposed network is that it will provide for a decentralized hub, with each terminal in the network having capabilities identical to every other terminal. Thus, any terminal will be able to act as a reference terminal, and this function could be rotated among the network participants. In addition, each terminal will have the capability to maintain its own call records data, and thus will not have to rely upon other terminals or telecommunications administrations to generate bills to customers. This design will avoid potential conflicts over hub location and be consistent with the desire of most administrations to retain control over their own traffic and billing procedures.

While there will be a need for a network control center (NCC), its function will be largely administrative, rather than operational. For example, the NCC will retain overall data on the network and provide input into the signatory participants in order to reach administrative decisions regarding loading and network expansion. The NCC will not generally be required for day-to-day operation of the network.

5.0 SPACE SEGMENT

Under the proposed BOD network, Signatories will jointly lease full-time, non-preemptible space segment from INTELSAT and provide such capacity to users on a per-minute or other time-sensitive basis. Space segment for the North America-Pacific network will be acquired from INTELSAT in the West - East/East - West directions with the costs shared by participating signatories based upon usage or some other agreed formula. This trans-Pacific network could also easily be expanded to include West/West capacity for intra Pacific communications and East/East capacity for intra-North American communications. Because of the carrier-hopping capabilities of the TDMA terminals, capacity added in this manner would be integrated into a single seamless network of BOD users.

The space segment acquired from INTELSAT in this manner will be dedicated by the network participants exclusively for use in the BOD network. Users will have access to this capacity either on an on-demand or alternative basis, depending upon the customer's preference. The network manager and signatories involved in the network will jointly determine the amount of space segment required to insure minimal blocking of communications channels. As experience with the network grows, and administrations become familiar with the patterns of use, the efficiency of the network will likely also grow.

6.0 PRICING

Tariffs for half circuits in the BOD network would be established by each signatory on an independent basis and then combined to provide both halves of the satellite circuit. Thus, for example, a rate for 64 kbps BOD communications between the U.S. and Japan would be published; prices would also be established for multiples of 64 kbps up to T-1 and E-1 circuits. In addition, bulk discount, off-peak and other pricing incentives could be developed as the need arises.

Similarly, prices would be developed for calls between Japan and Singapore, the U.S. and Singapore and for each route in the BOD network. In this manner a schedule of tariffs would be created and published which would allow all users in the network to know in advance the space segment costs involved in communications to the various points in the network.

7.0 CONCLUSION

The proposed bandwidth on demand, metered network will allow users to have instantaneous access to all other users in the network and to pay only for the time during which space segment is utilized. For many current IBS users, who are leasing full-time IBS capacity but utilizing it only small portion of the time, this service could provide significant savings. In addition, many smaller companies, that cannot currently justify the cost of full-time space segment capacity will now be able to enjoy the benefits of "pay-as-you-go" private line satellite communications.

8.0 CONTACT

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BROADBAND NODE CONTROL ARCHITECTURE FOR MULTIMEDIA SERVICES

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ABSTRACT

ATM-based broadband networks provide the capability transporting a wide range of multimedia services. This paper focuses, not on bandwidth, but on the number of calls loaded to the broadband network, and discusses how to optimize the call processing capacity for a wide range of varying load in the multimedia services network.

1. INTRODUCTION

With the use of Asynchronous Transfer Mode (ATM) technology for the Broadband ISDN (BISDN) services, there is growing interest in multimedia services taking advantage of this technology. The ATM technology offers the flexibility, that is, the technology allows one physical line to support any given number of channels at a wide range of different bandwidths of up to 150 Mbps. This advantage of multiple channels at multiple bandwidths well meets the requirement of multimedia services.
In terms of the switching technique to be used for the processing of multimedia services (connection-oriented) there is the complicated issue of calculating the number of calls for the facility design. While the number of calls for each individual service can be estimated roughly by past experience, predicting what services will be activated simultaneously is extremely difficult. Because the combination of services will widely vary depending on the user's purpose. Widely varying service usage means a great difference in the number of calls. This varying factor is posing technological and economic difficulty in the design of switching facilities for multimedia services.

This paper examines the problem of multimedia services, focusing on the number of calls rather than the bandwidth. (The number of connections also needs to be considered, but the number of calls herewith represents factors of issues on the multimedia services.) And its purpose is to present a method of controlling the number of calls for the multimedia services while introducing possible solutions to the economic problem in terms of management of medium- and small-size networks.

2. BASIC ISSUES OF MULTIMEDIA SERVICES

The application of BISDN technology for multimedia services allows one physical line to deal with communication services from low speed to high speed information at a bandwidth of 150Mbps. As examples, low speed services may include text mail and telemetry. As for high speed services, high resolution image database access, video program, video-telephony, video-conference, and high speed facsimile, etc. may be provided. Table 1 shows the maximum number of channels that can be handled by a 150 Mbps line. The wide range of numbers is the basic point of the issue discussed in this paper.

In the case of H4 rate (135Mbps) high resolution video program services, a 150-Mbps line supports only one channel. [Fig.1(a)] When the duration of service is 30 minutes, the maximum number of calls will be 2 C/H (call per hour). In the case of low-speed data services (e.g. text mail) which require a bandwidth of 9.6 kbps, the 150-Mbps line can support up to 14,000 channels. [Fig.1(b)] Given the per-call holding time of 20 seconds, the maximum number of calls will be 2,500,000 C/H. The problem here is that the number of calls which can be handled varies depending on the services. For example, designing a switching facility based on the requirement for the H4 rate high resolution video program service can result in the failure of the entire plan to introduce multimedia services because of the lack of capacity. On the other hand, a switching facility designed for the text mail service will have a capacity of 2,500,000 C/H. If this facility with such large capacity is used for handling a call load of 2C/H, it is very uneconomical, even taking into account the reduction in the equipment cost in the future. As explicit in these examples, the problem of the introduction of multimedia services lies in the facility design and the calculation of the number of calls has a significant impact on the provision of multimedia services. A similar problem is found with the 2B + D line of narrowband ISDN (NISDN), where the combined traffic of voice and data communications must be calculated. However, since the bandwidth of BISDN is more than 1,000 times greater than that of NISDN, the traffic load can widely vary, thus making it difficult to calculate the number of calls for BISDN services.

In reality, a 150 Mbps line at a user-network interface will never set up 14,000 channels simultaneously, but extreme examples are used here to stress the basic issues of multimedia services.

3. CALCULATION OF NUMBER-OF-CALLS FOR MULTIMEDIA SERVICES

This section explains how to calculate the number of calls required for multimedia services. Let us assume that there is a workstation connected to a local switch. The workstation supports the bandwidth of 150 Mbps (B) and is capable of providing the multimedia services of S types. The local switch accommodates K subscriber lines, all of which are intended for use of multimedia services. Such local switches as this one and toll switches interconnecting them comprise a regional network (the number of nodes in the region : R). Here, let us assume that the user of the workstation uses the S type of services within the 150 Mbps bandwidth (B) by occupying C channels of bandwidth b for the duration of h, generating traffic load of e. Tables 2 and 3 show examples of applying this assumption to individual business users, along with the calculated number of calls during busy hour (BHC). In these examples, the difference of the total number of calls is 27.5. The purpose of this paper is to present a method to achieve a cost-effective facility design considering this difference.

With multimedia services, it is difficult to determine the BHC value per line with accuracy. This is because measuring the BHC value for each individual service and calculating the sum of the value for each individual service and calculating the sum of the values (N) does not always equal the BHC value of the entire multimedia services. [Fig.2] The busy hour can differ for each individual service. In addition, the combination of services and the number of channels, simultaneously occupied for one service, are difficult to predict. Therefore, the simple sum of the BHC values of individual services is usually greater than the BHC value per line.

In the future, it is expected that, by measuring the actual number of calls on the multimedia subscriber line, the accuracy for predicting the number of calls during the busy hour, and the margin for peak load can be improved. However this paper does not aim to predict such numbers, so the numbers are not discussed in detail. In order to proceed with the analysis, the following formulae are used herewith. When the number of calls for a service is N_i, the total number of calls N(t) handled at the node for one hour from time t can be expressed as follows :

$$N(t) = \sum_{k}^{L} \sum_{j}^{S} \sum_{i}^{C} N_i$$

and

$$\sum_{j}^{S} b_j C_j \leqq B$$

Where C is the number of channels connected simultaneously for different calls,
S is the number of service types, and
L is the number of lines accommodated in the switch.

Next, the number of calls in the busy-hour period (N_{BHC}) is chosen from the largest one of N(t)s :

$$N_{BHC} = [\, N_{(0)}, N_{(1)}, \cdots\cdots N_{(23)} \,]_{\max}$$

Then, the total call processing capacity (N_{NW}) required for the network with R nodes is obtained by :

$$N_{NW} = \sum_{l}^{R} N_{BHC}$$

4. SOLUTIONS

4.1 NODE HANDLING UP TO PEAK LOAD

The basic concept is to handle the busy hour calls by providing each node with enough capacity for processing the multimedia services. However, this approach is uneconomical, for a large margin may be required to insure the flexibility in the multimedia services provision.

$$N_{NW} = \sum^{R} \sum^{L} \sum^{S} \sum^{C} N_i$$

N_{BHC} calculation is omitted.

4.2 NUMBER-OF-CALLS RESTRICTION

In general, an economic solution is to apply a number-of-calls restriction and to avoid excess facilities. The call restriction is activated at a level of a predetermined call processing upper-limit. Two preliminary solutions are discussed, and a proposed solution (4.2.3) is presented.

4.2.1 RESTRICTION ON SUBSCRIBER LINE BASIS

The call processing upper-limit is set on a per-subscriber-line basis to restrict the number of calls flowing to the switching system. This eventually limits the flexibility in the multimedia services because the restriction is applied to some lines even when the local switch is still capable of handling more calls. A possible improvement may be to relax the restriction by applying a high-rate-billing to the services exceeding the upper-limit. With this high-rate-billing, however, one foreseen problem is that a subscriber may be charged at the expensive rate even when they are not provided with sufficient quality services during the congestion period.

$$N_{NW} = \sum^{R} \sum^{L} \left| \sum^{S} \sum^{C} N_i \right|_{UL}$$

UL : Upper Limit

4.2.2 RESTRICTION ON PER-NODE BASIS (WITH CONGESTION RELIEF APPLIED)

The upper-limit is set on a per node basis to restrict the number of calls flowing to the switching system. The restriction is applied based on the sum of calls per node. The switch initiates call-origination and call-termination restrictions to relieve the congestion.

This allows more flexible use of subscriber lines for the services, to the 4.2.1 solution.

$$N_{NW} = \sum^{R} \left| \sum^{L} \sum^{S} \sum^{C} N_i \right|_{UL}$$

4.2.3 RESTRICTION ON NODE-GROUP (NETWORK) BASIS

This method enhances the service flexibility by restricting calls on a node-group basis, rather than on a per-node basis. Call processing, which is conventionally performed at each individual node, is centralized to one control point called the Regional Control Node (RCN). [Fig.3] The RCN performs call processing for all the nodes in the same node-group.

The RCN equips an extra capacity to be commonly used by the nodes in the group. When traffic load exceeds the capacity of a node because of the use of multimedia services, this extra capacity is used to assist that over-loaded node. Unlike the method described in 4.2.2. which per-node call restriction, this method provides network-wide call restriction.

$$N_{NW} = \left| \sum^{R} \sum^{L} \sum^{S} \sum^{C} N_i \right|_{UL}$$

The purpose of this node-group restriction approach is to deal with the excess fluctuation in the load. This centralized control approach may be seen as identical to the host-remote control, as far as system configuration is concerned. But this approach is not intended to centralize O&M functions fully to the RCN. On the other hand, this centralized approach has a strong affinity with the Intelligent Network architecture in the light of the services processing.

The following is the guideline to calculate the RCN capacity.

$$P_0 = \sum^{R} (N_r + M_r) = \sum^{R} N_r + \sum^{R} M_r$$

where Po is the required capacity for the regional network,

N_r is the capacity to handle the busy hour calls at Node r, and

M_r is the margin for the excessive load (or the capacity for the excess fluctuation at Node r)

Po is the sum of the required capacity at individual nodes plus the sum of the margin for the excessive load at individual nodes. The result is equivalent to the physical transfer of the capacity and the margin from individual nodes to the RCN. Hence, the result here is equal to that of the 4.1 method.

The multimedia service requires a relatively higher margin ratio than the single media service. Reducing the margin ratio can produce economic effects.

To reduce the margin ratio, the margin is centralized to the RCN, considering the balance between the flexibility and the economy. The required capacity of the RCN can be calculated in the following formulae:

$$P_1 = \sum^{R} N_r + \frac{1}{R} \sum^{R} M_r$$

$$P_2 = \sum^{R} N_r + \alpha \sum^{R} M_r + (1\text{-}\alpha) |M_r|_{max}$$

P_1 is the sum of required capacity for all the nodes in the node group plus the average margin value for a node. The resulting capacity is centralized to the RCN.

$\frac{1}{R} \sum^{R} M_r$ is the common capacity shared by all the nodes.

This means some nodes in the group may not satisfy the originally required level of margin at the peak load.

P_2 is the sum of required capacity for the nodes in the node group, α times the margin value for all nodes, and ($1-\alpha$) times the largest margin value among nodes. ($0 \leq \alpha < 1$) The resulting capacity is centralized to the RCN.

When $\alpha = 0$,

$$P_2 = \sum^{R} N_r + |M_r|_{max}$$

P_2 here means the sum of required capacity for the nodes plus $|M_r|_{max}$ shared by all the nodes. This means any node in the group satisfies the originally required level of margin under exclusive use.
When $\alpha=1$,

$$P_2 = P_0$$

This means any node in the group can satisfy the originally required level of margin.

The costs for the above cases can be compared as follows on the assumption that the cost is linearly proportional to the capacity:

$$P_1 < \underset{(\alpha=0)}{P_2} < \underset{(0<\alpha<1)}{P_2} < P_0$$

For economical solution with maximum flexibility for multimedia services, P_2 is suggested for the RCN's capacity .Then the α is determined by the number of service types available in the regional network.

5. CONCLUSION

The number of calls widely varies for multimedia services because channels of different bandwidths are used for different services. This paper proposes the control architecture centralizing call processing functions for several switching nodes in a regional network into a control point named a Regional Control Node (RCN).

By the RCN, spare network capacity can be allocated dynamically to the node which needs excessive power temporarily, thus ensuring both the flexibility and the economic advantage of multimedia services.

Table.1 Maximum number of calls per one physical 150 Mbit/s

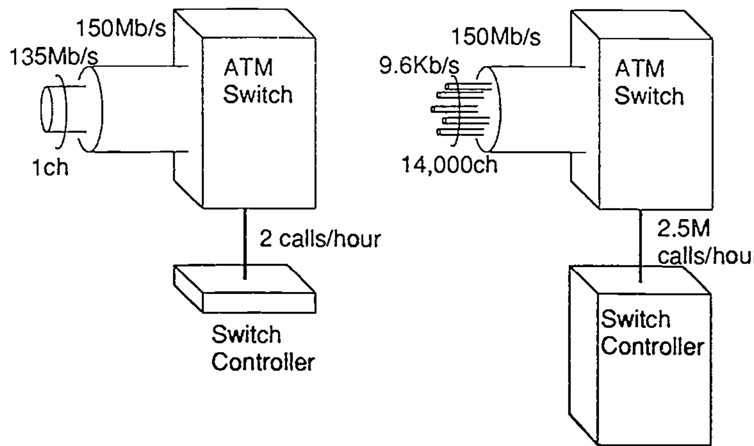
H4 rate video	135.0 Mb/s	1 ch	1800 sec	2 C/H
High speed data	1.5 Mb/s	87 ch	10 sec	31000 C/H
Voice	64.0 Kb/s	2100 ch	180 sec	42000 C/H
Low speed data	9.6 Kb/s	14000 ch	20 sec	2500000 C/H

Table.2 One 150 Mbit/s subscriber line used for a single business user (who uses video services usually)

	b	c	h	e	BHC
H4 rate high resolution video service	135.0 Mb/s	1 ch	30 min	1.0	2.0 BHC
Videoconference	10.0 Mb/s	1 ch	90 min	1.0	0.7 BHC
Electronic newspaper	1.5 Mb/s	1 ch	10 min	0.1	0.6 BHC
Telephone	64.0 Kb/s	1 ch	3 min	0.2	4 0 BHC
Document DB	64.0 Kb/s	1 ch	10 min	0.01	0.1 BHC
G4 facsimile	64.0 Kb/s	1 ch	10 sec	0.01	3.6 BHC
Text mail	9.6 Kb/s	1 ch	10 sec	0.01	3.6 BHC
					14.6 BHC

Table.3 One 150 Mbit/s subscriber line used for a single business user (who uses data services usually)

	b	c	h	e	BHC
H4 rate high resolution video service	135.0 Mb/s	1 ch	30 min	0.1	0.2 BHC
Videoconference	10.0 Mb/s	1 ch	90 min	0 1	0.1 BHC
Electronic newspaper	1.5 Mb/s	1 ch	10 min	0.1	0.6 BHC
Telephone	64.0 Kb/s	1 ch	3 min	0 2	4.0 BHC
Document DB	64 0 Kb/s	4 ch	10 min	0 5	12 0 BHC
G4 facsimile	64.0 Kb/s	1 ch	10 sec	0.02	7.2 BHC
Text mail	9 6 Kb/s	1 ch	10 sec	0 05	18 0 BHC
					42 1 BHC



(a) FIG. 1 (b)

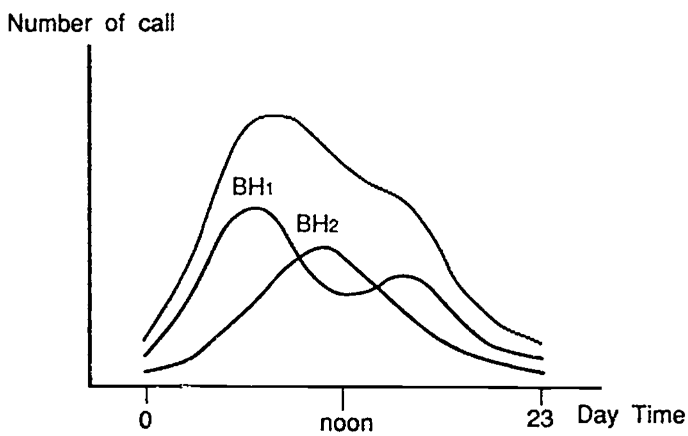


FIG. 2

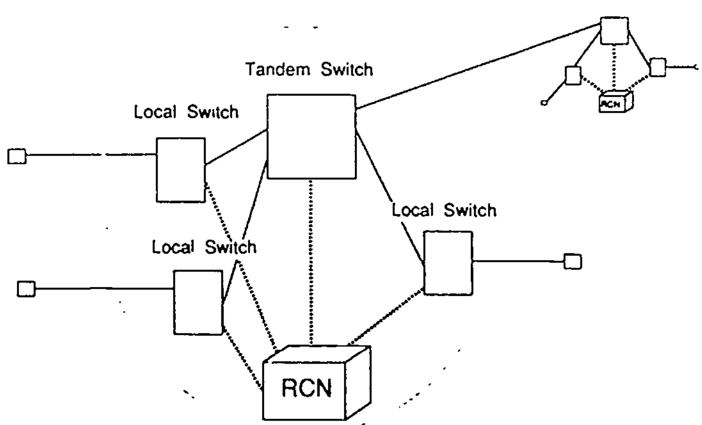


FIG. 3

ART AND TECHNOLOGY: BRIDGES TO A MULTICULTURAL SOCIETY

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The elimination of artificial cultural, social, and political barriers created by the cold war has added momentum to the technological forces that are rapidly uniting the world in a single global economy. However, the world's growing interdependence cannot guarantee peace or productivity where historical separatism and cultural ignorance persist. Fortunately, the same information revolution that is energizing world economic integration can be directed toward promoting multicultural understanding. In this paper we explore the use of art, our shared human language, in conjunction with interactive multimedia, virtual reality, and other new telecomputer technologies as a means to bridge disparate cultures, thereby creating a truly global society.

Long heralded by visionaries, the Information Age has arrived at last. A revolution without geographic, political, or cultural boundaries, it has overtaken us with no end in sight. New communications and telecomputer technologies are making it possible for us to manipulate and move vast quantities of information to learn, create, and interact in ways considered impossible only a few years ago. Teleconferencing and global computer networks offer unprecedented possibilities for human interaction. Historic upheavals, too, are furthering freedom of communications. While countless details are still being worked out, the globalization of markets -- whether of goods or ideas -- is a reality.

Regrettably, the barriers dividing countries and peoples are not entirely gone. Even where walls have been physically dismantled, ancient enmities and strife continue to threaten world peace. In spite of the fact that a global economy already exists -- with shared scientific and technological ideas, a single electronics industry, communications relay satellites, and a growing international fiber optics network -- historical and cultural distances continue to divide people and nations.

On the eve of the twenty-first century, the world is so inextricably interconnected that cultural and economic isolationism is unthinkable, even if it were desirab. . The future that can be built together, with respect and understanding for every contributing culture, is far richer, materially and spiritually, than any that can be envisioned alone. Global and individual wealth and well-being depend upon mutual respect and understanding.

Perhaps the most effective thing that can be done to promote multicultural understanding is to use the new technologies -- with their powerful capacity for shaping and delivering human interchange -- as virtual bridges across the vast distances separating cultures. However, if the information revolution is to fulfill its promise, these bridges must carry information that truly enriches and enlightens humanity. While the new technologies are still young and malleable, and their applications unlimited, it is essential that they be harnessed to a universal language through which our most deeply held values, aspirations, and beliefs can be communicated. Taking into consideration the special attributes, temporary limitations, and enormous potentials of the information revolution, we propose art as that language. Combining ancient and contemporary arts with the new technologies will greatly enhance multicultural learning and understanding.

ART AS THE LANGUAGE OF MULTICULTURAL LEARNING

There can be no more distilled expression of a culture than its works of art. In creating art, consciously or not, artists are attempting to communicate at a powerful emotional level to those within their own culture. The best work transcends its cultural matrix and speaks directly to our common humanity. This is why art serves so superbly as a universal language -- as a means toward understanding the history, culture, and values of other peoples (1).

While there are countless disciplines which might reasonably serve as a means to understanding culture, such as history, sociology, mathematics, and science, only art lends itself to the full range of experiential capabilities offered by the new technologies. Numerous seminal projects explore art's natural capacity for communication through visual, aural, and spatial means -- the very means Information Age technologies so powerfully enhance. Furthermore, there are philosophically compelling reasons why art is uniquely suited as the language of a new multicultural learning.

Art has always been central to human society, our own late twentieth-century American tendency to treat it as peripheral to the main concerns of life notwithstanding. From the day man began to dwell in caves and hunt large beasts, drawing pictographs on cavern walls, art has served both as material evidence of our vision and as an essential means of transmitting our values from one generation to the next. Life is celebrated in song, film, narrative, dance, and myriad other art forms, from the implements and ritual of the Japanese tea-ceremony to the expressive form of Michelangelo's *David* to the line and color of an O'Keefe.

Historically, art has been a significant force for the preservation of culture; yet it has also been a primary agent in the transformation and revitalization of civilizations. For example, the art of the Italian Renaissance did not merely document the intellectual and cultural revolution then occurring; it fueled the changes in perception that redefined humanity for European civilization well beyond the bounds of the Italian peninsula and the fifteenth century. Art is no less appropriate to fuel the revolution at hand. Mankind is redefined in terms of an expanded world view.

COMBINING ART AND TECHNOLOGY: WHAT'S BEING DONE NOW

Interactive multimedia technologies offer remarkable possibilities for learning through art. A review of current projects clearly demonstrates that art linked with and enhanced by telecomputer technologies has the potential to serve as a primary vehicle for increasing multicultural understanding. In these projects the very nature of learning is being expanded and democratized. Beyond them, the new virtual reality (VR) technology offers visions of art encounters that were previously unimaginable: virtual walks around the precincts of an ancient temple-city; dances with partners in other time-zones; entirely new meanings for *theater-in-the-round*. While skeptics may believe we are years away from realizing such possibilities, American researchers are currently touring virtual architecture (2), and Japanese department store customers are renovating their kitchens in cyberspace (3). For all the new technologies, advances are being made at an astonishing pace.

A National Gallery in Every School: Interactive Video

Museums, universities, businesses, foundations, artists, and others are engaged in ongoing research into computer-aided art exploration and its positive implications for society. Already, efforts such as the National Gallery's American art videodisk project offer the public significant learning opportunities beyond those available a mere two or three years ago. The museum has digitized a library of 10,000 images from its American art collection onto a single high-resolution videodisk, making its holdings widely accessible to students not only of art, but of American history and culture. (The museum is distributing 2,500 disks to American schools free of charge.) The superior image quality and durability of the medium are obvious advantages over other methods of presentation and preservation (such as traditional slide libraries or videotape). What's more, the student can access images quickly in any desired order, request enlarged details, and retrieve and study information at his or her own pace (4).

Although definitive research has yet to be done regarding the effect of interactive technologies on learning, it is arguable that the capacity for interaction is this project's most important benefit. Ample experiential evidence supports the concept that interactivity improves the learning process. Active as opposed to passive techniques of participation and exploration produce a higher level of involvement on the part of the learner and therefore a greater depth of emotional, as well as intellectual, understanding (5).

The National Gallery is not alone in exploring the possibilities of interactive videodisk; among others, institutions as venerable and diverse as the Louvre, the London National Gallery, and the Art Institute of Chicago have produced (or are now producing) not only videodisks, but more complex multimedia systems that allow their users to explore interactively such things as an artist's complete oeuvre, biography, techniques and materials; as well as historical maps and textual information about the period during which the artist worked (6). The Tama Techno-Art Museum, currently devoted to high-definition, interactive exploration of the paintings of Vincent Van Gogh, opened in November, 1990, near Tokyo. Its designers plan to extend interactive capabilities to the works of other artists as well (7).

Exploring Ancient China, the Mayan Empire, and More: Interactive Multimedia

Numerous interactive multimedia systems are already up and running, among them the remarkable Emperor Qin project, produced under the direction of Ching-chih Chen of Simmons College School of Library and Information Sciences, and currently in use at the University of Tennessee at Knoxville. Much excitement was generated by the discovery in 1973 of nearly life-size terracotta warrior figures in a field outside the ancient capital of Xian, China. This project allows a multifaceted exploration of the archaeological excavation of that find, and of the lifetime of the first Chinese emperor, Qin Shi Huang Di. Emperor Qin's vast third century B.C. burial site was found to contain an army of over 2000 of the warrior figures -- each with individual features of face and costume -- as well as other artifacts and works of art. Combining still and full-motion video, audio, and text in English and Chinese, two impeccably researched double-sided videodisks (already being converted to alternative formats) contain hundreds of thousands of still and motion images of the excavation process and its artifacts. Included are oral interviews with Qin scholars who elucidate the significance of the find, as well as extensive text from previously unavailable Chinese sources and American publications treating the subject. An index (in English and Chinese) points the way to use at varying levels of knowledge, so that scholarly researchers, high-school students, and the interested general public all may benefit optimally from the videodisks. The individual user can browse as desired or rapidly access information anywhere in the program; peruse such information for any length of time; and rotate, zoom in on, and otherwise manipulate images and text (8).

Palenque, a program produced by the Center for Children and Technology at Bank Street College of Education in New York City, allows children to learn about Mayan art and culture through many of the same kinds of multimedia interaction. The program, for which a child narrator acts as a guide (at the main menu-level) to the Mayan city of Palenque, is built explicitly upon the thesis that an understanding of an entire culture can be achieved through initial exploration of its art (9).

A Poem, a Painting, and a Symphony: The Individual Masterwork as a Gateway to the World

Contrasting with information projects like *Emperor Qin* and *Palenque*, which begin with relatively broad subject matter (an archaeological dig; a Mayan city-plan), are projects designed to radiate outward from a single work of art. For IBM Educational Systems, Morgan Newman and Allen De Bevoise have produced a prototypical interactive multimedia system designed around a single poem, Alfred Lord Tennyson's "Ulysses" (10). At a conference convened by the San Diego Communications Council in October 1990, Mr. James Dezell, IBM Vice President and General Manager, Educational Systems demonstrated this project. Designed primarily with high-school students in mind, the Ulysses project allows an individual to read, listen to, or see any of several different actors' dramatic readings of the poem -- making it possible, among many other things, to note and compare interpretations. The student can request definitions of words and explanations of unfamiliar phrases and literary allusions; access historical background information on the Trojan War and the poem's namesake; observe as one of several literary critics discusses the poem's significance, or ask to witness dialogues between given critics. The student can also select collateral information on various poetic forms, Greek mythology, nineteenth-century English literature, Tennyson's life and literary oeuvre, and the social and cultural environment of Victorian Britain. The project incorporates text, taped interviews, music, still images of art from the Homeric period, dramatic film footage, and clips from television news and other contemporary documentary sources. Information is layered, via icons and hypertext (indexed words), in such a way that students can pursue to varying depths issues and matters of individual interest, and bypass information considered irrelevant or tangential to a given purpose (11).

La Guernica, produced by Robert Abel and his partners, is another interactive multimedia project with a single art work at its core. An image of the Picasso painting inspired by the infamous bombing attack on the town of Guernica during the Spanish Civil War serves as the base of a program allowing exploration from art formal, art historical, biographical, political, and larger historical perspectives. The student can ask to hear Picasso or any one of several critics discuss the painting; access text regarding its formal qualities or its place in Picasso's career; listen to eyewitness accounts of the actual attack on Guernica; and ask for additional information regarding the event's historical context and political impact (12). Ultimately, this project and others like it allow students to synthesize related information and build a unified vision of a particular passage in human history far more quickly than they might have done via traditional study of isolated disciplines.

Music projects built around single works include Voyager Company's compact disks allowing exploration of Beethoven's *Ninth Symphony* and Stravinsky's *Rite of Spring*. These works can be accessed at various skill levels via musical, historical, cultural, or political information pathways. Of special benefit to the student of music is the capability to retrieve and read textual information regarding a specific musical passage while synchronously listening to it (13).

Among other capabilities, users of the Beethoven disk can search for individual themes, request a display of Beethoven's original score, and refer to textual commentary by Robert Winter, a musician and Beethoven scholar at the University of California at Los Angeles (14). It is also possible to leap from a glossary containing musical concepts such as "dotted rhythm," to a textual definition of the concept, to an aural example of "dotted rhythm" within the symphony. According to Professor Jack Logan, whose music students at San Diego State University use the interactive multimedia *Ninth Symphony* disk, it encourages students to "go beyond passive listening and become involved in discovering why the symphony unfolds as it does (15)."

Using Multimedia to Promote Multi- ural Understanding: The Ojibwe Curriculum Cr oads Project

There are also new projects incorporating use of interactive multimedia technologies in larger learning contexts. One of these, the Ojibwe Curriculum Crossroads Project, is being developed by Corinne Nason and Yvonne M. Wilson for exploration of Ojibwe culture by native and non-native American students. An interactive multimedia component on Ojibwe art and culture is used in conjunction with an oral history project involving Ojibwe elders and classroom visits from Ojibwe storytellers and artists. The project addresses issues of cultural pride and self-esteem, and encourages students in cooperative problem-solving, learning through experience, writing, and active participation in the creation of new aspects of the program. Increased multicultural understanding is an explicit goal of the project (16).

Bringing the Learner into the Creative Process: NewBook/Warsaw 1939

While not technically involving multimedia, a program of interest because of its high degree of interactivity is *NewBook Editor*, developed at the University of San Diego (USD). *NewBook* allows its users to read electronic "books" designed with multiple branching plots, and at the same time create a record of thoughts and decisions regarding the path taken through the book. A teacher can be present electronically to contribute discourse or to comment "in the margins" of the student's investigation. The program operates in real time, so that student and teacher immediately affect each other's writing. The reader can try out various interpretations of the material from various points of view, and receive immediate critical guidance (17).

The first experimental "book" created for (and with) *NewBook Editor* is a history/ethics/creative analysis project called *Warsaw 1939*, dealing with events in Poland prior to World War II. According to the project's developers, "It is interactive to the point that it will not function *unless* the student reads and thinks" (18). *NewBook/Warsaw 1939* is designed for use at three levels. The first level offers historical background information incorporating hypertext which allows the student to select and pursue at will information of particular individual interest. Level two assumes the reader is inside the Warsaw ghetto in 1939; he or she is asked to make decisions (via hypertext) that determine what happens next. While other projects currently offer both the hypertext and role-playing scenario capabilities of *Warsaw 1939*, level three distinguishes this project by allowing users to reread a compilation of the textual paths and ethical decisions taken thus far; comment upon it; select passages from it; and incorporate these passages as desired in their own analytical essays. Furthermore, students can link their writing to the existing text, and thereby create composite or "new books" (19)

Expanding Cinema Arts: Creating Interactive Multimedia in the Classroom

Beyond providing the opportunity to select, pursue, and absorb information at an individual's own pace -- even beyond enhancing the learner's mental engagement -- interactivity's ultimate value may lie in its encouragement of creativity. A project of a type entirely different from those just discussed, and having a long developmental history in an educational setting, is the Rowland Animation program. Originated fifteen years ago by Dave Master, an art teacher in the Rowland Unified School District of Los Angeles, the program began with a student production of a 20-second animated film, made with little more than a Super-8 camera. Now the much-lauded program has evolved so that students can combine original drawings and clay figures with computer graphics, still and full-motion video, and natural and synthesized audio (20). Although Rowland films have won many awards, the benefits to the students producing them may be even more impressive than the films themselves. Among these benefits are improved critical-thinking skills, increased self-esteem, and assurance in learning and using new technologies as creative tools (21).

Most recently acquired technological tools include Macintosh-based video-editing and production systems (gifts from Digital F/X and Apple Computer) and a network of PS/2 computers awarded by IBM. According to Master, the video-editing systems will be used in conjunction with computers and VCRs for frame-accurate editing, graphics importation, and titling; and the PS/2s will be used in producing interactive multimedia projects like the *Ulysses* project previously discussed (22). In this case the new technology is making it possible for its users to create end products incorporating and exploiting the very technology used in production. This is a phenomenon of the Information Age, and a primary mechanism of its acceleration.

Stepping into the Video Display: Current Virtual Reality Projects

Few in communications-related fields will not have heard *virtual reality* described. Using a computer with powerful graphics and sound generation capabilities, position and motion sensors, a mask that shuts out everything but stereoscopic images from two graphics displays, and a glove or full body suit that allows sensory feedback, it is possible to experience the sensation of entering a three-dimensional space or "virtual reality" in which one can move around, "feel" and manipulate objects, and interact with others who have "entered" the space. Research and development efforts for the new virtual reality (VR) technology are already producing medical, military, aeronautic/space, architectural, design, and fine art applications (23).

In his book, *Virtual Reality*, Howard Rheingold describes a walk he took through a virtual version of Sitterson Hall at the University of North Carolina in Chapel Hill, where VR research has proceeded since the late 1960s. The actual building, now being used as the site of further VR research, incorporates changes made to the architectural plans as the result of earlier virtual walk-throughs by architects and prospective occupants (24). It is only a matter of time before experimental applications like this one become purchasable products. According to Rheingold, "With the 1989 entry into the VR industry of (California software companies) Autodesk and VPL . . . the notion of architectural walk-throughs left the realm of research and entered the world of commercial development" (25).

Together, Japanese and American companies are also exploring VR's capabilities for virtual interior design/decoration. In mid-1990, VPL and Matsushita Electric Works began exploring a joint venture to allow Japanese department store customers to use a VR system to select kitchen appliances (26). A year ago the system became available to customers in one Tokyo showroom; within the first six months it proved so popular and effective in selling new appliances that Matsushita made the decision to expand to one hundred showrooms within five to ten years.

In a virtual kitchen whose dimensions and decor are identical to his kitchen at home, a customer can see how various appliances sold in the store would look and fit. He can even open appliance doors to check for proper clearance. VPL is continuing to work with the Japanese firm on enhancements to the system, which will include giving the customer the ability to quickly reposition appliances; change color schemes, surface textures, and lighting effects; and "try out" insulation against unwanted environmental noise (27).

Creating Virtual Works of Art: The Banff Centre for the Arts

Research into fine arts applications for VR technology is also under way. The Banff Centre for the Arts in Alberta, Canada, is hosting an ongoing "Art and Virtual Environments" project, with a goal of providing artists not only with state-of-the-art VR tools, but of moving "beyond the constraints of goggles and gloves to include pertinent developments in telepresence, audio virtuality, collaboration at a distance and interactive multimedia" (28).

Via this project, several artists have already completed virtual reality works. Lawrence Paul, a native Canadian of the Salish tribe, created a VR environment called "Inherent Rights, Vision Rights," that has since been exhibited at the National Gallery of Canada in Ottawa. The viewer/virtual reality explorer enters a virtual spirit lodge inhabited by figures derived from the artist's paintings. These figures take on various behaviors dependent on the action of the VR explorer, and together all "participants" move about in a complex, three-dimensional soundscape (29).

The Banff Centre has also begun working on the technical problems involved in transferring multimedia information, with the ultimate goal of allowing interaction on the same project by artists in widely separated locations (30).

THE NEXT STEP: MAKING THE NEW TECHNOLOGIES MORE POWERFUL AND ACCESSIBLE

Technology is already being used to enhance art learning and teaching in a multicultural framework. The logical next step is to make systems based on this technology more capable and accessible to people everywhere. These enhanced systems will assist in understanding not just a single art tradition and the culture in which it arose, but a multiplicity of traditions and cultures and the relationships between them. This interactive multimedia, multicultural education will ultimately allow human beings to redefine themselves and their place in a global society.

It is of utmost importance that the new generation of systems be readily accessible and affordable for people in many countries and diverse learning environments: otherwise, it will benefit only a narrow elite. What can be done to ensure that the next generation of systems will meet these goals? The following five broad areas of activity illustrates the task at hand:

Expanding the Information Space

More areas of knowledge can be integrated into the software information space. Currently existing projects demonstrate the concept of using art as a starting point for the investigation of a single culture. The Qin project, for example, allows the individual using it to begin with a study of the Qin warrior figures and other artifacts, and from them explore outward to an understanding of the culture of the Qin dynasty *limited only by the amount of information in the database* -- which, given the thoroughness of the project, may not be much less than the total information available anywhere on the subject at the present time. However, when the culture to be explored is one for which more information exists (for instance, the long and productive Tang dynasty of China), new challenges are created by the radically increased size of the database and the correspondingly increased complexity of the information links within that database. The size of the database increases even more dramatically when information about multiple cultures is linked.

The challenge is to fashion an information base that allows the highly idiosyncratic and creative linkages made in the human mind, so that its users can follow curiosity wherever it leads. For example, a student might begin exploring imperial architecture of the Qin era, follow links to Mayan architecture in Palenque, and from there progress to a study of other indigenous North American cultures, including the Ojibwe. Alternatively, the student might begin with an Ojibwe carving, proceed to Mayan sculpture, and from there to the terracotta warrior figures of Xian. Finally, the student might compare the art and culture of the Qin dynasty with later Chinese dynasties, such as the Tang, and possibly even "browse" forward in time to Chairman Mao's Peoples' Republic and the present day.

Fortunately, new high-capacity storage devices make large databases feasible. However, because of the number of independent researchers and their locations at various international sites, the database envisioned will be both physically distributed and stored in a variety of formats. "Information highways" -- the high-bandwidth, optical fiber data channels needed to tie this distributed information base together into an integrated network -- are now beginning to be put in place (31).

To recapitulate, the hardware to support very large, distributed, multimedia databases is already available or in the final stages of development. The software required to support these databases still needs to be developed. Currently much work is being done on organizing and accessing very large, distributed databases. However, to date, the vast majority of this work focuses exclusively on textual and numeric data. The work being done on very large, distributed databases needs to be extended and linked to the work being done on multimedia databases, in order to develop data storage techniques, rapid retrieval strategies and algorithms, and standardized interface protocols, so that information from distributed, independently developed multimedia databases can be accessed and merged in a seamless fashion.

Expanding Opportunities for Multimedia Creativity

The active and creative aspects of the interactive learning experience can be enhanced. Most of the projects reviewed here support the research component of the learning experience; using one of these is analogous to doing research in a large library with a well-designed card catalog. The student's transition from doing research, through performing analysis, to creating a reflective or bold new work, is not supported.

While the Rowland Animation project is distinct from the others discussed, in that it does support creative production, the initial research/gathering of materials for student productions is done through traditional methods rather than through interactive multimedia systems. (Although the students are producing multimedia and even interactive multimedia products, they are learning the way people have always learned.)

To a degree, the USD NewBook project does address the integration of interactive information acquisition with the creation of an intellectual/creative product by the learner. However, this end product is essentially a traditional essay; it contains neither nontextual elements nor hypertext links.

The full benefit of interactive multimedia learning will only be realized when it is possible for users, in their own analytical or creative products, to reflect the intellectual and sensory richness of the learning experience. That is, interactive multimedia "term papers" and creative products are the natural (and necessary) corollary to interactive multimedia "textbooks."

To write multimedia "term papers" multimedia "word processors" are needed. Essentially, these are authoring systems for interactive multimedia documents which will allow nonprogrammers to create and edit these documents as easily as text is now manipulated with word processors. In fact, the large-scale creation of interactive multimedia textbooks in itself requires such authoring systems.

Work on this problem is currently being done in various locations. One such project is the MAEstro Multimedia Authoring Environment under development at Stanford University. MAEstro is designed to facilitate the addition of new media and/or new media formats to the authoring system. However, it is limited in that it is designed for linear presentations requiring no interaction on the viewer's part (32). For the new generation of systems, projects like MAEstro can be extended to provide support for the full range of interactive multimedia capabilities.

Enhancing Interpersonal Interaction in Multimedia Environments

Interpersonal interaction can be enhanced and integrated with the interactive multimedia learning environment. There are two major approaches to achieving the interpersonal interaction envisioned. One is direct realtime interaction, conceptually an extension of the current teleconferencing technology; the other is nonrealtime interaction, conceptually an extension of the current computer networks with their personal E-mail and special interest group capabilities.

In the long run, direct realtime interaction offers great promise for enhancing the learning experience and allowing it to be shared between people of various cultures. The nonverbal aspects of this interaction would, for example, allow a saxophonist in Osaka to sit in on a jam session in San Francisco without the musicians having to know each other's languages. However, most intellectual and much artistic communication will require the use of language. Given the linguistic diversity of the world's citizens, it is unreasonable to expect that all participants will understand any single common language.

Machine translation of natural languages has proved to be a difficult problem, but one which is beginning to yield to faster computer hardware and advanced software design techniques. The NEC corporation, for example, has developed a prototype two-way interpretation system which directly translates between spoken English and Japanese. The company plans to expand the system to include Thai, Chinese, French, and Korean (33).

While in some ways more constrained than realtime interaction, nonrealtime interaction will, in the near future, probably play a more significant role in enhancing interpersonal communication and collaboration. Nonrealtime interaction presents fewer technological challenges than does full realtime teleconferencing, and also has certain intrinsic advantages. It allows participants in the information exchange to review messages from other participants and to formulate their own messages at a pace and time convenient to them. When participants communicate across many time zones -- as they do, for instance, in the Pacific-Rim area -- time differences of half a day make normal realtime communications (such as phone calls) difficult to arrange. Finding a mutually convenient time for communication becomes more awkward when several people from scattered time zones are involved; cost and logistical difficulties aside, teleconferencing is so hard to arrange simply because of time differences that it cannot be used for routine multiparticipant interaction.

The form of nonrealtime interaction proposed here is a radical extension of current E-mail systems. The messages will in fact be interactive multimedia documents, rather than simple text documents, as is the case with current E-mail. For example, using the new system, a musicologist in Lima might incorporate passages of Peruvian flute music in an E-mail communication with a colleague in Jakarta or Sydney.

The previously described user-friendly multimedia authoring capability will be an integral component of multimedia E-mail. We envision some form of machine translation capability as another component allowing the new E-mail systems to effectively link participants from multiple cultures. Fortunately, due to the elimination of the voice recognition challenge and the relaxation of timing constraints, the nonrealtime translation of written language is much less difficult than realtime (instantaneous) speech translation. Even before solving the problem of automatic translation, work can begin on the data communication protocols required for exchanging interactive multimedia documents via E-mail.

Zooming into the Virtual Future

Research on virtual reality and attempts to integrate VR with other multimedia learning techniques can be expanded and accelerated. The enhancements suggested thus far involve using pieces of available technology in new combinations, possibly adding layers of complexity in the development process. But they are enhancements that can be done in the near future, with widely available, relatively inexpensive equipment.

VR requires a significant amount of special-purpose hardware, and will therefore be less available than the other new technologies discussed. On the other hand, VR is beginning to leave the laboratory and enter the market place, and -- if the history of other computer-related products is any guide -- once sales reach a certain critical volume, economies of scale will lead to a rapid decrease in the cost of VR systems. When that happens, virtual reality will offer the promise of even more dramatic changes in the ways we learn and create. Tom Furness, director of the Human Interface Technology Laboratory (HITL) at the University of Washington, believes the impact on education/experiential learning could be enormous (34).

With regard to implications for original art, an artist may ultimately be able to create an entire virtual world for others to explore -- a world that not only looks and feels and sounds as the artist would have it, but that has its own history and laws of physics; is described by its own mathematics; and in which certain sociological and political behaviors are appropriate. Perhaps automatic machine translation of human languages will be possible in this world, so that people from various backgrounds may even interact verbally.

While VR applications represent a slightly more distant future than the other new technologies, it is worth noting that development of an experimental national virtual telecommunication network is in progress, with the ultimate goal of creating a high-bandwidth international VR telecommunication channel (35). The important point is that, when and as they are developed, VR capabilities -- like technologies deemed more feasible for the near term -- can also enhance learning, creating, and human/cultural interaction.

Increasing Accessibility and Reducing Cost

A global high-bandwidth communications network and standardized, moderately priced multimedia workstations can be developed. Although high-capacity information highways are beginning to be put in place, connecting cities and countries around the world, in order to support the broad-based interactive multimedia learning envisioned, these information highways must serve the entire global village. A critical goal is to expand the existing network so that information available at remote sites can be transmitted to locations with no on-site database capability, such as small schools and offices -- and ultimately, private homes (36).

Another important goal is the development of the standardized, low-cost, multimedia workstation/personal computer also required to make interactive multimedia learning widely accessible. The computer industry is already beginning to address this challenge. For example, companies including Analog Devices and IBM/Texas Instruments/Intermetrics (the last-named three working jointly) are in the process of developing digital signal processor (DSP) chips together with standardized interface software for inclusion in the next generation of personal computers. These integrated DSPs will greatly increase the capacity of personal computers to process realtime video images (37).

Barring unforeseen technical difficulties or changes in the economic climate, workstations capable of supporting an interactive multimedia learning environment will be available in a timely fashion.

The End Result: A Revolution in Learning

The cumulative effect of enhancing the capabilities of interactive multimedia and other new-technology systems in the ways described, will make possible a revolutionary reformation of education as we know it, in terms of form, content, and accessibility. The widespread availability and self-directed nature of interactive multimedia learning will make it useful beyond the traditional school setting. It will be especially valuable for the independent, lifelong learning crucial to inhabitants of a fast-changing world.

The vision is of people everywhere actively pursuing their own interests through the intellectual and sensory richness of the art-centered global multimedia information base. Foreseen is the universal ability of children and adults alike to interact and collaborate with fellow explorers in the multimedia environment, and to create and exchange original multimedia products. As human beings build and cross virtual bridges into unknown cultural territory -- and there learn, share dreams, and creatively work together -- mankind will know itself as citizens of a rich and truly global society.

MAKING IT HAPPEN

If citizens of a global society are to live in peace, not only goods, services, and technical information must be exchanged, but values and visions, as well. Why do Americans feel uncomfortable unless they're calling each other by their first names? Why do Japanese find it unacceptably rude to say no? Why, in both these cultures, are family farmers esteemed beyond the limits of apparent reason? Such questions exist for every culture on Earth, and no matter how seemingly inconsequential or foolish, begin to penetrate to the heart of cultural identity. When we can answer a thousand questions about each other, the dreams binding us together will begin to be stronger than the history dividing us.

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Social Impact of Cellular Telephone Usage in Hawaii

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1. ABSTRACT

Hawaii is noted to have the highest penetration rate of cellular telephones in the United States. This sudden surge in the use of anew technology has been accompanied by questions related to social and lifestyle impact, especially in the area of driver safety. The following study reports on the analysis of exploratory data gathered from high school and university students, on-duty police officers, as well as other Oahu residents using cellular phones for a variety of business and personal applications.

2. BACKGROUND

In less than a decade from its introduction into the marketplace, the cellular telephone has found a welcome home in the hearts and minds of the American public. Though application of cell technology may be relatively new, its human interface is, in fact, a familiar reminder to an already comfortable mode of communication, beloved by at least three generations. Conceptually, the telephone is also the perfect companion piece to another all-time American favorite: the automobile.

This seemingly made-in-heaven match capitalizes on an illusion of freedom and independence: two of the strongest elements defining American culture. A combination of maintaining accessibility via telecommunication while remaining physically free in a moving vehicle provides a sense of personal control over space and time. It is a powerful temptation within the reach of many: those who may have already lost other forms of control over their daily lives, as well as those in power who are simply seeking to preserve the status quo. For some, it serves as an efficient business tool that will help them better perform their designated duties; for others, it is a transformational technology that opens a new and previously unattainable dimension in their lives.

Respondents: The following study is a preliminary foray into the attitudes and impressions of two sets of Oahu residents concerning cellular telephones. It represents the aggregate views of 169 high school and university students as well as 945 Honolulu police officers on traffic-related duty who were surveyed during the period of May through November, 1992. The survey instrument included closed and open-ended questions on a variety of portable communication technologies, from which cellular telephone data has been extracted for this report. In addition, ten in-depth, open-ended interviews were conducted with representative users of cellular telephones; from strictly business users through the now-prevalent continuum of mixed business and social use, to the strictly "safety & security" minded users. It should be noted that the student sample is not representative of the total student population in Hawaii and may, in fact, be biased toward a more affluent and sophisticated sub-set of the younger population. Although all students were attending public institutions of education (Kalani High School and University of Hawaii at Manoa) no extrapolations can be made to a wider population base. Additional information on the police sample is provided in Section 5.

3. HAWAII'S CASE

Hawaii's unique geography, limited road system, premium property costs, and more traditional family values may have put it ahead of many other states in the applications of this new technology.

Hawaii is noted for two distinctions in the cellular telephone market. First, it seems to have the highest penetration rate of cellulars in the United States; approximately 9% (anticipated 10% by first quarter of 1992), compared to the highest mainland rate of 7-8% in Las Vegas.(1) Second, while mainland cellular telephone users seem to prefer mobile units, Hawaiians are firmly committed to portables. The difference in portable use rates are quite startling: an estimated 90-95% in Hawaii compared to 26% portable use on the mainland in the second half of 1992.(2)

One line of reasoning that would explain both of these phenomena would be the timing of the introduction of this service and the physical layout of the populated areas of the islands. One must note that cellular technology was not introduced into the islands until mid-1986 three years after the granting of the first FCC licenses on some mainland locations.

Yet, because of the FCC's west-to-east granting of Rural Service Area (RSA) licenses, the island of Kauai became the first benefactor of such a license through a GTE Mobilnet application.

Thus, by getting a relatively "late" start but with more comprehensive coverage, Hawaiians may have been introduced to this technology by more experienced marketers and may have skipped the earliest (and bulkiest) generation of the equipment. In addition, because of limited road systems, people are not spending as much time "on the road" as they would on many mainland states. To make their investment in cellular technology more worthwhile, it makes sense to have a portable unit that can be used in a variety of circumstances - and not just in a car. For a younger or less affluent market segment this also translates into keeping in touch when the primary mode of transportation is not a car at all but a bike, moped, or motorcycle.

4. PRIVATE IMPRESSIONS

One of the tasks for all those surveyed was to rate their own frequency of use of cellular telephones and their impressions of this technology on a five point scale (frequency of use from "never" to "regularly" and impressions from "negative" to "positive"). Results from both groups, as can be seen in Figures 1 and 2, show a relatively large number of individuals who have used cellular phones (71% for police and 66% for students) with a majority in each group having a positive impression of this technology. Negative impressions range from 11% for the student group to 17% for the police officers.(3)

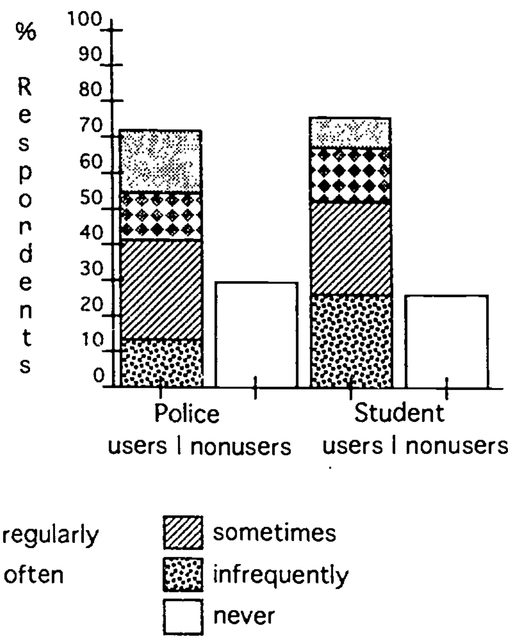

FIGURE 1. FREQUENCY OF CELLULAR PHONE USE BY STUDENTS AND POLICE OFFICERS

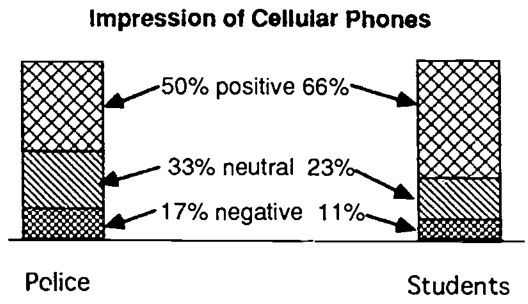

FIGURE 2. POLICE & STUDENT IMPRESSIONS OF CELLULAR TELEPHONES

A full range of attitudes and impressions toward this technology were recorded, from negative to ambivalent to positive. In addition, between 23-33% of the populations studied remained neutral in their impressions.

Negative Impressions: Typically, negative attitudes toward the cellular phone come from those who are not cellular phone users themselves, and if they are, their objections are generally limited to the inappropriate use of the instrument by others. The most often-heard complaint is danger to safety on the road; followed by lack of social etiquette in public places such as restaurants, theaters, meetings, and classrooms. The younger generation is almost unanimous in its praise of cellular telephones. Two of the often-cited negative issues related to this technology, that of privacy and matters of traditional etiquette do not appear to be of major concern to this group. Of over 150 students surveyed in this category, fewer than 4% had strongly negative impressions of this technology. This number climbed to almost 9% for police officers.

In the police data, a positive relationship exists between the frequency of use and a positive impression of the technology; the more frequent the use, the more positive the impression. In fact, out of 231 respondents who used cellular telephones with any regularity, only 15 (or less than 7%) had a negative opinion of this device whereas at the low-use level the numbers were almost equally divided between negative and positive impressions, with a slight leaning toward the negative (51% to 49%).

Ambivalent: The best example in this category illustrates how a simple chore, given the chance, can create an ambiguous social behavior. A high school student on a very tight schedule had borrowed her mother's cellular telephone for the day so that she would not miss a deadline for calling in her order for senior-year photographs. As she was making the call from her car, she commented with great misgiving to those sharing the ride: "I feel like a yuppy scum." Of course, this person should be pleased to know that a recent market survey in

London has put "yuppies" fifth on the list of top cellular phone users, behind "people who travel, busy people, entrepreneurs and 'wheeler dealers.'"(4) It would not be unreasonable to assume that some of our collective impressions of a technology will be based on the image we conjure up of its user population. This image itself seems to span a wide spectrum of positive, negative, and "shaky" adult characters, ultimately leaving one with an ambiguous perception of cellular phone users.

Positive: Any number of factors may account for the more positive image that cellular telephones enjoy with the student group, including their receptivity to new technologies based on greater exposure to a variety of such technologies throughout their lives and the specific professional experiences of the law enforcement officers.

The most often-cited positive impression of this device is related to its convenience. Many who see it as an indispensable tool for safety and security are adamant about classifying it as a necessity, rather than a luxury.

5. SAFETY AND SECURITY

5.1 ON THE ROAD

One of the most controversial social issues regarding the use of cellular telephones is road and highway safety. The most vocal critics of this new technology will invariably point to the hazards of being in the vicinity of a driver weaving from lane to lane while dialing a number or being engrossed in a telephone conversation.

While earlier research shows that the safety benefits of cellular telephones in cars may offset potential hazards,(5) it could not be automatically assumed that such results are generalizable to the current situation in Hawaii. Several conditions have prompted a re-evaluation in this state: first, contemporary use of cellular telephones in Hawaii is no longer limited to the business community but extends to the general public; second, the number of individuals with access to such devices has increased dramatically over the last several years; and, finally, with the increase in number and variety of users, the use patterns may have shifted, both in terms of the purpose of calls and their number and duration. In addition, the roads and driving conditions on Oahu are quite different from those on the U.S. Mainland.

"House Concurrent Resolution Relating To Highway Safety," of Hawaii's Sixteenth State Legislature (1992) acknowledged the need "to obtain statistics on the potential dangers and the extent to which ... cellular phone use while driving has contributed to traffic and pedestrian accidents in the State."(6) As neither the state's Department of Transportation nor the Honolulu Police Department had collected any statistics that would allow for a retrospective search and analysis of relevant traffic accidents, it was decided to conduct an exploratory survey to determine the extent to which on-duty traffic officers have observed the interference of cellular telephone use with safe driving habits on Oahu's roads. Because of the exploratory nature of this study and in the interest of time for reporting to the next legislative session, it was decided to accept the inherent shortcomings of a self-administered instrument.

To this end, 1700 questionnaires were distributed in late October, 1992 through the Honolulu Police Department's Records & Identification Division to all police officers with traffic-related duties. In addition to inquiring about cellular telephone-related accidents or unsafe driving habits observed, this three-part questionnaire also dealt with frequency of personal use, impressions, and safety-related aspects of other mobile or portable telecommunication media such as radio head-sets, multiple radio speakers, boom boxes, laptop computers, and portable television sets. Of the 945 valid forms returned by early November, questions in Part II of the survey (personal experiences as police officers) have been analyzed and will be reported in this paper.

<u>The reader is urged to keep in mind that the respondents were not asked to report documented facts, but to simply state their own perceptions, impressions, and personal experiences.</u>

Questions which appear in bold italics in the remainder of this paper have been taken directly from the survey instrument and represent a subset of the 26 questions asked of the HPD officers.

In your experience, does cellular or mobile telephone use contribute to or cause automobile accidents?
Never / Seldom / Occasionally / Often / Very Often

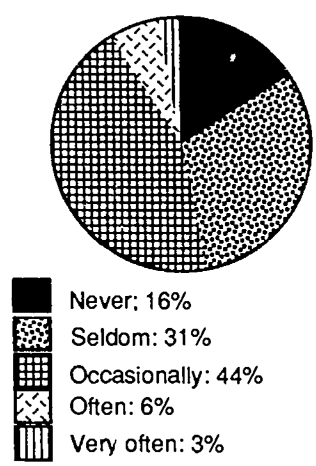

FIGURE 3: POLICE OPINION of CELLULAR PHONES CONTRIBUTING TO AUTO ACCIDENTS

Of the 892 police officers responding to this question, only 16% (or 142) felt that cellular phones were never a contributing factor in accidents. While 280 (31%) thought that this technology was seldom involved in serious safety violations, 390 or 44% of the respondents saw cellular phones as an occasional contributor to auto accidents. Of the remaining 9% who had reason to believe that there was a much greater safety hazard associated with cellular phone use on the road, 6% registered "often" and 3 % chose "very often" as their category of response to this first question. See Figure 3 above.

In the past twelve months of investigating accidents, in your opinion how many accidents seemed to involve cellular phones as a contributing cause to the accident? None / 1-2 / 3-4 / 5 or more

This follow-up question was answered by 742 of the respondents. This lower number in some measure reflects the assignment status of some of the officers within the last twelve months. Of this number, 17 or 2% reported having investigated five or more accidents in which cellular telephones were a contributing cause. Another 54 (7%) had seen 3-4 telephone-related accidents while an additional 27% had investigated one or two such accidents. The majority of the respondents (64%), however, had not investigated any accidents in the previous 12-month period in which cellular phones could be considered a contributing cause to accidents. See Figure 4.

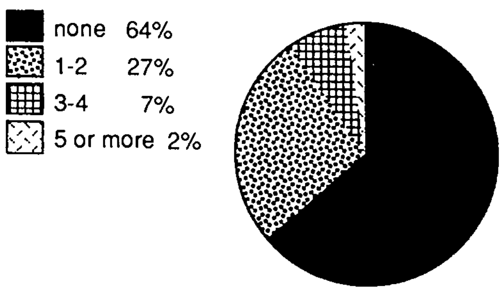

FIGURE 4: NUMBER OF ACCIDENTS IN WHICH POLICE IMPLICATE CELLULAR PHONES AS CONTRIBUTORY CAUSE (12-MONTH PERIOD)

Is cellular or mobile telephone use while driving less or more risky than eating while driving? Less Risky / As Risky / More Risky

Many of the advocates of cellular telephones argue that automobile drivers engage in a variety of behaviors that lead to at least equally if not more hazardous driving conditions. Among the activities cited are drinking hot beverages, eating, smoking, and applying cosmetics (or shaving). The survey approached this issue from several different perspectives, including a parallel set of questions involving such distractions as noisy children, unrestrained pets, and smoking. This line of reasoning led at least one officer to propose the banning of noisy, bouncy, children from moving vehicles while it prompted another to defend pets as highly desirable companions in cars! Figure 5 shows a wide variation of opinions on the risks of cellular phone use as compared to eating while driving.

A comment from a "strictly business" cellular phone user was that drivers have an inherent knowledge of what they are capable of doing behind the wheel and that their use of cellular telephones will follow the same pattern of behavior. In other words, "If you know how carefully you need to bite into your hamburger and how long it takes you to accomplish this task without endangering others, then you will follow the same rules when trying to make a phone call." Of course, if not all drivers are as conscientious as this respondent while eating, the presumption is that they will also have the same failings in their use of the telephone.

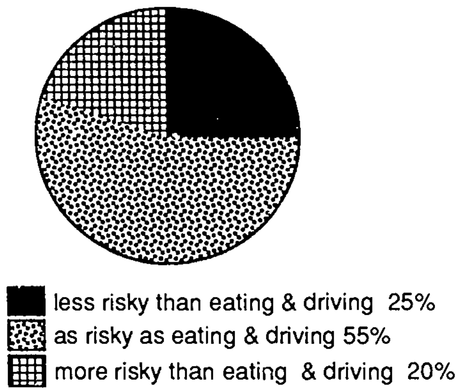

FIGURE 5. CELLULAR PHONES: POLICE OPINIONS OF RISK

Do the benefits of cellular phones (such as reporting drunk drivers or accidents) outweigh any risks caused by their use (such as driver inattention)? Yes / No

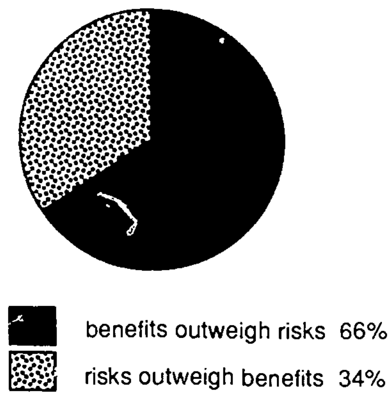

FIGURE 6. POLICE OPINION OF THE BALANCE OF BENEFITS AND RISKS OF CELLULAR PHONES

5.2 PUBLIC AND PRIVATE SAFETY

A growing number of subscribers nationwide and in Hawaii report their primary use of this technology as a safety net in times of crisis. Statistics for this phenomenon abound in the industry and can be seen in nearly every issue of the industry's trade journals. For example, a survey of cellular phone users in October of 1991 revealed that 40% of current subscribers considered themselves exclusively business users, but "only 17% of non-users interested in cellular say they would use it solely for that purpose."(7) Cellular Marketing's 1992 mid-year cellular carriers survey results show a steady trend of 18% decline in subscriber phone bills even as the industry is reporting a 57% subscriber growth rate. (8) This indicates that new subscribers to this service are more likely to be non-business users. To illustrate, when the business and non-business customers are lumped together (as in Cellular Marketing's survey noted above), the average bill is estimated to be $77.88 down from $87.40 six months ago and $95.00 in 1991.(9) In Hawaii, the average phone bill for those who are subscribing to cellular for safety reasons alone is approximately $30.(10) Individual interviews have shown the lower range to be approximately $16-$20 per month, or just a few dollars more than the minimum monthly subscription rate offered by the companies.

One way to assess the public's image of the cellular telephone as a safety tool is to look at patterns of cellular sales and local occurrences of crimes or disasters. Reports from mainland states have indicated an unprecedented surge in cellular phone sales and subscriptions after well-publicized crimes such as the Zywicki murder case.(11) Ron Nissen, former press secretary to President Ford and now a spokesman for the Cellular Telecommunications Industry Association in Washington was quoted as saying, "Every time somebody gets their car stolen or gets hurt or killed in a carjacking, there's an increase in customers."(12)

Hawaii cellular telephone companies have also noted a surge in demand for portable communication associated with a local crime against a young woman during Christmas of 1991 as well as the more widely publicized case of hurricane Iniki during the Fall of 1992.(13)

6. LEGISLATION

6.1. POLICE RESPONSE

Would you support or oppose legislation regulating the use of cellular and mobile telephones by the driver while the car is in motion? Support / Oppose / No Opinion

Because the Honolulu Police Department testified before the Legislature on behalf of this study and the questionnaires were distributed from the Captain's office, there was some concern that the respondents might feel obligated to reflect what they may have believed to be the views of the top administrators. Although some regional patterns became evident in the process of data entry, there was no indication of an overall bias and the aggregate result seems to confirm the independence of individual respondents.

Of the 909 officers responding to this question, 295 or 32% would oppose legislation limiting the driver's use of cellular telephones in a moving vehicle, while 355 or 39% would support such legislation (See Figure 7). Some of those supporting such legislation placed contingencies on their positive responses, such as "reasonableness of legislation." On the other hand, a number of those who opposed legislation seemed to find more pressing safety issues on Hawaii's roads; for example, banning the use of radio headsets or political "sign waving" during political campaigns. The most-often cited reason for not mandating new regulations is that there are already ample laws addressing this issue through the "driver inattention" category. The advantage of such a catch-all category is that it can be extended equally to all future technological additions to vehicles which can potentially cause even greater distractions than telephones.

In the latter category we can already place emerging technologies such as the extended mobile office, including a variety of laptop computers, fax machines, and "personal communicators."

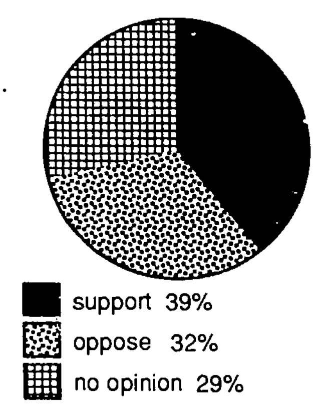

FIGURE 7: POLICE SUPPORT OF LEGISLATION

6.2 OTHER RESPONDENTS

A subset of the University of Hawaii sample population participated in a semester-long computer-mediated discussion of the pros and cons of legislative action related to the use of all phones in moving vehicles. These respondents were unanimously against such legislation. The following comments are typical of the many received from the student population and the larger public sample:

"It is the responsibility of the driver to make sure they are capable of using a phone while driving. If they are not, then they should not [or will not] use it." "I think it would not be practical and fair to cellular phone users to make such a restriction. If they do that, they should put a ban on CB radios, and police scanners, or any form of mobile communications that is used while driving also. But they would never do that. Why pick on cellular phone users only?"(14)

6.3 PROSPECTS FOR LEGISLATION

There is currently a gridlock in the state court system caused by mandatory sentencing requirements imposed by the legislature and a rising number of drunk driving, child abuse, and spouse abuse cases being brought to trial. The courts are seeking some relief from the legislature for granting more discretionary options for the judges and are clearly stating that any additional legislation which affects the workload of the courts should be supplemented by budgetary allocations to defray the costs of the judicial process.(15)

At a time when Hawaii is facing diminishing revenues and the state budget is being scrutinized for every possible cutback, it would seem unlikely that the legislature will consider legislative action against cellular telephone use when many in the field of law enforcement believe that the current catch-all category of "inattention to driving" can be used and enforced against unsafe cellular phone use. On the other hand, some police officers believe that even if cellular-related legislation is difficult to enforce, it should still be placed "on the books" to discourage frivolous use of the telephone while a vehicle is in motion.

7. OTHER SOCIAL ISSUES

There are a variety of social issues related to the use of cellular telephones. Some, such as privacy and fraud, have received extensive publicity. Others, such as personal and societal costs of the technology, unethical or illegal uses, and the inherent limited availability of the current services are argued away in terms of future technical or social fixes. The latter concerns are not limited to cellular telephones, but apply to the vast majority of communication technologies introduced into the American culture during the past decade. As all of these areas are worthy of lengthy discussions, any tokenism will be dispensed with here. Instead, the remainder of this paper will focus on identifying certain emerging themes as potential areas for further research.

A synthesis of results from over 1100 respondents begins to establish some behavioral patterns of cellular telephone use. Such patterns are not only apparent to the users themselves, but also equally apparent to the non-users, as may be witnessed by the growing trend toward establishing "social protocols" in public places. Such patterns of use and behavior can take on positive or negative overtones, or can be classified as impulsive or spontaneous behavior which may have both positive and negative connotations. The following categories are a first attempt at identifying themes and are not intended to be mutually exclusive.

Impulsiveness and Spontaneity: To check (up) on people on the spur of the moment. There is a greater tendency to keep in touch with "significant others." On the one hand this may lead to stronger interpersonal relationships; on the other, it may border on overprotectiveness and result in a total lack of private time. It may soon become difficult to draw the line between impulsive spontaneity and compulsive tendencies of the "need to know" variety. Although the majority of normal phone users will report that they keep their telephone "shut down" to avoid receiving calls, others will report that they must leave the phone on, and are effectively "on call" at all times - not for business, but for personal relationships. In such cases a spontaneous changing of plans can just as easily lead to negative as to positive results in a relationship.

Adventuresomeness and risk taking: To go places and not feel afraid; to go places never gone before, being secure in finding directions. The portable phone serves, in effect, as a safety net which allows more risky activities such as travelling late at night, unaccompanied, and in unfamiliar territories. Spontaneous behavior can also be classified under this heading for many individuals who are unaccustomed to this form of decision-making.

Responsive & responsible behavior Some responsibilities become more bearable, or perhaps less burdensome - and thus more possible - when portable telephones are used. Keeping in touch with a baby-sitter while enjoying a night out can reduce the new parents' guilt or anxiety. Networking with homebound people in the community becomes easier and more streamlined from the road. The father-to-be can be reached at any time when the crucial call comes in. Examples are as varied as the responsibilities we assume in our daily lives.

Control and power: Fundamentally, this technology can be used as a powerful instrument of control. Its power is dependent on the dominance of the individual subscriber in existing or potential relationships:

Being in control. Many use this device as an enabling tool that allows them to remain in control of an environment broader than their immediate physical surroundings. By forwarding calls from land-line phones, individuals can expect to be reached for decision-making at all times. One interviewee in law enforcement has combined several unconnected (in the sense that no call forwarding takes place from one device to another) telecommunication technologies to maximize this control. A pager is used for screening second-level priority calls; the portable cellular telephone number is shared with immediate family members and close friends but is otherwise used for business purposes; the mobile phone is used for high priority business calls only; and the 2-way radio is used for the highest level business-related emergency use. The individual stressed the importance of being in total control of the communication process. Although he receives incoming calls on the cellular phone, the conversations are generally kept long enough to screen the importance of the call. In most cases the calls are returned "when and where" he chooses at a later time.

Being controlled. At the opposite extreme, the portable phone is also used, in a sense, as an "electronic leash." At a time of rising crimes, especially against young women, it is not unreasonable to have a caring father or spouse provide a gift of this instrument. Whether there are any cultural or ethnic overtones to this practice remains to be studied. Although the rate of women subscribers is increasing across the nation, there seems to be even a greater preponderance of this occurrence in Hawaii. As mentioned under the heading of impulsiveness above, there may be cross-over of intentions from safety considerations to control when the individual feels obligated to keep the phone on at all times for incoming calls. That is, if there are feelings of shame or embarrassment associated with carrying a telephone, then the point of caring may have been crossed into invasion of privacy regardless of the original good intentions.

Bonding and Caring. The antithesis to the control and power perspective is that of loving, fun loving, and binding family ties. In a culture where traditional family values are quite strong and daily contacts span several generations, the cellular phone has strengthened this bond. Family members will keep in touch to arrange many social gatherings, and to stay in touch with those who may have no traditional access to telephones. For example, one family subscribed to a cellular phone service for an elderly family member who was confined to a long-term care facility with no in-room land-line telephone. In the aftermath of the Iniki hurricane, many extended families kept in touch by cellular phone and kept track of food and supplies being relayed from one island to another. Cellulars are also used regularly by fishermen and others who spend time on water or near shore.

A final phenomenon which is unique to cellular phones and fits best in this category is that of the "paid for" allotment of air-time (usually about 15 minutes per month) which may as well be used for purely social reasons.

An obsession with "connectivity": There is a euphoric feeling experienced by some users - especially newcomers to the service - which they attribute to the creation of a different temporal and spatial world. For some, this is a spacious and timeless utopic world from which they don't wish to escape. For others, it is an experience that can only lead farther and farther away from "normal" life, to where the instrument becomes the controlling and dominant force. When that final point is reached, most will pull back to reassess and redefine their relationship with the "tool." The addictive behavior this device seems to create in some seems to be a reflection of the individual's character rather than any inherent trait in the instrument. Yet, this is the perfect tool for constant connectivity and in that sense nothing like it had ever existed before.

8. OTHER MOTIVATIONAL FACTORS

Motivation for early adoption of cellular telephones, as with other new communication technologies, can be traced to internal and external factors. The external motivations, such as job requirements or potential for career advancement are relatively easy to identify and categorize. In these areas Hawaii seems to be following the same patterns as other states, with high usage of cellular telephones among individuals whose work does not confine them to an office desk or requires them to be outdoors: contractors, construction workers and builders; sales staff and sales executives; and real estate agents. Other professionals who consider themselves "on-call," will also avail themselves of a tool that guarantees interactive contact regardless of whether they are in a board room or on a golf course.

The more clearly identifiable internal motivations seem to fall within the context of gaining social status, or exploring new "toys." Few among the younger generation doubt the value of the cellular telephone as a status symbol. In a state that has more than its per capita share of wealthy residents and tourists, there is no scarcity of role models for early adopters of cellular phones.

It may be more difficult, however, to identify those individuals with an inherent desire for a different life-style. Taken individually, members of the latter group may be hard to locate or to categorize. But when their numbers reach a critical mass, they may portend a trend that is difficult to dismiss. Perhaps we have reached such a threshold in Hawaii

In more uncertain times, we grasp at anything that might improve our quality of life. In an environment where larger goals for independence are denied, there is a tendency to seek and accept alternative symbols. In Hawaii, perhaps even more so than many other states, two additional external factors may be providing the impetus for cellular telephone ownership. When the ultimate American dream of home ownership is closed to a large segment of the working population, it may create a greater need for more achievable and visible consumer goals. Coupled with a hospitable climate which allows for long-term stays outdoors or in one's automobile, this may account for some of the local variations in cellular telephone penetration and use in this state. In an environment where many live with their extended families in cramped quarters, a well-furnished car may be the next best option to the privacy and independence generally afforded to single-resident home owners, a cellular telephone becomes as much of a necessity as would a land-line phone in a conventional home.

Thus, portable cellular telephones have found a welcome home in Hawaii, overcoming the physical isolation of its land mass; limited and increasingly more congested road system; premium land and property values; and a more traditional outlook on family togetherness and bonding.

END NOTES

(1) Scott Silvey, Market Manager, GTE Mobilnet, personal interview, Nov. 11, 1992.

(2) Ibid, for Hawaii figures. Maxine Carter-Lome, ed. "New Users Soar While Subscriber Bills Plummet," Cellular Marketing, Vol. 7, No. 9 (Sept. 1992), p. 25.

(3) Throughout this paper, statistics related to this study which appear in percentage form have been rounded to the nearest one percent.

(4) "UK: Mobile Phones No Longer for 'Yuppies,'" From: NewsBytes (online news service), 25 Nov 92, 20:51:38 GMT. Researchers at Millward Brown, a market research company commissioned by Cellnet, asked their interviewees to describe the top five types of character who were most likely to use a mobile phone.

(5)Mobile Telep hone Safety Study: Report to the Legislature, Department of California Highway Patrol, March 1987.

(6) Excerpt from letter to Hon. Daniel J. Kihano, Speaker, House of Representatives, Sixteenth State Legislature, from Committee on Legislative Management, Re: House Concurrent Resolution No. 377, dated April 16, 1992.

(7) "Is That a Personal Call?" RCR (Radio Communications Report) Vol. 10, No. 20 (Oct. 21, 1991) p. 1.

(8) Maxine Carter-Lome, ed. "New Users Soar While Subscriber Bills Plummet," Cellular Marketing, Vol. 7, No. 9 (Sept. 1992), p. 24.

(9)Ibid.

(10) Both local cellular telephone companies, GTE Mobilnet and Honolulu Cellular Telephone Company, have informally confirmed this figure.

(11) Zywicki, a student at Grinnell College in Iowa was killed while driving to college and her body was found alongside a highway in Missouri. Co-incident with this report, Cellutech's sales for that month doubled from 3000 to 6000 compared to the previous month, and Cellular One reported a 50 percent increase in phone calls to its toll-free information line. (Chicago-Sun Times; NewsByte Service)

(12) "Crime up; so are car phone sales," clarinews@clarinet.com (UPI) (online news service) 12 Nov 92 6:10:55 PST.

(13) Although no formal studies were conducted at the time to ascertain a direct link between the homicide and increased demand for cellular phones, GTE Mobilnet registered an unusual rise in subscriptions coincidental with this crime. (Silvey) The case of hurricane Iniki has been well documented by the local press in terms of the cellular companies' public service assistance in providing the only means of communication with the island of Kauai residents when primary telecommunication services were disrupted for several weeks.

(14)Computer conferencing comments from students in a telecommunication services course. Fall semester, 1992. Almost identical comments appear on survey forms of both students and police officers; as well as interview transcripts from other cellular telephone users.

(15) Hawaii Public Radio newscast, 11/25/92.

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Imparja Television Pty. Ltd.

Australia's Aboriginal Owned Commercial Television Company

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1. ABSTRACT

The very remote areas of Central, North East, and Western Australia are served by satellite delivered Government and privately owned (Commercial) television services using three "footprints" of the Aussat satellite network (which is now privately owned by the Optus Corporation, Australia's second monopoly carrier).

The licence to operate the Commercial television service to the Central Zone footprint was granted to an Aboriginal owned company, Imparja Television Pty. Ltd., in 1987, following an application and submission of evidence to a Licence Grant Hearing of the Australian Broadcasting Tribunal by the Central Australian Aboriginal Media Association (C.A.A.M.A.) from which Imparja Television Pty. Ltd. was formed.

2. FEATURES OF THE IMPARJA TELEVISION SERVICE

2.1 GENERAL.

It took almost forty years for the thinly populated "outback" areas of Northern and Central Australia to be provided with the television services that had become available to residents in capital cities and larger regional to cities from the mid 1950s to the late 1960s (typically, in country areas, one channel carrying the programs of the government owned Australian Broadcasting Corporation and one channel carrying an advertising supported "Commercial" program). Because of the grossly uneven distribution of the population (85% of households contained within about 15% of the land area) it was not possible, in Australia, to contemplate the provision of even the Government, much less a commercial television service, in the "real" outback until satellite distribution of programs became possible.

The then Government owned Australian domestic satellite network, Aussat, which was established in the early 1980's, provided four spot beams for television services to remote locations. The beams covered the following zones:-

Western Zone
Central Zone
North East Zone
South East Zone

Each zone was to have a satellite distributed ABC Television Service and a commercial (privately owned, advertising supported) service. In the event, although a commercial licence was granted to the South East Zone, the licence was not taken. ABC services were established in all four zones. The Imparja beam power contours are shown in Fig. 1.

The Imparja TV service commenced transmissions early in 1988 after surviving an Appeal to the High Court of Australia by the rival applicant for the licence (the then licensee of the existing Commercial TV service in Darwin) which challenged the validity of the Broadcasting Tribunal's Decision on grounds of questionable viability of the proposed service.

3. OBJECTS OF IMPARJA TELEVISION

The major objects of Imparja Television, as set out within the Memorandum of Association, are to:

(a) provide adequate and comprehensive broadcasting and satellite services within and around the Central Zone Remote Commercial Television Service Area and elsewhere;

(b) provide educational broadcasting and satellite program services in the areas of health, law, social security and items of public interest, and in so doing attempt to overcome the problems of low literacy levels existent within the Aboriginal communities within the Central Zone Commercial Television Service Area and elsewhere;

(c) arrest social disintegration within the Aboriginal society by the provision of programs in Aboriginal languages with emphasis upon Aboriginal traditional culture and music;

(d) by the dissemination of information as regards employment opportunities and work programs, assist in alleviating significant economic problems that exist within Aboriginal communities;

(e) promote knowledge and understanding by the Australian community of Aboriginal culture and tradition and of the special difficulties experienced by Aboriginal people as a minority within that community;

(f) engage in and conduct research into areas of application of the broadcasting media and satellite program services to and for the benefit of Aboriginal people;

(g) ensure access by Aboriginal people to existing and forthcoming communications facilities in order that they may benefit in accordance with the objects;

(h) record and preserve Aboriginal oral history and music;

(h) employ and train Aboriginal people in the areas of broadcasting, satellite program services and the electronic media; and

(i) undertake and implement activities which further the economic and social development of Aboriginals and which are conducive to the advancement of Aboriginals.

In addition to the above-mentioned objectives, Imparja Television has other significant objects of a commercial television nature. One of the principal commercial objectives of Imparja Television is commercial viability within the long term.

4. ABORIGINAL OWNERSHIP OF IMPARJA

All the A and B class shareholders in Imparja Television Pty. Ltd. are Aboriginal interests. Whilst a controlling management interest is held by CAAMA, the balance of the A class management shares are held by a variety of Aboriginal interests located throughout the Imparja TV service area in the Northern Territory and South Australia.

A.T.S.I.C. (Aboriginal and Torres Strait Islander Commission) is the current sole equity shareholder in Imparja Television, with B class preferential shares.

Imparja Television is a 100% Aboriginal owned business enterprise and a very important question in this regard is what are the legitimate returns for the investment of the shareholders in Imparja.

5. COMPATIBILITY OF IMPARJA OBJECTIVES

It is appreciated that the potential may exist for some conflict or incompatibility between some of the above-mentioned objectives of a social or cultural nature and the objective of commercial viability.

It is the firm conviction of the Imparja Company however, that the Imparja social and cultural objectives are not necessarily in conflict with the Imparja objectives of commercial viability.

In terms of the struggle of Aboriginal people for real self-determination, self-sufficiency, economic independence and future survival as a viable racial minority within the dominant Australian society, it is possible that Imparja may effectively promote the social, economic and cultural aims of Aboriginal people within the Imparja viewing area whilst at the same time effectively pursuing the important objective of economic viability in the long term.

Indeed, the aim for and achievement of economic viability by Imparja in the foreseeable long term is likely, in turn, to assist and contribute towards the promotion of Aboriginal social, economic and cultural aims. An economically viable, profitable, independent and strong Imparja Television enterprise, surviving without being dependent upon government hand-outs, will substantially further the significant social, economic and cultural aims of Aboriginal people.

Moreover, it is possible that real Aboriginal self-determination, empowerment and economic independence will be achieved when Imparja becomes a viable business enterprise fully owned, operated and controlled by Aboriginal people.

The success of Imparja TV as a business venture will be dependent upon an appropriate accommodation and balance between the commercial viability and the Aboriginal social and cultural objects of Imparja. The right accommodation and balance in these respects will largely benefit Aboriginal social, cultural and economic development in the future.

6. SIGNIFICANT IMPARJA ACHIEVEMENTS SINCE JANUARY 1988

Since 2 January 1988, when Imparja commenced transmission and operations as an Aboriginal owned television enterprise, there have been a number of achievements of significance specifically to Aboriginal social, cultural and economic development throughout the Central Zone Remote Commercial Television Service Area, which encompasses the most part of the Northern Territory, South Australia, north western New South Wales and some parts of Victoria.

Specifically, the operation and development of Imparja has already achieved the following social, economic and cultural benefits for Aboriginal people within the viewing area.

1. The existence of Imparja Television as an Aboriginal owned enterprise, managed by a predominantly Aboriginal Board of Directors, has empowered Aboriginal people especially in relation to Aboriginal people managing a valuable enterprise or resource within the mainstream private corporate sector.

2. The opportunity for a diverse group of Aboriginal people to come together from around the large Imparja viewing area to run Imparja Television as a private enterprise with common corporate goals.

3. A policy of applying no charges to the Central Australian Aboriginal Media Association (CAAMA), the parent body, for all Aboriginal programs provided by CAAMA for transmission on Imparja Television, often foregoing revenue raising opportunities which would help the commercial viability of Imparja.

4. Imparja Television provides tangible training and employment opportunities for Aboriginal people. At present, some 12 Aboriginal people out of a total workforce of 38, or 31.57%, are employed or involved in training programs at Imparja, where a variety of management, administrative, technical, engineering, accounting, computing, sales, journalist and professional media positions are on the establishment.

5. Imparja provides opportunities for Aboriginal people to be trained in senior management positions, such as the recent appointment by the Imparja Board of a Senior Aboriginal Executive in training.

6. There are positive public perceptions or benefits to Aboriginal people arising from the running and control of a successful mainstream television asset.

7. Strategic advantages accruing to Aboriginal people in terms of Aboriginal community leadership and responsibility on such major community issues as the advertising or non-advertising of alcohol on Imparja Television.

7. IMPARJA'S BATTLE TO ACHIEVE VIABILITY

In the case of the Imparja Television service (using the Central Zone footprint of the Aussat, now Optus, satellite network) it is still not possible to obtain sufficient advertising income, with an audience of only 120,000 viewers, to meet the operating expenses. These expenses, for the 1991/92 financial year, totalled almost A$8.0 millions of which A$4.4 millions represented the cost of hiring a 30Watt transponder.

Fortunately for the Imparja company, the majority of the satellite hire charges have been met, to date, by Federal Government subsidies. The company's advertising income of some A$3.6 million / annum, or about A$30.0 / annum / potential viewer compares with the national average for Australian commercial TV services of A$100.0 / annum / viewer. Although there would appear to be some scope for some threefold increase in advertising income the nature of the outback lifestyle, with the lack of consumer choice, simpler needs for consumer goods, etc, mitigates against much stronger advertiser support in the future and Imparja's views is that its target of A$50.0 / annum / viewer is unlikely to be exceeded.

The advent of the Second Generation Australian Satellite Network, with its higher powered and wider bandwidth transponders will lead to a reduction in Imparja's transponder hire costs from about A$4.4 millions to about A$2.7 millions (approx 38%). Coupled with the aimed at 66% increase in advertising income (from A$3.6

millions to A$6.0 millions) the expected reduction in transponder charge could permit Imparja to achieve independence from Government subsidies by 1994/95.

8. TECHNICAL FEATURES OF THE IMPARJA SERVICE

The major technical features of the Imparja satellite delivered Remote Commercial Television Service (R.C.T.S.) are:-

(a) although generally referred to as satellite delivered services the Australian RCTS are Community Reception Services rather than Direct Broadcasting Services (DBS). In Imparja's case less than 1000 of its viewers depend on a Television Receive Only (TVRO) satellite reception facility at their homes. The majority are served by conventional VHF or UHF terrestrial transmissions from re-transmission installations with satellite receive facilities (including B-MAC decoder and controlled access decryption unit) connected to a low height and low gain vertically or horizontally polarised transmitting antenna. There are over 100 such re-transmission installations within the Imparja system, serving audiences from as low as 10 households to the largest serving about 5000 homes.(Fig 2.) The largest single audience of some 24,000 people at Alice Springs are served by a higher powered terrestrial transmitting installation operating on VHF Channel 9 located at a high point on the MacDonnell Range and with a studio to transmitter radio relay system

(b) the satellite uplink terminal adjoining the Alice Springs studio facility uses a 6.8 metre diameter parabolic reflector antenna, 300 Watts travelling wave tube amplifier to deliver the 14 Ghz. uplink transmission to the Optus satellite at the 160° East orbital position.

(c) the Imparja transmission uses the PAL-B colour standard but the satellite uplink (and therefore the downlink) are also processed by B-MAC encoding which enhances the satellite signal reception in areas of low power flux density. The encoding unit also provides access control by encrypting which prevents unauthorised reception outside the defined Imparja service area and provides multiplexed channels for stereo sound for the TV program and for other stereo and mono sound broadcasting services within the satellite footprint. An auxiliary data channel is also provided by the B-MAC unit.

(d) the satellite transmission facilities at the Imparja station in Alice Springs include various antennas, receivers, and recording equipment to permit optimum use of the Australian Satellite Program Service transmissions of the Channel 7, 9, 10, Network programs from Network Headquarters stations in Sydney.

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Telecommunications Applications for Education and Rural Development: A Comparison of the Australian Outback and Canadian North

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Abstract

This paper examines the use of telecommunications technology for education and rural development in the Australian Outback and in Arctic and subArctic Canada. The paper compares technology and applications including distance education, cultural programming, and commercial uses. The paper then analyzes the political and economic factors which appear to have influenced the development and utilization of telecommunications technologies in the two remote regions. It concludes with lessons that may be important for other isolated and developing areas in the Asia/Pacific region.

1. Introduction

Canada and Australia both have domestic satellite systems that provide communication services to remote regions. In both countries, Aboriginal peoples make up a significant proportion of the remote population. In both countries, the benefits of satellites for Aboriginal development have also been widely touted, but the results to date have been mixed.

1.1 The Geographical Context

Canada is a geographical and cultural anomaly. Eighty per cent of the population live within 100 miles of the U.S. border; these Canadians have long been exposed to U.S. television which can often be received over the air, and for nearly 30 years has been available on Canadian cable systems. The remaining 20 percent are scattered over Canada's 10 million square kilometers and 7 time zones. Native people make up about 2.1 percent of the Canadian population, and include Indians, Metis (people of mixed white and Indian ancestry) and Inuit. In the Northwest Territories (NWT), they make up 58.2 percent of the population, and a significant percentage in the northern parts of seven provinces. Fifty three native languages are spoken in Canada, belonging to 11 language groups. Many are considered endangered (Stiles and Litwack, pp. 17-18).

In terms of size and population distribution, Australia is similar to Canada. About 80 percent of Australia's population live along its eastern and south-eastern coast. The rest are scattered in a few cities and large towns, and in isolated farms, sheep stations, and aboriginal settlements. About 300,000 live in rural regions outside the coverage areas on the national broadcasting stations and conventional telecommunications.

The 1986 census estimated that Aboriginal and Torres Strait Islanders make up about 1.5 percent (228,000) of the Australian population of 1.5 million. There are Aboriginal communities in rural and urban areas, but only in remote Australia do Aborigines form a significant part of the population. The Aboriginal population is extremely diverse, with at least 40 languages being spoken in remote communities and another 100 languages dying out with the older population (Molnar, 1992, p.2). In addition, Torres Strait Islanders are a distinct group that consider themselves Melanesian, and different from mainland Ab...gines.

1.2 Media Use

In Canada and Australia, radio has been the major focus of Aboriginal broadcasting. In Canada, there are now more than 200 hundred native community radio stations. Eleven native communications organizations produce radio programs for regional distribution. In Australia, five regional Aboriginal media associations produce radio programs in various languages that are transmitted through the ABC, local radio stations, and short wave, and via satellite.

Video has also be used for information, community development, and cultural awareness. Aborigines quickly adopted video recorders in rural communities, even as they rejected print (Michaels, 1985). In the 1980's Aboriginal leaders saw access and control of the media as a means of addressing issues of cultural survival and management of their own affairs. Yuendumu in Central Australia, which began video production in the early 1980's has produced programs about dances, stories, bush food, arts and crafts, as well as a children's program. Groups which have received training from regional media associations and/or assistance from local resource people have also produced videos covering a wide range of topics of local interest, and involving sports teams, school classes, elders, health workers, etc. (Molnar, 1992).

2. Satellite Systems and their Origins

Canada became the first country to use a geostationary satellite for domestic communications with the launch of Anik A-1 in 1972, and its backup Anik A-2 in 1973. The name Anik which means "brother" in Inuktitut, the language of the Inuit or Eskimos, was chose to symbolize the government's commitment to use satellites to improve communications in the far north. However, several years passed before that promise was fulfilled. Canada is now using its fourth generation of satellites, the Anik D series.

The first generation of Aussat satellites was built by Hughes Aircraft, and closely resembles the SBS satellites and Canada's Anik C. Aussat 1 and 2 were launched in 1985, with Aussat 3 (the original on ground spare) launched in August 1987. Each satellite has eleven 12-watt transponders and four 30-watt transponders, all using Ku-band frequencies.

With the advent of Anik came the first live television transmissions to the far North. CBC network programming, most of which originated in Toronto, was transmitted to the Arctic on two transponders in Atlantic and Pacific time. Regional news from St. John's, Newfoundland, or Vancouver was inserted, but there was no northern oriented or native language programming.

Television quickly became popular among native and non native northerners alike. Indeed, the primary beneficiary was likely the Hudson's Bay Company with general stores (the modern version of the fur trading post) throughout the North. Early Hudson Bay advertisements proclaimed: "Magic from the Sky! Television from Anik! Get your TV set at the Bay." As early as 1970 native leaders expressed concern about the likely impacts of "southern" television and stated that there must be content about the North and in native languages (Hudson, 1990).

3. Development of Aboriginal Satellite Services in Canada

3.1 A Community Development Approach

It took more than a decade for native people in the north to obtain the benefits promised by the government in the late 1960's. However, during that period, a solid foundation for native broadcasting in the form of community radio and a development-oriented approach to media was built. One strong influence was the National Film Board's Challenge for Change program which used film as a participatory community development tool. The French concept of "animateur" or animator was applied to media projects from urban video and cable access to remote community radio.

The Department of Communications funded a pilot project in northern communications in the early 1970's with a community development approach. The CBC supported community radio through facilitating access to CBC radio transmitters. Pilot projects with federal and provincial support explored a range of community media models from local access to TV transmitters to portable video to community radio. Thus, when native people began to gain access to satellites, the community-oriented developmental model was already well in place.

Although Canadian network television was beamed to the North where it was both popular and largely irrelevant, radio by satellite was treated quite differently. From the earliest days, the CBC Northern Service used the satellite to feed programming including native language content to isolated communities. The difference was that CBC radio was already established in the North, with five radio stations across the Arctic. With the advent of Anik, these local stations became regional network hubs and redistributed their signals out to the villages in their region. Thus the communities received a mixture of national and regional content with a significant native language component.

Under an innovative CBC community radio project, each local community could contract with the CBC to produce a limited amount of local programming which could be substituted for network programs. In many cases the CBC trained local people and provided a small studio placed in a building supplied by the community. Most stations were run by volunteers with operating expenses covered with locally raised funds.

3.2 Experimental Satellites: CTS and ANIK-B

Northern television took much longer to evolve, despite continued protests from native leaders about the negative cultural and linguistic impact of CBC network television. The opportunity to demonstrate an alternative approach came with the experimental Communications Technology Satellite (CTS) or Hermes satellite, followed closely by Anik B.

Wawatay, a native communications organization, conducted a pilot project on Hermes that produced native language radio programming in Sioux Lookout, Ontario and delivered the programs via satellite to remote Indian communities with their own community radio stations that rebroadcast the programs to their communities and originated programs themselves on a rotating basis. Listeners were very enthusiastic about the regional programming, but Wawatay was unable to continue the project because the tariffs set by Telesat and Bell Canada were far beyond the means of the organization. Eventually an agreement was reached with TV Ontario that enables Wawatay to piggyback its audio signal on TVO's educational television transponder. At the community, the signal is split, with the TV component being rebroadcast over a low power transmitter and the radio signal delivered to the community radio station where it is retransmitted.

Inuit also used the experimental era to demonstrate and implement new broadcasting services for the North. Inuit Tapirisat of Canada, the national Eskimo organization, carried out a pilot project on Anik B which linked communities and produced programs. Another experiment on CTS linked eight Inuit communities in Arctic Quebec with an audio conferencing network. The network was used to broadcast two hours of Inuktitut language programming every other night for two months in 1978.

The Inuit used the Anik B project as a springboard to establish the Inuit Broadcasting Corporation (IBC) in 1981, using time on the CBC Northern Television Service channels.

3.3 Canada's Northern Native Broadcast Access Program (NNBAP)

The Canadian government formulated a Northern Broadcast Policy in 1982, stating that to maintain and develop native languages and cultures, northern native people should receive relevant broadcast programming, including content they produced themselves. As part of the policy, the government established the Northern Native Broadcast Access Program (NNBAP) in April 1982, a $40.3 million fund to be expended over four years to underwrite production costs for regional radio and television in native languages. In 1988, the government provided additional funding, of up to C$10 million over four years for facilities and C$3.5 million per year to operate them.

The primary objective of NNBAP was "To contribute to the protection and enhancement of Native languages and cultures in the North, and to facilitate northern native participation in activities and developments related to the North" (NNBAP, p.1). It funds three activities:

- production: radio: up to 20 hours per week, based on costs of C$500 per hour; and television: up to 5 hours per week, based on costs of C$8,500 per hour;
- distribution: funds to help societies distribute programs in remote northern areas;
- media research and development: funds for audience surveys to evaluate programming, conducted every three years by independent consultants.

The NNBAP funds one communications organization in each of 13 northern cultural and linguistic regions in the northern parts of the provinces and in the Yukon and NWT. Together, the societies serve 224,100 Canadian Aboriginal people (about 30 percent of the total aboriginal population; programming produced by the societies reaches approximately 320 communities (NNBAP, p. 1). Six societies produce radio only; two produce television only, and five produce both. NNBAP is staffed by a program chief and four regional coordinators.

Several of the societies use the Anik satellite system for program distribution and networking. IBC produces five hours of television per week, with a production center in Iqaluit (Frobisher Bay) and 3 smaller production units across Arctic. It provides Inuktitut TV programming to 30,000 Inuit in 48 communities in the NWT, Arctic Quebec and Labrador. Its programming is a mixture of news and current affairs, cultural, educational and entertainment programming.

Wawatay produces 21 hours per week of native language radio programming and 3 hours of television distributed to 20,000 Cree and Ojibway people in northern Ontario. Building on its capabilities, but with separate funding, Wawatay has started audio conferencing network to enable students to complete high school. Wawatay distributes 38 hours per week of distance education programs in conjunction with Ontario government.

A new satellite network has been formed to distribute programs produced by several native organizations, as well as educational programs. TVNC (TV Northern Canada) began distributing 38 hours per week of programming in January 1992; half is produced by native communications organizations and half is educational programming. The goal is to reach 100,000 people across the North with broadcasts in English, seven Indian languages and three Inuit dialects. TVNC will also sell commercial time (its license allows it to sell up to 12 minutes per hour) and lease production facilities, but revenue is expected to be low.

4. Development of Aboriginal Satellite Services in Australia

4.1 Origins of Remote Area Television Service

A historical analysis of the positions and interactions of the major broadcasting players concerning commercial television options for delivery by Aussat are complex and beyond the scope of this paper.[1] However, the key elements are important to a comparison of the Australian and Canadian contexts. While AUSSAT planned the technical parameters of the satellite system, including shaping of footprints for service to remote areas, the Australian Broadcasting Tribunal conducted an inquiry in 1984 into the regulation of the Satellite Program Services during which it expressed concern about concentration and control of the commercial broadcasting industry.

A parallel review of localism policy by the Department of Communications concluded that localism was 'paramount' as a structural element in the continuation of localism (Paltridge, 1990, pp. 11-12). Having decided that there should be a commercial equivalent to the ABC's proposed Outback service,[2] the Hawke government stated that "the Tribunal should reject any application ... which clearly exacerbated concentration of ownership or control in the Service Area concerned" (Paltridge, 1990, p. 13). It also recognized that the services would be uneconomic, but stated that there would be no federal subsidy, and encouraged "entrepreneurs that wish to take a strategic position in the broadcast system" (Paltridge, 1990, p. 13).

Faced with demands from rural Australians for access to more channels than the ABC, the Australian Broadcasting Tribunal decided to award a commercial franchise in each of the four regions where the ABC was to be distributed via a high powered transponder direct to viewers. The three RCTS providers are Golden West Network (GWN) in Western Australia, Imparja serving the Northern Territory and parts of South Australia, and Queensland Satellite Television (QSTV) in the northeast. The most interesting case was the Northern Territory. An aboriginal communications organization called

CAAMA (Central Australian Aboriginal Media Association) had started a radio station in Alice Springs to broadcast programming in aboriginal languages and to assist aboriginal people scattered in small settlements and on the land throughout the vast territory to obtain improved communication services.

The specifications for the RCTS licenses included the following:

a. licensees shall provide commercial television services ...

b. the areas served shall be those parts of each of the regions ... which are not included in the Service Areas of existing commercial television stations or commercial television translator stations;

c. the purpose of the licenses shall be to provide services appropriate to the needs of the residents of the areas referred to in (b) above;

d. licensees shall provide services utilizing 30 watt transponders in zonal beams .... (ABT, 1986, p. xiii)

These specifications are virtually impossible in the central region. Specifications a and c. may not be attainable: i.e. the service is commercial, but to serve residents' needs. Not only is the population too small to be a viable market. but a significant proportion of residents are Aborigines many of whose needs may not be served by commercial programming.

In addition, the requirement to use a 30 watt transponder (to be HACBSS transmission standard) resulted in transponder charges that were 180 percent higher than if a 12 watt transponder could have been used, which would have been adequate for community reception. an option which is actually used to reach an estimated 92,000 of the total 98,000 Imparja viewers (data derived from Paltridge, 1990).

4.2 The Imparja Network

Despite their concerns about the possibility of meeting these requirements, CAAMA applied for the Northern Territory television license. with support from Australian public broadcasters, in competition with a private consortium from Darwin. The aboriginal group's proposal for a television system called Imparja was accepted, and the decision to award Imparja the license was upheld on appeal from the Darwin applicant.

Imparja estimated that 38 percent of the population in the service region was Aboriginal and stated that there are at least 20 aboriginal languages spoken by at least 500 people in the central region. and that the Aboriginal population was generally more isolated and disadvantaged in terms of communications than the non-aboriginal population of the region (ABT. p. 7).Imparja proposed to produce 3.4 hours or 6 percent of program time per week. and to obtain a further 10.6 hours or 19 percent fr[illegible] regional and independent sources. for a total of 25 percent of regionally produced programs and programs selected for relevance and interest to the region (ABT. p. 138). Imparja proposed to produce news programs in three aboriginal languages in addition to English, pointing out that B-MAC channels could carry additional signals and could direct signals to specific receivers (ABT p. 157).

Despite its reservations about Imparja's financial viability, ABT awarded the license to Imparja, based on its "innovative proposal to provide a commercial television service sensitive to the diverse needs and interests in Central Australia" (ABT, p. 151). Imparja, however, has limited resources for production and operation of the network. While it has received funding from various government sources, there is no ongoing government program for support of aboriginal communications, as has been established for native communications in Canada.

4.3 Community Access using BRACS

In response to concerns about the potential impact of satellite-delivered television, the Australian government established a Task Force on Aboriginal Broadcasting and Communications, which published a report entitled <u>Out of the Silent Land</u> in 1984. The report's recommendations included:

• the coordinated introduction of satellite radio and television reception and rebroadcasting facilities to Aboriginal and Torres Strait Islander (A&TSI) communities;

• the provision of facilities to enable A&TSI people to control programs broadcast in their own communities;

• the encouragement of A&TSI broadcasting in radio and television production (Wilmot quoted in Molnar, 1992, p. 11).

The Broadcasting for Remote Aboriginal Communities Scheme (BRACS) was introduced in response to these recommendations. BRACS is administered by the Aboriginal and Torres Strait Islander Commission (ATSIC). the successor the Department of Aboriginal Affairs. BRACS equipment combines satellite reception, local retransmission, and simple audio and video production equipment. Communities can receive all ABC programming and one remote commercial channel; they can produce their own programs and substitute them for network programming.

As Molnar points out. the significance of BRACS is that has the potential to give Aboriginal communities access to. and control over. their own media and information at a local level (Molnar. 1992, p. 12). To qualify for a BRACS unit, remote communities must meet the following conditions:

• population of at least 200 people;
• 80 percent or more of the community to be Aboriginal or Torres Strait Islander;
• community has not been provided with any terrestrial ABC or commercial television service (Molnar, 1992. p. 13).

The BRACS package. which costs about $A45,000 installed. consists of an AUSSAT receiver and antenna. decoder. transmitter with range of 3 to 5 km.. and simple radio and TV equipment including microphone, audio cassette recorder, two video cassette recorders, TV monitor, video camera, speakers, and control units. By August 1991, 82 BRACS units had been installed (Molnar, 1992, p. 14).

4.4 Compressed Video: The Tanami Project

The Tanami network is a digital compressed video satellite network linking four aboriginal communities in central Australia, with links to Alice Springs and Darwin and other non-Aboriginal networks. The cost of the equipment was more than $A2 million; however, transmission costs via AUSSAT are minimized through use of compressed video, typically transmitted at 128 kilobits per second. The communities have used the network for personal communications among elders and other community members, meetings among the communities, and other informal exchanges.

The equipment was installed on a turnkey basis, after solicitation of competitive bids. The communities plan to contribute $350,000 themselves, and raise the remaining funds from user agreements (Toyne, 1992).To recover costs, they plan to contract with government agencies and educational organizations for interactive conferencing and program delivery for a variety of applications including adult education, community-based secondary courses, practical training, in service support for agency employees, interviews with social workers and other social service providers, etc. As of mid 1992, eleven government agencies had subscribed (Catlin, 1992, p.1).

There is growing recognition that telecommunications can be a cost effective means of providing services to remote communities: the alternative is infrequent visits from regional centers, where staff typically spend several times as many hours traveling to and from the communities as they do on site. As is true with most applications, videoconferencing is not likely to substitute completely for travel, but to supplement infrequent travel, and to bring opportunities to communities which have been too remote to receive many services.

5. Comparative Analysis

5.1 Policy following Technology

Both Anik and Aussat were justified on the basis of providing services to remote areas. In both cases, the need for reliable communications was clear, but the demand was not great enough to cover costs.

In Canada, it took more than a decade for Aboriginal people to gain access to the ANIK system to distribute Aboriginal programming and offer other communications services. The AUSSAT system is less than a decade old, so that comparisons may not seem apt. However, an analysis of similarities and differences to Aboriginal access and broadcasting policy in the two countries can help to explain the type and extent of Aboriginal use the satellite systems for broadcasting and educational services.

5.2. The Government's Response

The government's response in the two countries was quite different. The Canadian government focused exclusively on the CBC for several years, with projects to extend service to communities without television and radio. The CBC began to increase its amount of native language programming.

However, in parallel with extension of services, the CBC began to encourage community access to radio (and occasionally) television transmitters. The Department of Communications (DOC) also supported projects that took a community development approach with field workers, training, and community responsibility for facilities.

The Canadian access model appears similar to the Australian BRACS approach. However, in Canada, the terms of participation were more extensive, with the goal of ensuring community participation and responsibility. For example, in Canada:

- the community had to set up an incorporated non profit organization to do local broadcasting;
- the community had to provide space for equipment and people for training;
- the community had to make a formal request and negotiate with the CBC in order to reach an agreement to preempt CBC programs.

Canadian Aboriginal broadcasters were also able to take advantage of opportunities to gain first hand experience with satellite network production and operation through projects on CTS (Hermes) and Anik B. In addition to offering learning opportunities, these projects provided political visibility for Aboriginal broadcasting. The Inuit were particularly effective in using this visibility to establish IBC.

5.3 Financial Constraints

Transponder Lease Charges

It appears that the RCTS services are not viable, even with government subsidies. The total audience in areas without commercial services is estimated at about 500,000 of which 98,000 are served by Imparja through approximately 1,000 direct reception sites and 83 retransmission sites. The biggest single expense is the 30 watt transponder, for which AUSSAT charges more than $A4 million per year.

The original charge per transponder was estimated to be $A2.7 million, rising by 4 percent per year. In fact AUSSAT has increased the charges by 10 percent. Had the ABT known that the increases would be 10 percent, "it could hardly have avoided the conclusion that the project would have been rendered unviable" (Quoted in Paltridge, 1990, p. 17).

Government Licensing and Funding

There are two critical differences between government policies on Aboriginal satellite broadcasting in Canada and Australia -- both of which relate to financing. First, Canadian regulators did not make commercial viability a condition of licensing for Aboriginal broadcasters. Second, the Canadian government established a program (the NNBAP) which funds production and distribution costs of native language programming.

Funding problems seem to be the heart of difficulties in developing and sustaining Aboriginal programming in Australia. Imparja faces a commercial imperative which is the most crucial difference between Australian and Canadian aboriginal media policies, and I believe differentiates the Australian approach from other countries. In Alaska, native programming is carried over public radio stations that are supported by the Corporation for Public Broadcasting and other national and state funds for programming. Saame (Lap) programs in northern Scandinavia are also supported with government funds and distributed over state funded networks. Community media take a variety of forms in different countries -- including support from government agencies, foundations, churches, community fund raising. local advertising, or some combination of these. But without exception to my knowledge, **network** distribution of aboriginal programming is not expected to be commercially viable.

5.3 The Third World Dilemma

Imparja has found itself facing a classic dilemma shared by many Third World broadcasters who see their role as serving the information and cultural needs of their people, but who lack the resources to meet these needs. They find themselves turning to inexpensive imported programs that fill air time. Imparja has an added incentive to seek out popular entertainment: its was licensed to provide a commercial service that viewers pay to receive. Caucasian and probably some Aboriginal viewers expect to see a programming mix similar to that offered on commercial channels in urban centers.

5.4 Opportunities for Diversifying Funding Sources

In both countries there is a need to build a diversified funding base. While government support continues in Canada, native organizations face a danger of becoming too dependent on government funding. In fact, native communications funding has been cut substantially in recent years, forcing native newspapers to seek more advertising and to raise their subscription rates. Diversified funding for broadcasting will also be needed.

In Australia, the Tanami network may become a successful model for diversifying funding without giving up local control, through its contracts with government agencies for network access and services. In Canada, Wawatay has introduced distance education as an additional service and source of funding support.

Canada's TVNC faces problems similar to Imparja, as it attempts to generate revenue through a combination of educational programming and advertising in addition to native programming. However, a critical difference is that the native broadcasters using TVNC have funding for distribution from NNBAP, whereas in Australia, Imparja must continually negotiate with government agencies to secure funding to pay for its transponder lease charges.

Innovative models

Aboriginal organizations in both countries have developed innovative approaches to programming and fund-raising that could be more widely used, and perhaps become models for Aboriginal media services in other countries. They include:

- use of programs from community sources (BRACS, Yuendumu);
- use of programs produced by government agencies and other organizations (Tanami);
- development of inexpensive Aboriginal programs such as children's programs (IBC, Wawatay);
- leasing of transponder time to other users for distance education, training, etc.
- selling programs to the other networks (CAAMA);
- producing programs under contract for government departments (CAAMA);
- using spare satellite capacity for radio (Wawatay);
- leasing blocks of time on another channel to distribute programs (IBC leasing from CBC)
- selling time on the network (Imparja, TVNC).

6. Conclusion

Each new technology that comes along, from satellites to optical fiber to multi media, is accompanied by claims of myriad potential benefits that can be derived from them. As I pointed out in Communication Satellites (1990), the operative word is can. Whether they will be used for developmental purposes depends on factors other than the technology, which are largely political and economic, rather than cultural.

In Canada, the continued federal support for native communications through the NNBAP or its successor may be the single most important factor for the sustainability of native broadcasting. However, several native broadcasters have built strong political constituencies and are attempting to diversify their sources of funding.

In Australia, the commercial structure of the RCTS networks needs to be reassessed. It appears that these networks cannot be viable without an infusion of government funding, and that their attempts to be self-supporting force them to violate their commitment to meeting the needs of Aboriginal people.

Another unknown factor is how Optus will position Aussat in the new duopoly environment. At first glance, Optus would appear to have the incentive to market Aussat capacity aggressively, giving users the opportunity to take advantage of flexible satellite capacity to interconnect any number of sites at affordable prices. Yet if Optus regards Aussat as a monopoly provider of broadcast services and incidental to their competitive strategy, Aussat prices may not decline significantly. Remote broadcasting may collapse under the burden of transponders costing $A4 million or more per year. Thus whether Optus regards Aussat as an asset or an albatross could have a major impact on the viability of Aboriginal satellite services in Outback Australia.

1. For a detailed analysis of the origins of Australian rural satellite services, see Paltridge, 1990.

2. This service was called HACBSS for Homestead and Community Broadcasting Service.

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THE ROLE OF GLOBALSTAR, A SATELLITE-BASED PERSONAL COMMUNICATIONS SYSTEM, IN THE WIRELESS REVOLUTION

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Abstract

Loral Aerospace Corporation along with Qualcomm Inc. have developed a satellite system which offers global mobile voice an'، data services to and from hand-held and mobile user terminals with omni-directional antennas. By combining the use of low-earth orbit (LEO) satellites with existing terrestrial communications systems and innovative, highly efficient spread spectrum techniques, the GLOBALSTAR system provides users with low-cost, reliable communications throughout the world. The GLOBALSTAR system is designed to operate as a complement to existing local, long-distance, public, private and specialized telecommunications networks. GLOBALSTAR is not a bypass network but rather a system which will fulfill currently unmet telecommunications needs. This paper describes the present status and other aspects of the GLOBALSTAR system.

WHAT ARE THE WINNING TECHNOLOGICAL STRATEGIES AS THE WORLD MOVES TOWARDS WIRELESS PERSONAL COMMUNICATIONS?

A new era in telecommunications is beginning. The emergence of digital cellular telephones will soon usher in affordable, lightweight wireless communications. These new technological wonders wi;l revolutionize the market of mobile personal communications. This new market ultimately will realize a personal communications vision -- where an untethered user will use communications devices for business and personal use in supplement to, and at times bypass or possibly replace, the wireline handset.

Success for service providers depends on how they respond to the forces that affect the industry. The forces of technology, markets and services, competition and management shape the future. Much of the debate over the so-called "personal communications services" centers on technology issues. However, the users of these technologies do not care with what or how the services are deiivered. On the other hand, the issues that the users are concerned with are: quality, value, services, and seamless expansion of geographic coverage.

Technology tradeoffs and operating economies require operators to make tradeoffs and choose systems and coverage which support their largest customers' needs and expectations. Until now, the operators have been selecting technologies which can help make the quality of service better than "snap, crackle and drop" and have been trying to solve issues of cell costs. capital investment for expansion, and how to lower operating expenses.

Cellular service in the U.S. and Europe are on the verge of introducing the 2nd generation Digital Technology and are beginning to investigate the future expansion that this technology will allow. The new questions that will now be asked are:

- how can the low population density areas be serviced?
- how and at what pace should PCS be deployed?
- what technologies should be used to the introduction of digital voice and data?

- what new services such as enhanced messaging, ubiquitous roaming and position location will be required?

WHAT ARE PERSONAL COMMUNICATIONS SERVICES?

Life in the world of personal communications is not simple anymore. Not only is there cellular, paging and specialized mobile radio, but now CT-2, CT-3, DECT and something loosely defined as Personal Communication Services (PCS). Managers of systems such as cellular operations recognize the need to shift from the build mode of the industry to a re-engineering mode that is sensitive to a wider range of customer expectations. As operators scramble to meet these challenges, it is possible to become overwhelmed by the possibilities.

There are, however, four broad market development directions. These are cellular premium service, digital high-end portable cellular, microcellular portable personal communications services and mass market personal communications services.

Cellular Premium Services

Cellular Premium Service is characterized by present-day analog cellular services operating at 450 MHz, 800 MHz or 900 MHz, providing vehicular and portable handheld voice and voice paging.
Competition in the U.S. and elsewhere is generally by duopolies or monopolies with prices higher than wireline service. Primary users are upper income and business users.

Digital High End Portable

Digital cellular services reflect technical advances beyond analog premium services. These services can satisfy the enormous demand for cellular service and resolve the capacity problems of the first generation systems. In Europe, a standardized system called Group Speciale Mobile (GSM) has been developed to increase capacity for the limited NMT-450 and TACS-900 systems. GSM is developed to provide digital voice, ubiquitous roaming in Europe, and new data services.

Meanwhile, in the USA, the development of digital systems using the 800 MHz band is proceeding in an unregulated manner. Early standardization schemes endorsed by the Cellular Telephone Industry Association (CTIA) were based on TDMA technology and are now being challenged by operators seeking larger capacity increases. Recent validation trials of Code Division Multiple Access (CDMA) and spread spectrum technologies demonstrate its viability and large capacity increase over analog and TDMA. With such digital cellular systems, however, the market characteristics of monopoly or duopoly service providers, high price for services and a market of primarily business users remain the same as for Cellular Premium services.

Micro-cellular Personal Communications

A new personal communications service is rapidly approaching based in part on the evolution of cellular telephone products and services but using new frequencies (1.7 to 2.3 GHz) and technologies (CDMA). These systems, encompassed by the PCS concept, use predominantly microcell structures and wireless PBX technologies. User equipment is expected to be a very small, lightweight communicator type device. Provisions of digital voice with advanced calling features, such as messaging, data transmission and other new concepts are expected.

While some of the current cellular providers undoubtedly will be providers of PCS, the competition will mostly be multi-provider in nature. The price for services is expected to be high initially, but will gradually become less than the price of cellular service. The market characteristics are broader than cellular and are expected to include the residential market. PCS is expected to be a factor in providing competition to the wireline telecommunications infrastructure.

Mass-market Personal Communications

The future mass market focus for personal communications will be on low cost equipment and very inexpensive prices for services. Technologies will be outgrowths of microcellular PCS and wireless PBX based upon wireless access with digital fiber and/or satellite bypass providing long haul capabilities.

User devices are expected to be very small credit card phones with personal numbering, using intelligent networks providing ubiquitous seamless communications.

THE NEED FOR AN EXPANSION ROUTE STRATEGY

As the mass markets are approached with predicted penetrations as high as 25 percent, voice communications will migrate to wireless. This will result in a new playing field with no guarantees for existing players. Rapid transition (within the next 5 years) to digital technologies, GSM in Europe, CDMA in the USA and elsewhere, will offer feature-rich networks which will require innovative systems to keep up with customer desires.

As these new technologies are deployed, the ability to connect service areas, thus providing ubiquitous wide area services, and to interconnect these new technologies to each other and to previous technologies will be very important. The successful operators will alter sales channels and adopt operationally efficient systems which will generate more value than previous premium services.

Loral Qualcomm Satellite Services (LQSS), a partnership of Loral Aerospace Corporation and Qualcomm, Inc, is developing GLOBALSTAR technologies and the infra-structure that will allow operators to efficiently extend current cellular premium services and digital cellular services to cover areas which are not able to be economically covered, and to introduce ubiquitous micro-cellular PCS systems when they come on line. GLOBALSTAR provides the operator with new sales channels and new, exciting services such as international roaming, rural and wilderness connectivity, position location, maritime roaming, and digital services.

THE ROLE OF MOBILE SATELLITE SERVICES IN PERSONAL COMMUNICATIONS

Mobile Satellite Service (MSS) is no stranger to the mobile communications community. However, the systems that have been developed with synchronous orbit satellite technologies which were borrowed from the fixed satellite service (FSS). Early on, the maritime mobile user community required service, and thus the 65-member nation consortium called INMARSAT was created.

Originally developed for the maritime market, INMARSAT today is authorized to provide maritime and aeronautical services. In the future, INMARSAT undoubtedly will be authorized to provide land mobile services but not on an exclusive basis. INMARSAT will be required to share frequencies with other system operators such as GLOBALSTAR.

Current MSS systems (existing and planned) have been developed using geosynchronous satellite designs and as such, except for INMARSAT, provide only regional services. Technical limitations of satellite power and antenna size limits the use of the system to user equipment with directional antennas which must be pointed, at all times, toward the satellite.

New satellite designs in low-earth orbit, such as GLOBALSTAR, can supply services to low power user equipment with unobtrusive, small, omni-directional antennas, facilitating handheld units and consumer automobile applications. This allows the use of satellite communications by existing cellular telephone subscribers and at the same time facilitates an easy transition to PCS.

The difference in signal path length for communications between a low-earth orbit satellite system and a geosynchronous satellite is a major contributor to the ability of LEO satellites to be a natural component of PCS. A geosynchronous satellite is positioned at a fixed distance from the earth of 22,500 miles (36,000 km) while low earth orbit systems such as GLOBALSTAR operate at an altitude of less than 900 miles. The difference in path loss is 22 to 28 dB (over 100 times less power is received at the ground using comparable antenna diameters and satellite RF power). Certainly, some compensation for this path loss may be made in the geosynchronous satellite system but not without employment of risk laden, enormous, deployable satellite antennas. Geosynchronous systems will never approach the technological advantages of low-earth orbit systems.

Low-earth orbit systems have the ability to cover the entire world rather than a portion of the world with a constellation of satellites. This makes it possible to amortize the cost of a single satellite system over the world market. Finally, using new GLOBALSTAR digital technologies for CDMA modulation and vocoders developed by Qualcomm, Inc., with user prices near cellular, the spectrum may be shared between several satellite systems providing multiple access for millions of users worldwide. This competition and worldwide deployment will allow service prices near cellular.

THE GLOBALSTAR LOW EARTH ORBIT SATELLITE SYSTEM SOLVES THE TERRESTRIAL UBIQUITOUS COVERAGE PROBLEM

Terrestrial systems, such as cellular and PCS, can only expand their coverage areas to the extent that it is cost effective to invest capital in cells, MTSOs and transmission equipment. These limitations force operators to consider carefully the technology that will be used to build out a wireless network, the capability of that network to be competitive and profitable, and the value that can be generated. Wireless operators must focus on value when developing their company strategy. For instance, a cellular operator's capital to revenue ratio is generally between 0.8 and 1.0 today.[1] Maintaining this level of efficiency requires keeping capital investment for a cell to within the $200,000 to $500,000 range. With terrestrial coverage of only 10 to 20 miles for a cell, the likelihood of eventual seamless ubiquitous coverage is low in most rural areas.

GLOBALSTAR, with a single $350,000 gateway in the operator's market allows the operator to offer services in his entire area, thereby eliminating the great capital expense required to provide ubiquitous terrestrial cell coverage. In addition, the operator can offer new services such as paging, messaging, position location and digital data while maintaining his existing customer base since the GLOBALSTAR gateway equipment allowing satellite communication to users is added to the operator's existing equipment and uses different frequencies for transmission.

Dual mode mobile phones compatible with GLOBALSTAR satellites and either analog or digital cellular terrestrial services allow ubiquitous roaming between local terrestrial and the wide area satellite coverage. Switching between these systems is accomplished without the user knowing, just as he is handed off between terrestrial cells today.

Microcellular PCS systems, expected to develop in high density areas, will require the wide area coverage afforded by the GLOBALSTAR system even more than the terrestrial cellular operators.

In addition to the wide area coverage, which will bring additional customers into the cellular and PCS market, the satellite system brings new services. Wide area roaming is only one example. By exchanging databases of users, with validation provided by GLOBALSTAR, operators can facilitate roaming of their users, not only from the owner's system to another owner's system, but in between systems as well. Furthermore, GLOBALSTAR allows roaming from cellular to PCS and vice versa. International roaming is facilitated as well by exchanging user databases allowing users to make or receive calls anywhere. Numerous other advantages of GLOBALSTAR are too lengthy to enumerate here, but all are made possible by the addition of a single, low-cost gateway in the operator's area.

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[1] "Growing the Wireless Segment," Cellular Business, Volume 9, No. 13, December 1991.

WHAT IS NEEDED FOR GLOBALSTAR SATELLITE SERVICES TO BE LAUNCHED AND PROLIFERATE

The user equipment and gateway technologies have been reduced to chip sets. These have been developed by Qualcomm, Inc., and have been tested and validated for the digital cellular telephone industry in the USA. Similar digital technologies using TDMA have been developed in Europe for GSM, much of which will be usable through the GLOBALSTAR satellite. The satellite technologies are well within the state of the art. GLOBALSTAR uses tried and proven satellite repeater technologies which have been in production for over 20 years.

The World Administrative Radio Conference of 1992 (WARC-92) has taken up the issue of satellite communications below 3 GHz and frequencies have been allocated along with developing procedures for coordinating LEO MSS systems. The only development now required is the licensing of the GLOBALSTAR system. This licensing is entering the final phase and will be completed in 1993. The U.S. government has indicated it plans to license all applicants.

Although PCS developments are not yet mature, services to the premium urban cellular customers who wish wide area and international roaming and services in rural areas can be established now. The newly allocated MSS bands are mostly unused worldwide and are available worldwide.

Current proposals, by the USA and others, allocate these bands (1610-1626.5 MHz and 2483.5-2500 MHz) to MSS as well as retaining the RDSS allocation. Technical rules are in progress which will allow the extension of existing and planned cellular systems and prepare for the future wide area extension of microcellular PCS.

SUMMARY

The LEO satellite systems, such as GLOBALSTAR, offer ubiquitous wide area coverage, services to low power handheld or vehicle mounted terminals which cannot be economically provided by GEO satellite systems presently under construction or planned. The much shorter signal path length gives better quality, lower cost, higher capacity, and delay free transmission of communications for the mobile telephone user. GLOBALSTAR which utilizes CDMA and spread spectrum modulation techniques brings new services and easy access to spectrum for communications providers. LQSS will be offering wholesale capacity on demand to any and all providers of mobile services by adding a single GLOBALSTAR gateway to their existing terrestrial system. This enables providers to serve new customers that are now not economically practical to serve.

LEO systems are more robust, providing capacity even when a satellite fails, due to the rotation of the constellation. GEO systems, by contract, suffer entire regional system loss when an operational satellite fails.

LEO satellites are here to stay. They capitalize on digital technology and advances in the cellular industry such as the recently completed validation of the CDMA cellular system by Qualcomm, Inc. in San Diego, California. The economics they offer along with new services and ubiquitous wide area coverage make LEO systems a viable new and exciting technology.

TAOS, a new low-cost mobile-user LEO satellite network
for positioning and messaging

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Cannes, France

1. ABSTRACT

This paper describes briefly the missions of the LEO-MSS network, TAOS.
The conclusions of a study on the selection of a low-cost satellite platform are given.

2. MISSIONS

The French National Center for Space Studies (CNES) has been involved for 20 years in space-based networks for position-report and data collection, with such systems as ARGOS or COSPAS-SARSAT.
This experience together with the recent availability of new MSS bands at VHF/UHF allocated at WARC-92 and with the positive conclusions of market surveys have prompted CNES to set up a new satellite -based worldwide network ,called TAOS, (see reference 1) to achieve the following missions:
-Position report of a mobile towards a base station, initiated by either end (examples of potential user include car rental companies, the trucking industry, the railways transport)
-transmission of short digital messages with a response time of up to one hour (voice and real time message exchangeare excluded)
The initial studies have taken into account some fundamental constraints: low-cost of the mobile user terminal (about $500), low-cost satellites and launches, high traffic capacity.
The initial market areas envisaged include North America, South-East Asia and Europe; the system should offer capacity for around 500 000 terminals in each of these areas.

3. NETWORK ARCHITECTURE

The mission specifications described above have led to the selection of a constellation (see figure 2) of 5 small satellites, each on a low circular orbit of 1300 km altitude with an inclination of 57°.Five orbital planes are at 72° from each other. The constellation is controlled,i.e. the variation of the relative position of the satellites and their respective orbital planes is maintained within a limited angular range.
In the outbound link (figure 1), base to mobile, the base station message is routed to the mobile through the PSTN to a dedicated regional operation center and then to the gateway serving the area.To comply with the one-hour response time, one gateway is necessary for Europe, another for South-East Asia while two are envisaged for North America.

Cross-area traffic requires connexion of the various regional operation centers.
From the gateway , the message is uplinked at VHF (148-150.05 MHz) to the overhead satellite and downlinked to the mobile terminal at VHF (137.0-138.0 MHz) or UHF (400.15-401.0 MHZ).
The inbound link, mobile to base, makes use of the same frequency bands, possibly segmented, for up and downlinks.
All links use a spread spectrum modulation technique.
Positioning is achieved through Doppler and propagation delay measurement within the network.

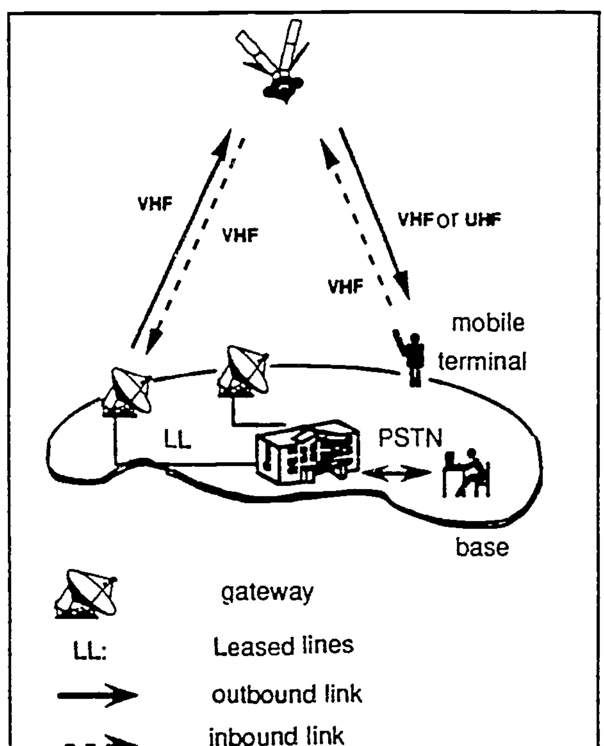


Figure 1 overall system architecture

4. THE SATELLITES

An optimization study has been conducted by AEROSPATIALE/ALCATEL for the TAOS satellites with the following intial constraints:

-low recurring cost

-launch by PEGASUS with the associated hydrazine auxiliary propulsion system (HAPS)

-Launch mass around 150 KG

-Required satellite lifetime of 5 years and system lifetime of 20 years

-shaped VHF/UHF antenna gain diagram to compensate for the free space loss dynamic range.

The platform has been defined around two components, the solar generator and the attitude control subsystem. Indeed the solar generator is the most expensive, volume consuming and dimensioning element for the satellite architecture and the selection of an attitude control design is closely related to the chosen solar generator.

A thorough investigation of more than 45 different designs has led to the selection of the following combination:

-omnidirectional solar array composed of 4 deployable petal -like wings covered on both sides with silicium solar cells,

-attitude control based on momentum wheels

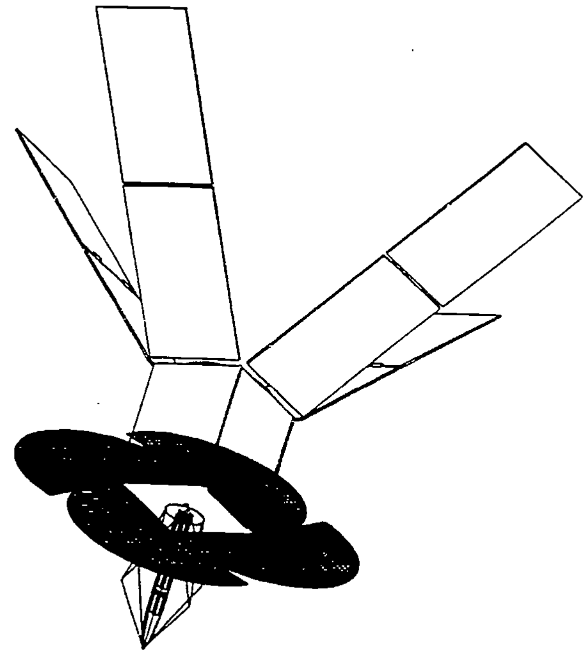


Figure 3 Satellite in orbit

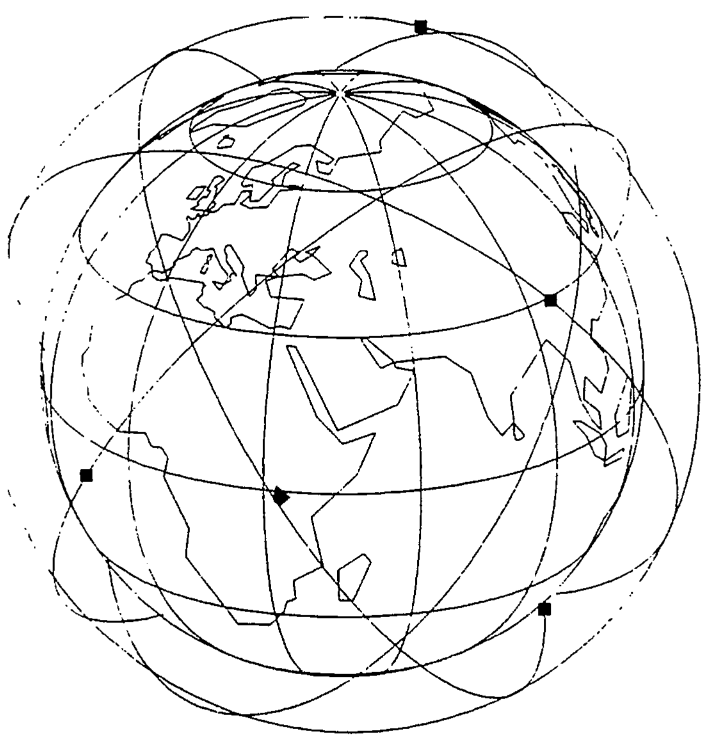


Figure 2 The TAOS constellation

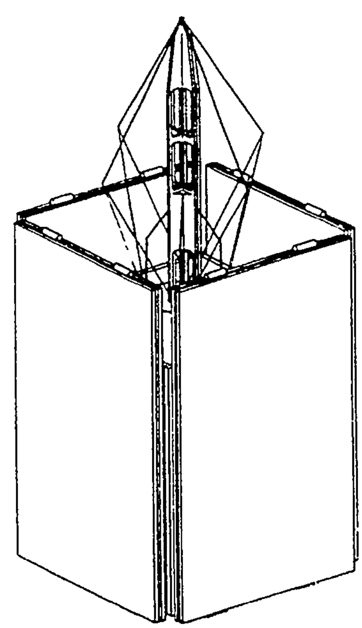


Figure 4 Stored configuration for launch

Here is a brief review of the subsystems main features:
The structure is a box-like body, 650 x 650 x 800mm, and use aluminium honeycomb sandwich panels; the thermal control is passive with a U-shaped heat-pipe between the two dissipating walls. Power generation is achieved through the solar generator delivering 270 W in daylight while during eclipose a Ni-Cd battery is used.The attitude control maintains all axes within 3°. The propulsion uses six cold-gas 0.1N thrusters ,the nitrogene is stored in 2 high pressure metallic tanks.A centralized computer is used for platform and payload data management. Command and telemetry is carried out in the frequency bands of the mission.

The repeater consists basically in signal amplification and frequency translation. The antenna selected is a fixed assembly on the Earth-panel with a UHF helix and a VHF rhombic element.
A deployable ground plane improves the antenna gain diagram.(see figure 3).

The total launch mass of the satellite is less than 150 KG (around 20 Kg for repeater and antenna), the platform needs 170W and the payload 100 W.

5. SYSTEM ASPECTS

Two potentially critical areas have been identified during the preliminary studies:
-availability of the frequency bands, in particular the 148-149.9 MHz allocation to MSS has a secondary status in 75 countries,
-impact of ionospheric propagation disturbances at VHF on Doppler measurements
Investigation on both aspects are carried out using a minisatellite, S80T, launched in mid-92 with ARIANE.

6. CONCLUSIONS

After demonstration of the feasibility of the system and confirmation of the market, the network TAOS will be gradually implemented during the late 90's. (Regulatory filing with ITU has been engaged under the name S80)

REFERENCE

(1)"A LEO-MSS system for position reporting and data messaging services." A.Gautier & P. Dumont,IAF-92-0424, 43rd congress of the IAF, 1992.

WEDNESDAY, January 20, 1993

Morning Plenary

NOTES

TELEPHONE DEVELOPMENT PROJECT FOR VALLE DEL CAUCA STATE COLOMBIA, S.A.

Dr. Fernando Garcés Lloreda
General Manager
Empresa Regional de Telecomunicaciones del Valle del Cauca S.A.
E.R.T. S.A.

1. INTRODUCTION

Colombia's geographic position within the Pacific Rim, its stage of development and rate of economic growth are solid factors in the process of economic liberalization which the country is undergoing.

2. COLOMBIA

As shown on figure 1, Colombia is geographically positioned in the north-western corner of South America, quite near the Panama Canal and has coastal extensions both in the Pacific and Atlantic Oceans. The country is crossed by the same meridian as New York and by the Equator. This strategic location makes Colombia a Pacific Rim country as well as a well situated transit point among South America, Europe and North America.

Internationally, Colombia is recognized as a responsible member of the economic community and is engaged in a policy of integration with major countries and regional economic groups, among which are Mexico, Venezuela and Chile. Colombian labor is relatively low-cost within the international context and offers the characteristics of ingenuity and responsibility.

3. VALLE DEL CAUCA

Valle del Cauca (see fig.2) is a Colombian State located in the western side of the national territory and covers an area of 21,000 square kilometers, which is mostly flat. It derives its name from the Cauca River, which bisects the state from north to south. Its coastal extension along the Pacific Ocean includes the port of Buenaventura where over 60% of national maritime shipments take place.

Valle del Cauca generates 14% of the gross national product, mostly agricultural production well-known internationally, such as sugar and fruits, and is in the process of sustained industralization.

Within the region, there is a firm believe that the future economic opportunities are related to the Pacific Rim and consequently that all efforts must be made to build the necessary infrastructures, among which telecommunications is a fundamental one, to achieve the region's economic take-off. This has motivated us to join hands with The Pacific Telecommunications Council and to offer this presentation.

4. TELECOMMUNICATIONS SITUATION IN THE VALLE DEL CAUCA

Cali, the state capital, with 2 million inhabitants, has a telephone density of 18 per hundred. Its metropolitan network is digital in its majority. The remainder of the region has a telephone density of only 4.4, and its network is almost totally vintage analog. Although these statistics compare acceptably within Latin America, they are well below what the region requires to achieve any significant economic development.

To attack the problem, in June 1990 Empresa Regional de Telecomunicaciones del Valle del Cauca - E.R.T. S.A. - was established as a commercial and industrial entity of the State of Valle del Cauca. It includes, among its shareholders, the municipal telephone companies operating within the state. Presently, E.R.T. is undergoing a process of progressive privatization from a state-owned entity into one with local private capital participation.

E.R.T.'s major objective is to promptly bridge the present unfulfilled telephone demand and to offer new added-value services.

E.R.T.'s first management decision was to retain a U.S. consultant, Dr. Eitel M. Rizzoni & Associates, to perform a comprehensive feasibility study and network plan for the new corporation. Through the use of the NETPLAN and NETCOST computer programs, developed by Dr. Mario Pietrogrande, the E.R.T. network configuration was planned and optimized both technically and economically.

5. TELECOMMUNICATIONS SYSTEM

The E.R.T. project covers the entire area of Valle del Cauca with exception of the city of Cali. Telephone service in Cali is provided by Empresas Municipales De Cali (EMCALI), a state-owned public corporation. The metropolitan network is 70% digital in switching and interexchange transmission. The interconnection with the national long-distance and international carrier is also digital, partly cable and partly optical fiber

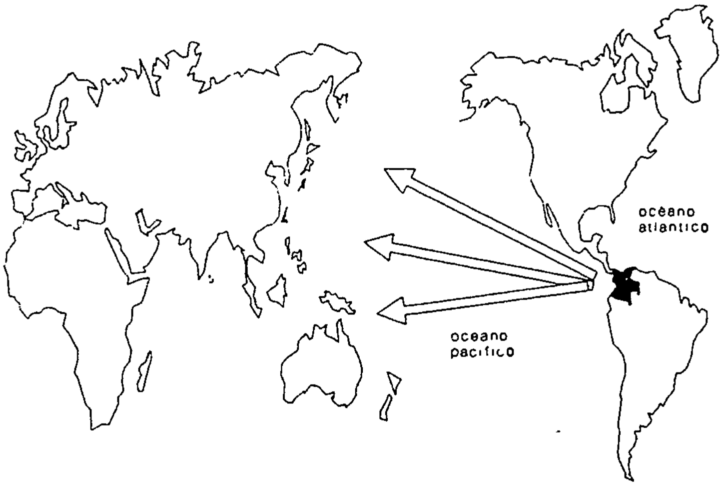
E.R.T.'s projected network will interconnect with the metropolitan Cali network as well as with the national long-distance and international networks operated by Empresa Nacional de Telecomunicaciones (TELECOM). Similarly, E.R.T. can interconnect with future networks offering value-added services.

5.1. E.R.T. Network Planning

Starting from the existing and projected telephone demand in terms of type of services, quantity and qua[illegible] and having developed community-of-interest factors between exchanges the present and future traffic matrices were developed for three points in time: 1993, 1995 and 2000. Also, potential new services to be provided by E.R.T. were estimated.

Several switching, transmission and routing alternative network configurations were analyzed and their relative advantages were compared. On the basis of traffic flow efficiency, network flexibility, grade of service, transmission quality and first and recurring costs, the most convenient configuration was selected and the new digital E.R.T. network was planned.

COLOMBIA FRENTE AL PACIFICO



MAPA No 1

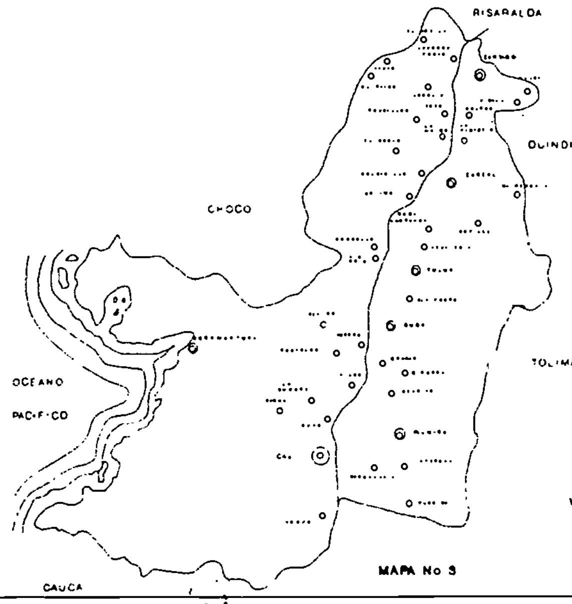
MAPA No 2

COLOMBIA

POBLACION	35.000.000 Hbts
EXTENSION	1.138.000 KLM2
CAPITAL	BOGOTA 7.000.000 HABTS

VALLE DEL CAUCA

POBLACION	3.500.000 Hbts
EXTENSION	21.000 KLM2
CAPITAL	CALI 2.000.000 Hbts



DEPARTAMENTO
DEL
VALLE DEL CAUCA

MAPA No 3

The planning included the interconnection between the digital E.R.T. fixed network and the future E.R.T. Cellular mobile network, for total integration with the national and international systems.

In addition, the economic viability was determined, as well as the project's financial rate of return, including a sensitivity analysis of financial parameters to determine the influence of their variability on the investment.

5.2. The E.R.T. Project

Eight network alternatives were configured and analyzed. The alternative technically optimized and of least cost was selected. The selected alternative utilizes one single transit exchange for the entire region, vis a vis more conventional solutions employing a number of transit exchanges.

The single transit exchange, located in Cali and totally duplicated for reliability requirements, will switch the entire long-distance traffic of the region. Traffic administration, network management and operation, and computerized billing are thus all centralized at this single transit center.

The E.R.T. network (see fig.3) will connect 56 towns, most of which are presently served with step-by-step equipment. The unfulfilled demand will require more than doubling the capacity in terms of switching lines and outside plant. The plan calls for total replacement of existing switching and outside plant equipment with modern digital equipment.

Inherent in the design is the future introduction of the digital synchronous standard. The implementation is planned in three phases:

Phase One 1992-1994: The back-bone transmission system will consist of a 170 kilometer, 140 Mb/s optical fiber route from Cali ı ' artago and a 140 Mb/s microwave system between Cali and Buenaventura (see figure 4). This long-distance system will carry about 70% of all long-distance traffic, as well as value-added services required by business customers.

The transit exchange to be implemented in Cali will switch all long-distance traffic and interconnect with the Mobile Telephone Switch of E.R.T. Cellular.

Phase Two 1995-1996: 100,000 digital exchange lines will be procured to serve 41 towns, as an addition to the existing 23,871 digital exchange lines. The transmission network will be augmented with a low-capacity digital microwave network to reach the secondary locations from the main trunk line (see figure 5). During this phase, the entire replacement of the outside plant will begin.

Phase Three 1997-2000: All remaining analog exchanges will be replaced by digital ones of larger capacity and 11 new locations will be provided with modern telephone service. In the year 2000, the E.R.T. network will consist of 196,000 digital telephones lines and oversized transmission capacity, to provide modern telecommunications services in the region.

5.3. Economic and financial viability

As a result of the optimization process of financial parameters via the NETCOST software, the following financial highlights were obtained over the 8-year period 1992-2000:

The consolidated statement of income shows a profit margin starting in the second year of operation, which could result in shareholders' dividend distribution starting in the third year.

The consolidated statement of cash flow shows positive accumulated cash flow for all years of operation.

The consolidated balance sheet shows solid shareowner's equity at the end of 8 years of operation.

The viability of the overall investment and satisfactory profitability are assured by the internal rate of return of 19%, over the eight years of operation.

6. A LOOK AT THE FUTURE

It is expected that the rapid economic growth of Valle del Cauca will result in the evolution of the E.R.T. network into a synchronous standard and ring configuration, including locations in the region at present unserved, as well as areas outside of the state limits. In this manner, variable bandwidth services can be extended on demand to cities requiring it.

Moreover, the growing commercial and economic importance of the port of Buenaventura within the context of international trade, leads to the consideration of a future international conection from Buenaventura, via a submarine optical fiber cable, to Lima and Santiago and from there to the possible optical fiber submarine extension to South East Asia. Similarly, a northern submarine fiber connection along the Pacific Coast to Mexico and the U.S.A. may be considered. These foreseable projects are presently discussed in international forums, such as the current PTC annual meeting.

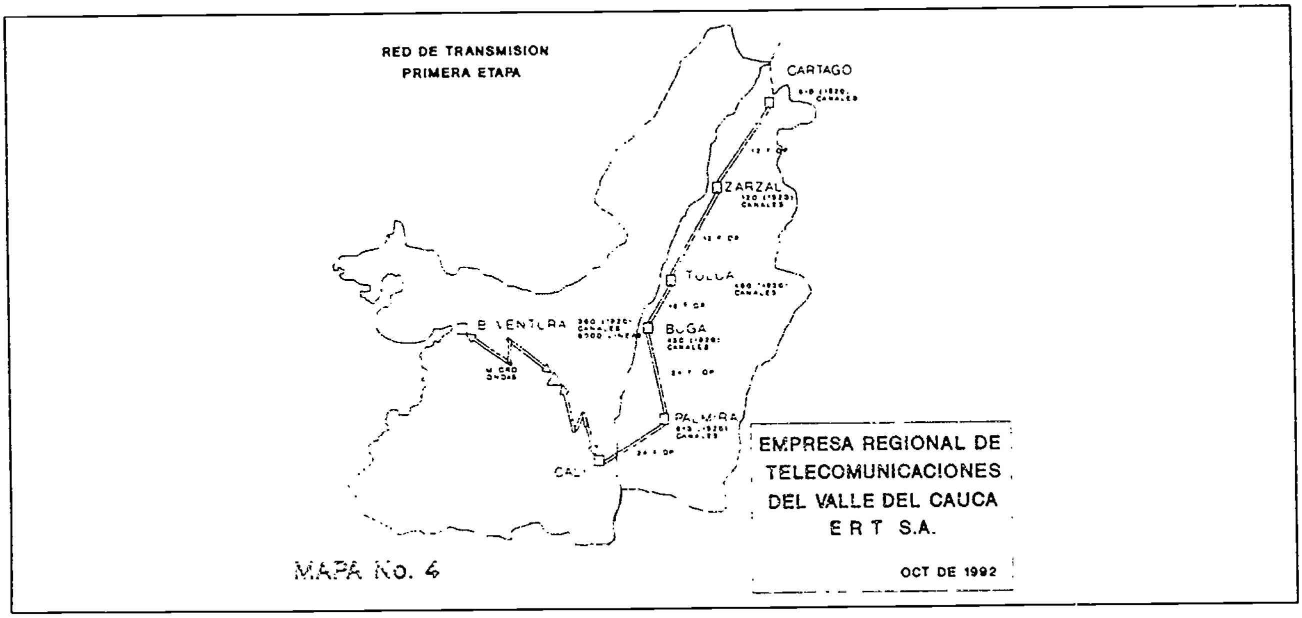
7. CONCLUSION

Finally, it should be noted that this project may serve as a model for the planning of other regional telecommunications networks in Colombia in accordance with the national economic liberalization program, as well as in other developing countries.

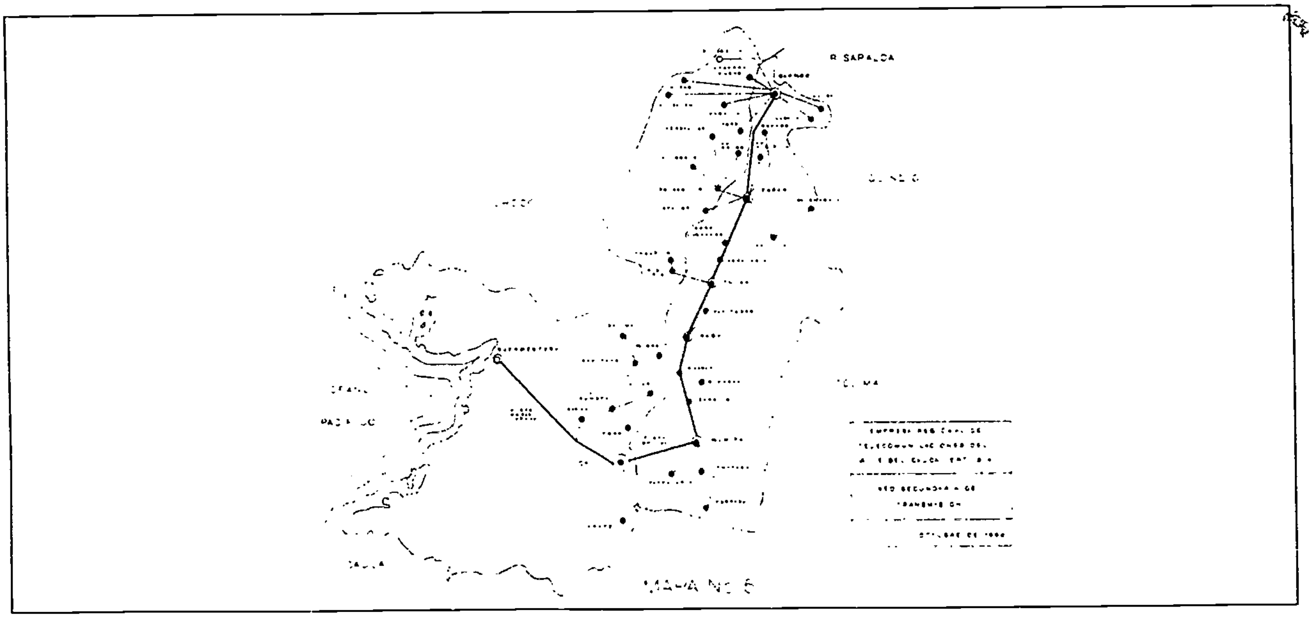
Recently, new telecommunications regulation has taken place in Colombia including the demonopolization of telecommunications services and the introduction of private investment, both national and external.

I have no doubt that commercial and institutional opportunities will develop which will facilitate our purpose of communicating efficiently anywhere on our planet.

To close, I wish to thank warmly the PTC organization and all of you for letting me speak about this Colombian Project.



MAPA No. 4



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Personal Communication Services — Now That I Can Have Them, Why Do I Really Want Them? And Thoughts on the Future of PCS in the Marketplace

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This paper discusses the main issues and concerns surrounding the imminent introduction of Personal Communication Services. From the concept of the service through its practical applications, the paper looks at how PCS may impact our lives. It questions how PCS will be received in the marketplace and, without drawing judgment on its current status, emphasizes that preparing the consumer market is just as important as the development of the services themselves.

Preface

That basic question — why do I really want them? — enters every consumer's mind as he or she looks at new products and wonders if buying them is a good idea. Every savvy marketer tries the question out while pretending to stand in the consumer's shoes. The answer could catapult a new product to success or seal its defeat. And the time has come to ask the question in reference to Personal Communication Services.

The history of new product introductions like PCS lies strewn with great concepts that failed to hit target markets. Some elegant and inventive ideas were committed to the development process but scrapped after a short introduction to the marketplace. Some of these failures can be attributed to poor timing, some to inefficient marketing, and others to a combination of the two with an added sprinkling of misfortune. This paper attempts to point out some possible concerns facing equipment manufacturers, wireless carriers, network operators and a handful of legislative decision makers that make up the PCS industry. Once common ground is reached among these interest groups, the consumer public and service subscribers will have the decisive judgment on whether PCS becomes another casualty along the new product road or reaches the heights of product acceptance and financial success.

This approach is not meant to condone or condemn any of the suggested solutions or technologies the telecommunication industry is considering for PCS. It is meant simply to look at the various parts of PCS, clarify the issues and shed light on the many possible outcomes, so we can reach an objective vision of the future of PCS.

The paper will first present a review of the history leading to PCS and a look at the basic philosophy of the personal communication service concept. From this discussion, it will move on to examine the introduction of PCS technologies and services. But above all, this paper will attempt to address some of the haunting and overshadowing questions that could lead to service acceptance or rejection by the potential PCS subscriber.

Section 1: Personal Communication Services — An Overview

What is it? — Philosophy of PCS

The philosophy of Personal Communication Service (PCS) is a concept still under construction. Terms have been coined to break it down into parts (Personal Mobility, Terminal Mobility and Service Mobility), yet these terms imply that a person using telecommunication services while in a state of motion is performing a form of personal communications. But PCS philosophy is about more than connecting telephone or data service to someone that is in motion. It is based on the idea that a single, unique number assigned to each user allows that user to send or receive telecommunication services from **any** telecommunication access point or device. In practice, PCS would give subscribers universal network access using personal services.

The concept of the Universal Personal Telecommunications Identifier (UPT), or the single universal telephone number, may be the cornerstone of PCS philosophy. This single number with an incorporated personalized secret code similar to a Personal Identification Number (PIN), identifies the PCS subscriber to the telecommunication networks wherever he or she goes. The networks will use the UPT identifier to recognize and track the subscriber's location and alert the supporting network node to what type of service the subscriber is entitled.

The ability to connect to people in places, not just to places with people, opens many possibilities. Tethered telecommunication services, whether the tether be an RF interface or local loop, links originating and/or terminating communication to a specific station or device. With true Personal Communication Service, the subscriber will be able to use the tethered stations or devices simply as points of access to send or receive calls in the form of voice or data communications.

Here are a few simple definitions of the major PCS concepts:

Personal Mobility: The user's ability to access telecommunication services at any terminal (telephone, cellular phone, pocket phone, etc.) based on a personal identifier. Also: the network's ability to locate the terminal associated with the user.

Terminal Mobility: The terminal's ability to access any of the telecommunications network services anywhere or any place while in motion. The network will be able to deliver any telecommunication services to the terminal identified by its network address.

Service Mobility: The telecommunication network's ability to deliver the user's customer service profile (identified by a personal identifier) to any intelligent network element requesting the information.

More on mobility as it relates to PCS appears in Section 3, "PCS Applications."

How did it get here? —Evolution of PCS

Existing technology often acts as the kernel of creation for the "next generation" of systems or devices. The telegraph inspired Alexander Graham Bell to eventually patent his invention — the telephone —in 1876. Similarly, the piston motion of the steam engine provided the basis for the reciprocating piston action gasoline-powered engine.

PCS has followed the same type of evolutionary upbringing. We can trace its family tree from the original patent issuance of Marconis' wireless telegraphy in 1896 all the way to the first operating cellular telephone Metropolitan Statistical Area (MSA) in the U.S. in 1983. PCS technology follows cellular technology; it results from blending evolving technologies of radio frequency engineering, telecommunication switching and micro computers. The technology that might claim PCS as its forerunner could possibly push communications technology to the limits of the imagination. Co-mingled voice, data and video capabilities may become universally available at a simple touch or whisper of a command.

Why continue? — Commitment to Developing PCS

Why would anyone want to commit to developing PCS, considering all the associated risk and uncertainties? The reasons could range from corporate egos sometimes associated with leaders in the field of wireless communications to the opportunity of capitalizing on a successful wonder-widget that will turn the wireless communication world on its collective ear. Whatever the developer's motivation, it is understood that PCS is coming and will be available to the consumer market. Corporate leaders are already demonstrating commitment to the development effort, which will eventually produce the devices and systems that support PCS opportunities.

Section 2: PCS Implementation

The PCS "Birth" Environment

The development environment of PCS technology reflects the environment of the standards-setting bodies themselves. Standards groups are developing PCS standards in an open, consensus-by-committee atmosphere. This approach is a far cry from the traditional, sterile laboratory environment usually controlled and designed to reflect the single wishes of one dominant presence. In this new product birth environment, the wishes and opinions of the many are heard and documented, producing a "mixed bag" of documented input and possible "standardized" approaches. Combined with the hybrid nature of the PCS system, the new birth environment makes the determination of multiple standards possible. Such is the present case in PCS development.

The standards bodies for PCS have created a situation that is often referred to as the "M A wars". "M A" refers to the term Multiple Access. Multiple Access in this case refers to the common air interface between the PCS pocket phone device and the supporting radio base stations. The different "flavors" of M A are Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA). Not that any of these forms of multiplexing are to be defined or judged as positive or negative; the standards-setting bodies simply have created a mish-mash as they have tried to define a common interface between PCS pocket devices and the PCS network base stations. Currently no single common air interface exists that the majority of cellular carriers have endorsed. As the implementation of PCS begins, the dominant multiple access multiplexing scheme must still be determined and then adhered to.

A similar situation in the U.S. occurred with the introduction of Video Cassette Recorders. Two different formats for VCRs appeared almost simultaneously on the consumer market. One of the formats was Beta and the other was VHS. After years of competition, the VHS-formatted VCRs have prevailed. A similar scenario could occur with PCS devices. PCS pocket phones, in satisfying the multiple M A interfaces, could operate in dual mode or even tri mode as they attempt to satisfy all competing RF interfaces. Then, as one or the other RF interface prevails, a switch within the pocket phone could deactivate the looser RF interface. The winning interface would remain to suck up all the available power left as a result of such an engineering fiasco.

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PCS Network and Device Development

Much is being printed concerning PCS device requirements. A fairly accurate, early profile of the base requirements, from a service/subscriber perspective, is still under development. We can, however, lay out some of the envisioned requirements:

- The cost of the pocket phone device is generally projected to be less than the average cost of portable cellular handsets we see today. That projection would place the cost of the pocket phone device somewhere around \$50.00 - \$150.00 (U.S.).

- The envisioned operating criteria for battery life is to be 24 - 48 hours of standby with 4 hours of actual power available for talk time. This standard would allow the PCS subscriber to recharge the battery of the PCS pocket phone overnight.

- The pocket phone device must be small enough to conveniently fit into an inside jacket pocket and must not weigh more than a deck of playing cards.

- The quality of the voice connection must be near "land line" quality and at least 10 times better than current AMPS cellular service.

- Capacities of the PCS network are envisioned to accommodate 4,000 to 10,000 voice channels per square mile using base stations that are no larger than a shoe box. These channels should be able to support voice and data communications at a possible user variable bandwidth reflecting the type of data or voice being transmitted.

- The PCS network and pocket phones will be equipped to guarantee security of the information being transmitted and received, as well as the authentication of the user accessing the network.

- The PCS network must be able to determine the location of PCS users at any given time while directing calls to those individual users through logical routing addresses. The network must provide this routing information without user intervention or action.

The network cost of implementing such service is envisioned to be roughly one eighth the cost of implementing an AMPS cellular system. This projection takes into consideration the reuse of some imbedded cellular switching functions, such as the mobile switching center (MSC). Given the implementation costs of the PCS network being one eighth the cost of current cellular carrier implementation, the average air time per minute will also decline to a reasonable level. Casual home PCS subscribers should be able to afford the service, which in turn should lead to increase usage and economies related to scale for PCS carriers.

Market Preparation

The Pavlovian customer response to PCS network and services implementation will occur only if the customer market is fed intelligent and systematic information about available PCS services. The incredible growth in the cellular market demonstrates that customers are aware of and accept mobile communications in an increasingly mobile society. The next challenge is to introduce services that genuinely have a perceived added value to the mobile service subscriber market. The successful vendor/manufacturer of PCS products may reap substantial rewards. Current telecommunications providers are attracted to the opportunity of becoming PCS carriers themselves. The market entry opportunity appeals to many telecommunication service provider "wanna-bees."

The potential down sides of the PCS opportunity revolve around companies that don't develop the right product or don't offer the right service. Those types of companies stand to face significant risk. For an example, look to Wang Laboratories Inc. of Lowell, Massachusetts, a company that entered bankruptcy proceedings in August, 1992. Wang had previously dominated the 1970's word-processing market with computer systems of their own design. Wang did not anticipate the market transition to personal computers, a blunder that all but wiped out a \$3 billion-a-year corporation.

RF "Turf" battles — Spectrum Allocation

The allocation and controlled licensing of the precious commodity known as radio frequency (or spectrum) has both U.S. regulatory agencies and European regulatory bodies either in a constant state of proposed rule making or eternally reviewing comments submitted during the proposed rule making process. The goal of this legislative effort is to provide or allocate a designated radio frequency band in which PCS devices may operate without disrupting existing radio devices. Obviously, this is not an easy task. Along with defining an operating frequency, the regulatory bodies intend to establish an International PCS device operating frequency that will truly provide the PCS subscriber universal network access wherever he or she may roam. In the U.S., the FCC has issued a Notification of Proposed Rule Making (NPRM), which designates for PCS use specific radio frequencies within the 1850 -1990 MHz range. The European Common Proposal (ECP) from the CEPT Ad-Hoc92 group specifies radio frequency allocation of 1900 - 2025 MHz as the assigned operating spectrum for PCS devices. Between these two frequency allocations, 60 MHz is assumed to be the common band width, available on both continents, within which PCS pocket phones can freely move and operate.

Spectrum and licensing issues also concern operators of the "Pico cell" PCS networks. "Pico Cells" are cells within Micro cells, which compose the cellular structure of PCS. The issues impacting these PCS devices are specific to the private network operators introducing "wireless" LANs and RF voice systems. The systems will have a low power operating range of a few hundred feet, providing Pico-cell operators with limited but effective single floor wireless operation. Pico Cell operations still require special attention to licensing and business issues relating to the use of the RF frequency at which Pico Cell base stations will operate while supporting PCS pocket phones.

Section 3: PCS Applications

The services envisioned for PCS use the theme of mobility as the basis for service description. When talking about specific services, that theme recurs throughout the explanation to reaffirm that these services are indeed for people in motion. Motion, incidentally, can mean either "walk about" or "zoom about" motion, as in the case of traveling at high speed.

We have identified at least three types of mobility: Personal, Service and Terminal. We will now revisit these terms to further examine the practical applications of PCS.

Personal Mobility

Personal Mobility-type services consist of telephone numbers, processes to authenticate and locate the person in motion, and services offered specifically to user groups that allow group function or privilege.

To reach a PCS subscriber, the network needs to know the subscriber's telephone numbers for work and home, a forwarding number to reach the subscriber while at an interim number, cellular numbers, PCS numbers or a voice mail number. Any of these numbers can be used to deliver the terminating call. The key to these terminating call services is the single Universal Personal Telecommunication Identifier, the one number that identifies the PCS subscriber to the network. Through the UPT Identifier, the network can locate the PCS subscriber and determine what telephone number (home, work, cellular, etc.) to use when routing the call to that location. All these functions the network will perform automatically, without manual PCS subscriber intervention unless the subscriber desires certain specific nonpresubscribed routing instructions.

The network also uses the UPT Identifier to authenticate the PCS subscriber. In order for this process to work, however, the UPT Identifier first needs to be registered with an entity called an "authentication center." The authentication center acts as a validation point, reinforcing the control of fraud. UPT Identifier registration occurs at the initiation of the subscriber's service. Also registered with the authentication center is a coded security number embedded in the subscriber's pocket phone. Algorithms included in the security number provide accurate verification of the PCS subscriber.

As the subscriber moves throughout the telecommunication network, the network will automatically recognize the subscriber based on these security numbers (this process is called "autonomous registration"). Autonomous registration could be accomplished by using the paging frequencies of the wireless network. This registration activity then notifies a location database (another information checkpoint) and the authentication center where the subscriber is located. At the same time, the coded security number sequence imbedded in the PCS pocket phone is shared with the authentication center.

A group of consumers can also subscribe to group service with group UPT Identifiers. In this situation, PCS functions are controlled through a main number, then are distributed to the appropriate individuals within the group based on their specific UPT Identifiers. The UPT Identifier qualifies each user in the group for any special features (voice mail, call screening, etc.) associated with the main service. These service groupings could be family groupings or business groupings.

Service Mobility

Service Mobility services should guarantee that service groupings or individual services can be received or initiated anywhere, any place, at any time. The services to which the PCS customer has subscribed at his or her place of service activation will guarantee the delivery of those services throughout the PCS network. Some of these services could be voice mail, custom calling features, distinctive ringing and selection of grouped UPT Identifiers.

Call screening will also be available where caller identification information is available in the network and can be processed. Call screening will let subscribers determine the importance of an incoming call. The call originator can prompt the subscriber during call setup by entering a coded number sequence. This special sequence identifies the call's level of importance. For instance, family members could override a screening table by entering a password that has been shared only among the family members.

Call delivery is an adjustable option based upon a predetermined call level priority, caller profile or caller option profile. This feature will allow the PCS subscriber to have the network send some calls to his or her cellular phone, some calls to voice mail, etc., based on each call's priority or profile. The PCS subscriber can include voice prompts such as greetings or announcements to inform calling parties of certain conditions, or that the call is being forwarded to voice mail because the subscriber is not available.

Terminal Mobility

Terminal Mobility services will enable PCS subscribers to identify the specific features available or applicable from a specific terminal. For example, a terminal that has identification through a certain ID or PIN could receive video text and voice services simultaneously, while a terminal without such identification could not. The PCS subscriber would be able to identify the possible terminal mobility constraints or applications that would control what type of communication was possible from that terminal.

Terminal mobility will receive support from a location database. The location database will deliver network identification, routing information and any special billing information (usually applicable when terminals are separated and specified to their capabilities, uses or user group privileges).

Billing for terminal mobility services will provide special billing information based upon either special billing plans or the need for delivery of billing detail from one terminal to another, tracking possible discounts or user activity on the identified terminal.

Section 4: New PCS Services versus the Ford Edsel

Developing Personal Communication Services, devices and networks that everyone wants takes vision, sound engineering, commitment and tenacity. The services' and devices' ability to actually fulfill PCS subscriber needs and meet standards with which they associate value is something different. The perceived value of the service will be the key to the subscriber's willingness to pay and PCS' ultimate success.

An example of creative engineering and inventive design gone wrong occurred in the mid 1950s, courtesy of the Ford Motor Company. The company's development program and introduction for the Ford Edsel was reported to be one of the most extensive, state-of-the-art efforts that Ford had ever undertaken. Engineers incorporated the newest, most advanced design and engineering technologies into the development effort. They introduced ergonomics advanced for the time, intending to give the potential Edsel buyers gadgets, special features —anything that would make operating the vehicle easier. This new line of automobiles was even named after the son of the owner of Ford Motor Corporation. What more could anyone ask for!

The result of the Edsel's new product introduction is also well referenced and documented, more so than anyone would like to admit. The Ford Edsel was a failure. Despite all its wonder-gadgets, it was visually unappealing. Customers saw no real use for it. They had not been prepared at all for this new product; Ford expected people to automatically buy it for what it was, and thus virtually ignored a marketing effort. After a few years of disappointing sales, this state-of-the-art product was abandoned, leaving the few purchased Edsels to become curiosities in garages and backyards.

Then what do consumers want?

The story of the Edsel shows us that the customer market and/or service users will make or break the new product regardless of the previous process — or lack thereof — that developers have put into the new product development. Which brings us to the next question — what are some of the expectations out there in the marketplace that impact new product introduction?

A few are critical, the first being: how does the user perceive the service itself? The second: how does the user perceive the value of the service? The third: is the service easy for the subscriber to use? And the fourth: does the service do what it is supposed to do?

As these questions relate to PCS, the first concerns the subscriber's overall impression of the service. With a universal service such as telecommunications, the PCS subscriber might be concerned about his or her privacy. The subscriber might perceive being constantly available as boon to his or her creativity and productivity or a nuisance mandated by a corporation, a personal responsibility or the necessity of a job. The perception of this service will be positive if the productivity and creativity points add up to be greater than the necessary nuisance issues of the job or responsibility.

The second point —perceived user value of the service — involves how many times the service or device has really assisted the user in the way he or she wishes. If the service has satisfied a significant critical situation or an immediate need, a one-time successful operation might generate a feeling of well-being about the service and a "what if I need it again and I don't have it" type of mind set.

Thirdly, the service should be easy to operate. It should locate subscribers and route calls quickly, efficiently and invisibly. Most service users operate in a "don't know, don't care" mode, demonstrating little interest in the overall Common Air Interface or Network support issues going on behind the scenes. The service user will only want ease of operation and as little manual administrative intervention as possible.

And the fourth point —PCS service operation must truly provide the service that the subscriber is expecting to receive. If calls are to receive a prioritized prescreening before they are delivered to the called party, then the service had better live up to those expectations and deliver only the screened calls. If the user location is to be forwarded to a centralized location database so that the subscriber can receive important calls while on the golf course, then the calls should be delivered to the place they are expected. If the UPT Identifier guarantees the subscriber security against fraudulent use of his or her UPT ID, then fraud should virtually not exist in the PCS network.

Pricing, service availability and other issues such as invasion of privacy are also points that the subscriber should be aware of. Subscribers can be educated on all these issues through proper market preparation. Such education, including the distribution of information about the service's advantages and how to use the devices, will diminish potential rejection. If PCS subscribers know the truth about what the service will and will not perform, their expectations will be in line with service's capabilities, thus increasing the chances that they will be pleased and the service will be a success. Like the example of the Edsel, all the best design, engineering and development will not guarantee new product success without customer education and market preparation.

COMPETITION FOR ELECTRONIC SUPERHIGHWAYS IN THE PACIFIC

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Abstract

Information is increasingly seen as an economic resource essential for world trade and national income. Control of information networks can be as important for the flow of trading information as control of the sealanes was in early colonial days. The growth area for today's trade is the Pacific Rim region and control of the information network in this region is a target of the telecommunications giants.

Introduction

The economic resource, information, whether transmitted by voice, data or image, is increasingly seen as essential for world trade, exports and national income. Electronic highways for the carriage of this resource can be regarded as the 21st century equivalent of the carriage of resources on the 19th century rail networks and 20th century motor highways. Trade was increased by the development of those railways and roads. Today, electronic information network owners are anticipating an increased market in the carriage of information and they are competing on a world-wide basis for this important information market. They have seen motor superhighways used to facilitate trade by carrying traffic at high speed and avoiding bottlenecks, and now for the important resource, information, they wish to establish superhighways.

Electronic Information Networks

Electronic information networks are the highways of the information economy because they carry telecommunications services which are vital for the business ventures of today and the 21st century, as organisations are becoming more dependent on a continual flow of accurate and timely information. It is not surprising therefore that these networks, like motor highways, are subject to continuous change and upgrading. This arises from the rapid change in the technology offered and the increased demand flowing from the growth in the service sector.

Electronic networks have changed dramatically in recent years, and the technical advances are so pervasive, and so much a part of our environment, that it is difficult to remember that many of the services did not exist in the first half of the twentieth century. For international telephone traffic the first long distance submarine cable suitable for good quality telephone conversations was laid across the Atlantic in 1956. The first Intelsat telecommunication satellite was launched in 1964. Since that time microwave networks have challenged the land-line networks in the birthplace of telecommunications – America – and have had a major impact on networks worldwide. In more recent time cellular telephony has made it increasingly difficult to escape from the telephone call, and pagers have become an essential

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accessory for many people. In addition the advent of fibre optic cables has massively increased the carrying capacity of land lines and submarine cables and the increases in capacity continue. A wealth of conduits now exists for the transmission of information.

The sets of information being forwarded over these networks are becoming more complex as business consumers seek to transmit not only the traditional voice messages of the pre-computer age, but also text, data, video and image services. Expectations have changed. Consumers have high expectations of these new electronic information networks. The patient telephone consumer who a decade ago would wait all day to obtain a telephone connection to a relative overseas is now impatient if the connection is not as instantaneous as a call to a neighbouring suburb or adjoining town.

Information

The information which is the resource carried by the networks varies with the source and the demand, it also differs from other resources. Information does not have the same exclusive possession aspects that other resources have. It is not like a tangible exhaustible item such as an apple or a cake. Because of its inexhaustibility it can be sold or given, yet still retained. It can be used many times, yet be available to use again. It can be used without permission or stolen with the original owner unaware of its loss or use.

Many information suppliers have realised this uniqueness about the resource 'information' and its place in the worldwide marketplace. The interlinking of the computer and telecommunications and the establishment of electronic information networks, permit the transference of databases over great distances at great speed. World trade in the provision of information for share trading, banking, shipping, security etc. has now become big business. Though some of us working in the information field are astonished at the naivety of the people paying for information which is either extremely wrong or extremely out of date. Some people do not appear to be aware of the 'garbage in, garbage out' factor.

However, the sale of databanks about consumers and businesses can be very profitable indeed. Despite the requirements of privacy principles which most countries enforce on carriers and service providers a large industry exists worldwide for the collection, storage and release of information.(1) The general public appears to be oblivious of where the personal information collected by an ever-increasing number of bureaucracies, financial institutions, consumer survey groups, clubs, magazines, etc. ends up.

Chaum (1992) states "it is almost impossible to learn the full extent of the files that various organizations keep on you, much less to assure their accuracy or to control who may gain access to them".(2) Notwithstanding legal attempts to curb the flow of this information into irresponsible hands, the restrictions imposed by limited membership of information provision networks (e.g. recent changes in Australia re credit information)(3) can be overcome by surreptitious use of the photocopier, the telephone or the computer. The need to protect information about individuals from improper disclosure or use, has been taken up by the writers on communications law issues and transborder data flows, (4) who recognise that although the physical capabilities for the transmission of information on a global basis exist, there remain many issues for nations and consumers about the legal aspects of that transmission.

Global companies

Yet information is the life-blood of the global company and its branch system, these companies expect to be able to transmit information across national boundaries and even complain about the restrictions of today's borders. They also require communication networks secure from the threat of industrial espionage.(5) Global companies are searching for economic efficiencies, reliability and security in the transmission of information.

Is this as 'new' as the companies would have us believe? Lamberton (1992) realistically sees the worldwide network model as more like "--- a medieval Mediterranean trade route model" than "--- the technological wonderland model of the global village" (6) because of psychological distance and the limits of organization.(7) It would be wise to remember that traders have always had to deal with the handicaps of the organizational structure, and in the information market that applies to global companies on both sides of the market - buyers and sellers.

Changing Organisational Structure

Many changes have been made in the organisational structure of information industries in recent times. Much has been written about this change. A heavy emphasis has been placed on the supply side of the information market by many of these writers, but this should not detract from the change in organisation structure which has occurred on the demand side of the market. Economists look at supply and demand.

The services of electronic information networks are sought by global trading companies operating in global markets. They require efficient modern telecommunication services and they seek networks which can concentrate on company requirements of quality, capacity and advanced functions. But they require those attributes across the globe, not just in their home country.

Companies have tended to see the national telecommunications operators as being unable, or unwilling, to supply the rapidly changing technology of business communications. While the telecommunication operators (PTTs) have seen the global companies as self-interested entities which expect to bleed the national telecommunication coffers for their own interest in state-of-the-art technology for which the network's residential user (and even small business) has little use and perhaps little knowledge.

The companies paint a picture of the traditional telecommunication network operators as not keeping up with developments and constrained by financial limits and community service obligations. The PTTs, with a century-long history see their critics as newcomers who may or may not be in existence in ten years time.

The International Telecommunications Union (ITU) works to ensure a high quality telecommunications network, however it must be admitted that the world's telecommunication networks have varied in the past, and will vary in the future. Yet both developed and less developed nations have made huge strides in upgrading their communications networks in recent years. It should therefore be recognised that the line of argument used in the debate about telecommunications sometimes concentrates on past organisational structural faults without recognising recent improvements.

Network Environment Change

The network environment is changing, competitive telecommunications networks are emerging. The opportunity to move outside the traditional national boundaries of the telecommunications regulated monopoly structure has been presented by satellite technology, which can easily cross national borders, by deregulation and by the evolution of telecommunications technology. Telecommunications operators, once tied to their home territory are now promoting their network infrastructural expertise in a stepping stone exercise towards global networks. Newcomers are forming partnerships to invade markets. Advances in digital technology are presenting opportunities to both the old and the new operators of communication networks.

Governments are encouraging their telecommunication suppliers to take advantage of the competitive climate in the industry. In the United Kingdom a second telecommunications network (Mercury) has been granted the right to compete with the traditional PTT monopoly, British Telecom (BT).(8) This network utilises digital technology and has the ambition of a global digital highway across the Atlantic, into the United States and then into the Pacific. A partner in the network is the powerful Cable & Wireless, a name wellknown in the industry.(9)

The French telecommunications industry of the 1990s is a far cry from that of the 1960s-70s before the Nora and Minc Report (1978) and the French Government's determined action at that time to take the national system into the information age.(10) Today, France Telecom is one of the world's largest telecommunications companies. It is aggressively marketing for a share of the global information network market and its name is often mentioned in reports of consortia vying in the new network market. Recently it has been aiming at the establishment of a Pacific Rim telecommunications superhighway.

In the United States the divestiture decision by Judge Greene in 1982 altered US telecommunications profoundly.(11) Those outside the US now see a range of US telecommunications companies competing for contracts in their countries. No longer is AT&T seen as the one and only PTT for the United States. Of course US residents and informed foreigners know that AT&T was not the 'only one', instead it was the dominant firm in the industry. But the message which has been given over time to television viewers of other countries, especially by competitors lobbying in countries where governments have been pressured to introduce deregulation (12) has been that AT&T has during the 20th century been the sole provider of telecommunications in the USA until recent legal decisions.

Other Pacific Rim countries have also deregulated their telecommunications industries. In Japan NTT and KDD now have rivals in their previously protected markets.(13) In Australia a second public telecommunications network - Optus - has been licensed as a national telecommunications carrier. The consortium involved in Optus - including Cable & Wireless, Bell South (one of the US 'Baby Bells'), and the Australian companies Mayne Nickless, AMP and National Mutual - had to purchase the loss making Aussat satellite system as part of the deal.(14) In New Zealand the national telecommunications network has been purchased by a group including two US 'Baby Bells' - Ameritech and Bell

Atlantic. This internationalisation of the post-divestiture Baby Bells demonstrates the global ambitions of the new competitors in the industry and, as will be shown later, can lead to some interesting affiliations.

Private Networks

It should be acknowledged that trading companies have had private lines for transmission of their information for some time. Dixon (1991) describes how Ford of Europe decided in the mid-1980s that their telecommunications network was not up to the job. Their existing European networks lacked the quality and in some instances the capacity to meet their requirements of graphics (fax and CAD/CAM drawings), data and voice traffic. In 1991 Ford Europe became the first company to implement a private all-digital network crossing international boundaries. This network designed, delivered and serviced by Siemens, is an ISDN-based Wide Area Network (WAN), it replaced six dedicated networks, four private and two public.(15) Siemens advise that it was designed to support CAD/CAM terminals, together with 14,000 digital and 3000 analog telephone handsets.(16)

The Important Services Sector

The structure of world economies has changed during the 20th century, the importance of the primary and secondary sectors for employment and gross domestic product has been downgraded by the rise in importance of the services sector. Indeed, the services sector is the fastest growing sector of world economies, and information services are the fastest growing segment of the services sector.(17)

An important and growing segment of the services sector is the information services sector. 'Information services' can be defined in many ways. An information service is provided when a network carries a message - conduit, or mode of delivery - alternatively an information service is provided when financial information - content - is supplied. This is one field where both the medium and the message are important.(18)

Riddle claims that developed countries, in general dominate world trade in services (19) but she sees service industries as growth leaders in the Pacific Rim.(20)

Pacific Rim Services

There are many definitions for the term 'Pacific Rim' but for this paper it refers to East Asia, Japan, the ASEAN nations, Australasia and North America. East Asia includes China, South Korea, Hong Kong and Taiwan. The ASEAN nations are Indonesia, Malaysia, Philippines, Singapore and Thailand. Australasia covers Australia and New Zealand while North America includes the United States of America and Canada.

Pacific trade in services, such as finance, tourism and transport is increasing, and depends on the telecommunications network available in the region. When satellite technology networks started operating in the region they expanded market capacity, but also threatened the secure markets of incumbent cable networks. Now the new optical fibre networks with greater capacity threaten both types of transmission networks.

Crew (1988) discussed telecommunications in the Pacific Basin and showed the planned optical fibre cables in the Pacific area, and their potential capacity. It is obvious that the global digital highway has reached the Pacific Rim and we must expect the trade consequences.(21)

An international telecommunications superhighway to carry voice, data and image traffic at high speed across international boundaries could facilitate trade in the Pacific Rim area. As Pelton and Iida (1992) stated "--- the key machinery that makes this vast economic region a reality is not fleets of planes, or ships, or stock markets, or banks, but rather the ever increasing information and telecommunications systems that enables and empowers all these services and more."(22)

This area requires electronic highways because it has the potential to become one of the biggest telecommunications markets in the world. The regional population requiring basic telecommunications facilities is immense and growing rapidly. In addition, the rising standard of living in the area is bringing a demand for telecommunications services for consumers. The area's industrial growth is also responsible for a demand for the most advanced telecommunications products for business enterprises. "Nevertheless, initiatives must be taken in order to forestall complete dominance of world markets by service transnationals from developed market economies"(23) states Riddell.

Growth in the usage of telecommunications in the Pacific Rim area is being pushed also by technological change and deregulation. The numbers of cellular phones in use are rising dramatically, submarine optical-fibre cables are being laid and more domestic communications satellites are operating. In addition previously closed national markets are being opened to competitive operators. Langdale (1989) saw telecommunications and trade in electronic information services as prominent international policy issues, (24) and Fell (1990) agreed.(25)

Global Links: End To End Transmission

Aspiring global supercarriers are using changes in market structure to form linkages which can facilitate the establishment of global networks for the information requirements of the 21st century. They recognise that global companies rely on information flows, and that in the end-to-end transmission of that information the standard of service has varied widely. In this market both buyers and sellers are searching for economic efficiencies and reliability in the transmission of their information.

Cable & Wireless advertises its global digital network and proclaims itself 'The World Telephone Company'. This company which has been in international communications for over a century is well aware of the importance of telecommunications to the rapidly growing Pacific Rim area, and to the global companies operating in the region. It has a strong base in Hong Kong with the Hong Kong telecommunications company (HKTI) and is present in the markets of the US and Japan. Bakunowicz (1990) stated that HKTI owns around 60% of the Asia/Pacific telecommunications hubbing market.(26) Yet Hong Kong is in an ownership transition phase. Cable & Wireless has a base in the Australian market with its 24.5% shareholding in Optus Communications, the recently appointed second public telecommunications carrier. Ownership of the Aussat satellite system was a government requirement of the Optus contract. In addition it has a one third holding in AsiaSat 1 which has footprints over northern and southern Asia.

American Telephone and Telegraph Co. (AT&T) is spreading outside the US with joint ventures in many countries. It is continuing its history of expertise in R&D by conducting joint research with Japan's KDD on what is described as "--- the world's longest optically amplified fibre optic cable system."(27) It will be interesting to watch future actions taken by these partners. In 1991 AT&T entered into a joint venture with Hutchison Telecom of Hong Kong which linked Hong Kong into the AT&T EasyLink Global Network. Stine (1991) of The Asian Wall Street Journal claimed that AT&T controlled nearly 40% of the world's electronic-mail market.(28)

MCI has operations in 50 countries and its international networks cover Europe, the US and Hong Kong. In Australia it is associated with AAP in AAP Telecommunications, and in New Zealand with New Zealand, second carrier, Clear Communications. With Hong Kong Telecom it operates a virtual private network service between the United States and Hong Kong providing lower per call rates than direct dial services.(29)

France Telecom has been forming links around the Pacific for end-to-end transmission. Deregulation of telecommunications in Japan has allowed France Telecom to form an alliance with International Telecom Japan (ITJ), and it has been making use of deregulation in other national markets. In August 1991 it took a ten per cent stake in an international consortium - Kalori Communications Group - of Bell Atlantic Corporation, American Information Technologies Corporation (Ameritech), and Hutchison Telecommunications (Hong Kong). The Group hoped to become Australia's second telecommunications company, however it was not to be, the Kalori Communications Group lost out to Optus Communications.(30) As some consortium members already had involvement in Telecom Corporation of New Zealand, France Telecom had been positioning itself for the creation of a Pacific Rim telecommunications highway, linking Japan, Hong Kong, Australia, New Zealand, and the USA.

Hutchison Telecom is a recent newcomer compared to the other competitors and it concentrates on non-wire services. However it is an aggressive competitor in telecommunications and has established a world base in mobile telecommunications. It has a one third share in AsiaSat 1 with Cable & Wireless and has joint ventures with other global telecommunications companies.

Low Earth Orbit - Iridium

Iridium presents the potential of a new satellite based global communications system to challenge the economics of the existing transmission technology. Designed by Motorola and expected to become fully operational in 1996 Iridium will allow communication via cellular mobile telephone type low-cost handheld receivers and use a constellation of small smart satellites that are placed in a low earth orbit to provide continuous line-of-sight coverage.(31) Hutchison Telecom has joined forces with Motorola in the venture.(32)

National Interest

Governments in the area are aware that the international carriers are interested in the Pacific Rim region. They know that improved telecommunications will bring more global companies to their area and they are eager for those companies to locate in their region to increase trade, production and employment, and raise standards of living.

Conclusion

This communications infrastructure which is so necessary for business is the competitive area of the future. Entry into national telecommunications systems in the Pacific Rim region has been facilitated recently with the opening up of the telecommunication market structure, the technological changes, the internationalisation of telecommunications and the growth of global information networks. The global carriers are interested in the area, but what will be the consequences and who will own the information?

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The Market for Multimedia Distance Education for Corporate Training in Japan-US Business & the Management of Information Technology

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1. ABSTRACT

Some telecommunications project in the Pacific region fail due to an inadequate understanding of product/service initiatives vis-a-vis the global marketplace. This paper studies the marketing of distance education for students of business in the Asia-Pacific region. The educational impact and management of new information technologies such as cyberspace are explored. Related issues such as intercultural groupware and Moore's Law are also considered.

Key Terms: Market, Multimedia, Intercultural Distance (Adult) Education, Corporate Training, Telelearning, Cross-cultural Management, Groupware, MUDs(Multi-User Dimensions), Virtual Environments, Artificial Realities, Moore's Law, & Cyberspace.

2. INTRODUCTION, METHODOLOGY, & HISTORICAL CONTEXT

When I originally submitted this paper proposal shortly after the successful conclusion of PTC 1992, I thought this would be a relatively easy paper to write and deliver. Building on our January 1992 demonstration of the JAIMS videoconferencing system (VCS) and network, I was under the impression that it would be comparatively trivial to extend, refine, and further develop our educational applications for a wider audience. How wrong I was! In retrospect this has been one of my most challenging endeavors, primarily because of the continual revolutions and speed of advance in the emerging technologies of multimedia in particular and information technologies (IT) in general. Moore's Law of computing power **doubling** approximately every year is certainly alive and well in Hawaii as elsewhere. Let me give you a recent example of our purchasing decision for a laser printer. The new model was enhanced from 300 to 600 dpi which is twice the resolution (for the same price of $1595) as last year's model, but now equipped with 8 megabytes of RAM. This is more RAM than the internal memory of the computer to which it was being attached as only a high-quality output device!

At the outset it is important to define our key terms. Definitions of other vital words in the title of this paper will be stated below. However, at the beginning it should be understood that education is broadly construed for the purposes of this paper. We do not make a big distinction between training and education as they are components in the spectrum of human resource development activities that are critical components of the life-long learning process. Some authors maintain that education is longterm; whereas, training is what you do to dogs in the short-run. The neat compartmentalization of post secondary education into a 4-year degree followed by graduate school is rapidly breaking down. In many parts of the world a 3-year undergraduate degree is the norm. The shelf life of any degree having to do with information systems management, especially in the context of the significant bilateral relationship between Japan and the US is decreasing at an alarming rate.

Allow me to offer one example to illustrate this crucial point. One year ago, a well-respected professor of Decision Sciences received teaching awards for his instruction in telecommunications at the graduate level. This Ph.D. was particularly well-versed in LANs and traveled throughout the Asia-Pacific region delivering seminars on LANs and related topics. However, his research interests shifted and his teaching assignments were changed. As a result after only one year of benign neglect, he became unqualified to speak on the same topic for only a 2 hour presentation. Some psychologists tell us that the average human can learn at the rate of 4 chunks per second (whatever a chunk is). For a professional to remain abreast of the fast-moving developments in the management of information technology s/he must be continuously "chunking down" bits and bytes of new information. So where does training end and education begin? I think it is largely a moot point. Whatever we choose to call it -- education, training, or learning -- successful corporations in the future must do more of it, faster, cheaper, and better.

By way of chronological perspective, in the global recessionary environment of spring 1992, JAIMS was encouraged to conduct market research into the satellite business opportunity for extending our core competencies in cross-cultural management and communication. We employed a tradi-tional survey questionnaire methodology but conducted the survey using telecommuni-cations technology by administering an untraditional one-minute FAX/FAX back form. The form was sent to 250 of the Fortune 500 companies with which our management partner already had established good business relations. Even though the methodology was intriguing, the response was discouraging. The deployment of business TV for cross-cultural corporate training to improve US-Japan business may be viewed as an example of technology push rather than demand pull or in other words, a technological solution in search of a problem.

Next, in response to several ongoing expressions of interest from ASEAN countries, in the summer of 1992, JAIMS decided to conduct a pilot study of the market for high-quality, MBA-type coursework electronically delivered on-site to one or more ASEAN nations. The results were encouraging but not indicative of a strong demand-side pull for the technologies of distance education in the region. This relatively weak demand coupled with still unsatisfactory telecommunications infrastructure in the region caused us to put this project on the backburner along with the aforementioned satellite business TV possibility.

Even though we put these projects on hold, JAIMS continued to experiment and innovate in the utilization of our VCS. For instance, in June 1992 we co-hosted a high-level conference with a representative cross-section of participants from academic, governmental, and corporate communities of different regions to facilitate the reunification of North and South Korea. At one point in the discussions, it became important to contact a specific member of Prime Minister Kiichi Miyazawa's Cabinet. This we accomplished at the flip of switch on our VCS console in order to capture the full meaning of the intended communications in both directions, including subtle, non-verbal cues which research indicates accounts for approximately 93% of the communication from facial movements and voice tones.

Another path-breaking distance education application occurred in the following month (July 1992). A professor of marketing was teaching an AACSB-accredited course in Japanese marketing in the cooperative program between the University of Hawaii and JAIMS, known as the JEMBA/JMP (Japan-focused Executive MBA/Japan-focused Management Program). As part of his curriculum he assigned the Harvard Business School case study on SONY. Our international MBA students drawn from over 15 countries in each cohort class, presented their analysis not only to their fellow classmates, but also in real-time to the current product managers at SONY in Tokyo while the students and teacher remained in sunny Honolulu, thanks to the "magic" of VCS.

In the Asia-Pacific region there are other schools, programs, and projects making good use of instructional technologies at the graduate level. One of the more innovative enterprises in this regard is the Fielding Institute which was recently written up in Technological Horizons in Education (1). Other noteworthy educational efforts that have come to our attention are the Network Communication College of the Pacific (NCCP) and the distance education program at the Nee Ann Polytechnic Institute of Singapore. The Asia Pacific Economic Cooperation (APEC) is also studying significant enhancements to its existing electronic network.

These and other mind-amplification initiatives could benefit from the emerging compression/ decompression technologies such as Wavephore which can piggyback via imbedding in existing video signals to reach the entire Pacific Basin. This break through technology was announced at the end of summer 1992. By acting as a "parasite" on existing signals distance educators could reach the entire Asia-Pacific Region (Figure 1).

Subsequently, during fall 1992, I first heard the term *cyberspace*. Cyberspace has many definitions, but the following montage is indicative of the revolutionary breadth and depth of this unique, generic concept which is not just another pretty technology as I originally thought:

> "Cyberspace: ... a new stage, a new irresistible development in the elaboration of human culture and business under the sign of technology. A new universe, a parallel universe created and sustained by the world's computers and communication lines ... Accessed through any computer linked into the system; a place, one place, limitless; entered equally from a basement in Vancouver, a boat in Port-au-Prince, a cab in New York, a garage in Texas City, an apartment in Rome, an office in Hong Kong, a bar in Kyoto, a cafe in Kinshasa, a laboratory on the Moon ... Everywhere and nowhere, a place where nothing is forgotten and yet everything changes ... A common mental geography, built, in turn, by consensus and revolution, canon and experiment; a territory swarming with data and lies, with mind stuff and memories of nature, with a million voices and two million eyes in a silent, invisible concert of enquiry, deal-making, dream sharing, and simple beholding ... Its corridors form wherever electricity runs with intelligence. Through its myriad, unblinking video eyes, distant places and faces, real or unreal, actual or long gone, can be summoned to presence. From vast databases that constitute the culture's deposited wealth, every document is available, every recording is playable, and every picture viewable. Around every participant, this: a laboratory, an instrumented bridge; taking no space, a home presiding over a world ... and a dog under the table. From simple economic survival through the establishment of security and legitimacy, from trade in tokens of approval and confidence and liberty to the pursuit of influence, knowledge, and entertainment for their own sakes, everything informational and important to the life of

> individuals -- and organizations -- will be found for sale, or for the taking, in cyberspace. The realm of pure information, filling like a lake, siphoning the jangle of messages transfiguring the physical world, decontaminating the natural and urban landscapes, redeeming them saving them from the chain dragging bulldozers of the paper industry, from the diesel smoke of courier and post office trucks, from jet fuel fumes and clogged airports, from billboards, trashy and pretentious architecture, hour-long freeway commutes, ticket lines, and choked subways ... from all the inefficiencies, pollutions (chemical and informational), and corruptions attendant to the process of moving information attached to *things* -- from paper to brains -- across, over, and under the vast and bumpy surface of the earth rather than letting it fly free in the soft hail of electrons that is cyberspace.(2)

The above are merely indicative highlights of an intensive literature review that I conducted (3). One thing that emerged loud and clear from this review of the relevant literature is that *multimedia* is but one subset of a long list of subsets within the over-arching superset now being called by spontaneous consensus, cyberspace.

During the remainder of this short piece, I'll focus on some of the issues and implications arising from an in-depth inquiry into the key words and constructs utilized in the title of this paper. The new technologies of virtual reality and artificial environments cause us to question our very understanding of such common terms of distance (adult) education, multimedia, and global management. Nonetheless, let's start with a consideration of the fundamentals of marketing.

3. MARKETING & THE MARKETPLACE

A basic marketing plan should at least address the 4 Ps: 1) Price, 2) Product, 3) Promotion, and 4) Position. Perhaps the first order of business is to formulate a crystal clear image of the product. For the purposes of this paper our "product" is Intercultural, Multi-media, Distance (Adult) Education.

For the past 20 years, JAIMS has been engaged in intercultural education for global managers. In our graduate programs our adult student body has had an average age of about 30. This cross-cultural management component of our "product," which is really a service activity in this case, is positioned historically quite appropriately as a high-quality experience that builds practical application via internships on top of a solid theoretical foundation. However, the new dimensions have to do with extending the availability of the product via distance education and enhancing its quality via the multimedia format.

Okay, but a) what specifically constitutes distance education and b) how multimedia should it be? To utilize some technical jargon we could rephrase the question somewhat as follows: "How much bandwidth is really required for educational communication and how much of full-motion video of human interaction is redundant, distracting, and irrelevant?"

To pursue this point a bit further we should realize that the market size for a given product -- e.g., FAX, is a function of the cost/performance ratio. Consequently, how much greater would be the market for any desired multimedia distance education if delivered in an edutainment format on a pay-per-view basis anytime. anywhere -- e.g., TV screens at home, PC displays at the office, wireless laptops in the air, Personal Digital Assistants (PDAs) while waiting in traffic jams, and so on? This is the central question that will be addressed in the remainder of this paper, as we'll pospone a consideration of our pricing and promotional policies for another time and place.

4. MANAGEMENT

Just as marketing is generally conceived to have four main components so does the classical definition of management as: 1) planning, 2) organizing, 3) delegating, and 4) controlling. Even though it is difficult to manage the turbulent nature of the burgeoning constellation of information technologies, we must do our best to cope for our organizations very survivals are at stake in academia as well as the business sector. Information can be viewed as a strategic asset and deployed as a competitive weapon. Even in education, the superior management of information technologies would enable an enterprise to "benchmark" best in class professors, curriculum, courseware, etc., and deliver these high-quality educational products and services by competing in time, convenience and cost to a wider audience than those schools utilizing inferior information assets.

5. CYBERSPACE ENCOMPASSES ALL INFORMATION TECHNOLOGIES

So, why and how does the sudden appearance of cyberspace as a virtual reality affect the topics under discussion in this paper in such a fundamental and profound manner? Let us begin by realizing that text-based cyberspace systems are already in daily usage at JAIMS and elsewhere in the educational world. For example, as part of our regular curriculum and alumni network communications our participants use bilingual word processors to break the language barrier between Japanese citizens and the rest of the world, utilizing such information utilities as Nifty-Serve (the Japanese counterpart to CompuServe).

Consequently, text-based cyberspace is already here and everywhere. The heavy users logged worldwide every minute on the InterNet is an example of this text-oriented virtual reality. However, in the realm of text-based cyberspace such as courseware delivered and "discussed" via some vendor's version of E-mail merely "tells;" whereas, some experts would argue that multimedia "shows" (2, 3). Now the revolutionary idea of cyberspace is that it changes the pedagogical methodology of education (adult distance education in particular) to one of "exploration" rather than (or in addition to) being told or shown. Preliminary results from primitive Multi-User Dimentions (MUDs) like HABITAT (5) process of exploration extends the categories of intelligences engaged from symbolic *telling*, through the *visual* senses which are *shown*, and indeed beyond the visual into the *kinesthetic* realm of *feelings* and *emotions*. *Business Week* (6) reported, "Carnegie Mellon University's Joseph Bates has created animated characters that exhibit emotions based on theories of human behavior. The next step: Virtual worlds filled with creatures that can interact with humans."

Many people are waiting for Moore's Law to come to the rescue once again as currently these virtual creatures require the power and speed of Silicon Graphic's Iris Indigo machine or even more sophisticated models to animate the beginnings of the evolution of artificial life. In fact, entire companies are springing up to explore the implications of Moore's Law within the next millennium.

Perhaps an example from the proposed *virtual* JAIMS Juku will illustrate these important distinctions. As part of JAIMS new strategic direction into Multimedia Resource Development (MRD) we have been creating, packaging, marketing, and distributing our own Computer-Assisted Language Learning (CALL) software. Currently, our multimedia explorer series software is largely text-based with some limited animation sequences and sound bites. Consequently, this is primarily in the *telling* and *hearing modes*. However, with high resolution, fast 3-D color animation enhancements our software could be upgraded into the *visual mode*. Yet, if such visually-oriented software could be further upgraded to run interactively in a MUD such as Fujitsu's improved version of HABITAT, players (at last count more than 10,000 worldwide) interested in learning the Japanese language, practicing business protocol/ etiquette, or exploring the Japanese mindscape could interact with computer programs and/or icons and earcons representing real teachers, characterized to look like Japanese *sensei*. Naturally, the student-participants can stop by the nearest "headshop" to obtain whatever icon they choose to represent themselves from merely a green dot to a fire-breathing Godzilla. Therefore, the instructional designer and curriculum developer will be evolving from an author/ wordsmith through a film-maker to arrive at the highest level of space-maker or environmental architect in the broadest sense of the words. The challenge for such curriculum designers is to truly use the graphics and other unique features of a MUD such as "persona modification" to justify the additional bandwidth requirements over and above existing text-based distance education networks.

6. THE FUTURE

Obviously, one of the key components of any educational system is a first-rate, comprehensive library. So what will the Library of the Future look like in Cyberspace University (CyberU)? Not only will all symbols be on-line and accessible from anyplace at anytime, but images will also be conveniently searchable and able to be easily spliced into video reports and other docudramas and so forth. Not only will exploring students seek out desired information, but the library will pro-actively seek to inform the student when some new information is entered into cyberspace that is useful for the student's particular selected path of developing their human potential to the fullest possible extent. In this regard, Xerox's recent announcement of a 1/4 ounce "classroom" addressing information using a copyrighted picta-glyph system will certainly find many educational applications.

Currently available is technology that will simulate cross-cultural business negotiations that attempt to ascertain true intentions, deception and lies, as well as the accurate interpretation of stated or spoken content which only accounts for 7% of face-to-face total communication. Such technology raises ethical concerns and questions regarding whether it is permissible to lie on substantive matters in cyberspace. Certainly, the technology exists already to detect such deceptions. Should it be deployed with or without the consent of the observed?

So how far in the future is cyberspace? According to Faith Popcorn, one of the most accurate forecasters of future corporate profit opportunities:

> Some call it "cyberspace," others call it "artificial reality." What Virtual Reality is, is a technology that makes it possible to synthesize a world -- a 3-dimensional, touchable, feelable, hearable, visible, interactive world computer-generated images and sensation.
>
> To enter this world, a person puts on some sort of special clothing (at the moment, gloves and goggles)-- that gets connected to a computer the experts are calling a "Home Reality Engine." Gloves receive and transmit data (Nintendo has already licensed a simple version of it for its home games); goggles (some call them "eyephones") situate you by sight and by sound in the synthesized space. Pointing a gloved finger transports you through the space-grasping an "artificial object" in artificial space sends very real sensations back to you via the glove. Sounds very Star Trek, but Virtual Reality technology exists right now. (NASA and the military have the most serious applications at the moment..) Jaron Lanier of VPL

Research in Redwood City, California, said in 1989 that Virtual Reality could be in people's homes by the turn of the century. And that, of course, is less than ten years away.(7)

3-D is already up and running on SUN work-stations with inexpensive "filters and glasses."

Regarding the future for multimedia distance education, the last thing I'd like to report on was a very stimulating briefing I received from Mr. Murakami at Fujitsu's new Kawasaki research facility in December 1992. I'm only now beginning to appreciate some of the implications of what I was shown.

Allow me to summarize some of the more significant developments one-by-one. A new genre of entertainment via a Virtual Reality Theater (10' x 30' screen) with artificial life-forms (virtual creatures) was recently publicly demonstrated. However, the educational possibilities were also immediately apparent to some of the high-ranking executives in attendance. These virtual creatures, known as Charlottes and Blobs (Binary Large Objects) display emotion following a psychologically sound model of behavior. A general observation is that a common hardware (HMDs, head-mounted-displays, datagloves, bodysuits--etc.) fixation is overemphasized. A lot of the benefits of virtual reality can be obtained by more comfortable human interfaces--e.g., voice, keyboard, joy stick, or electric wand.

Speaking of an electronic baton, one of the most impressive demonstrations I witnessed was two virtual families (like the traditional Hatfields and McCoys) who didn't like each other, but were eventually conducted to sing together via a human maestro only waving an electric stick. Naturally, these are only the beginning steps, but distributed CSCW (Computer Supported Cooperative Work) and other groupware for international project teams would seem to be a logical extension of this pioneering prototype.

Not only do these "blobs" display emotion by changing the color of their skins, puffing up their body, and so on, but they also demonstrated primitive rote learning capabilities such as "follow the leader." Each blob was endowed with a certain personality; however, such traits can easily be altered via pull-down menus as illustrated by Dr. John Bates of Carnegie-Mellon University (CMU) in the USA. Not only are persona modifications relatively easy, but also environmental engineering in cyberspace is comparatively easy and inexpensive. Consequently, a participant-student can create his or her preferred learning environment and even alter it from time to time. Or a meeting/manager-facilitator could rearrange the bargaining table and chairs, negotiating environment, and presentation room to fit each particular situation.

7. CONCLUDING REMARKS

So given all of this chaos in global management and intercultural communication, what will JAIMS do in 1993? JAIMS intends to keep "swimming into" cyberspace using the optimal mix of IT available in our technological environment at each purchasing point in time. If in doubt, we'll wait for Moore's Law to run its course which is projected to start leveling-off by the mid-90s, at which time Fujitsu is planning on having Virtual Reality widely available on FM Towns PCs.

How much will edutainment in cyberspace cost? Nobody knows for sure. However, it's virtually certain to cost less and be better than in the past. What will be the size of the market by the beginning of the next millennium? As discussed above, this is an almost impossible question to answer, but suffice it to say that it's already growing rapidly and will be huge by the turn of the century.

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New Directions in Asian Telecommunications II -- Russia's Reach for Global Impact -- Integration or Devolution?

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1. ABSTRACT

Since PTC '92, Russia has leapt forward with zeal to meet, and begin the hard work of overcoming, the looming challenge of reconstructing its national and international telecommunications infrastructure.

Progress has required policymakers and commercial entities alike to address complex jurisdictional issues within and without the Russian Federation. Such issues include harmonization of the roles of governmental authorities and private enterprise; "privatization" of national and regional operations; creation of regulatory structures and approaches at the national and regional level; inclusion of foreign participation in basic infrastructure. Add to these requirements 1) the daunting challenge of financing internal development without a fully convertible revenue source from domestic operations, and 2) the inherent difficulty of meeting rising expectations of the domestic and international market in the face of limited financial resources and sheer man power limitations.

Nevertheless, as summarized herein, Russia has developed a master plan for network development: an apparent regulatory blue print for a coexisting national infrastructure and interim, short-term service upgrades for prime customers; a tentative, evolving resolution of the roles of domestic and foreign industrial participants and governmental bodies. More definitive solutions are in process within the Parliament. And, in terms of meeting operational objectives, Russia is at a point where future plans for a complete new basic network complex can at least be discussed as initial major upgrades move into the procurement phase and beyond.

2. INTRODUCTION

Following the collapse of the Soviet system in December, 1991, Russia has begun in earnest the task of rationalizing its telecommunications infrastructure and the institutions that support that sector.

Although one element of this rationalization is the de-evolution of vestiges of central planning through the sponsorship of telecommunications joint ventures and joint stock companies of various regional significance, there is a countervailing trend toward centralized management and control of key international facilities and network centers. Russia appears to have accepted the assumption that its global reach depends upon its ability to leverage the scale of its market through the effective consolidation under state enterprise control of the major gateway systems and associated infrastructure. The need to attract Western technology has also been incorporated into Russia's planning, and new CoCom policies and structures has allowed progress in this direction.

The consolidation of Russia's telecommunications network supports five main objectives:

1) To ensure a coordinated internal development;

2) To reinforce Russia's privileged status as a telecommunications bridge among the now independent Republics of the former USSR;

3) To exploit nationwide geographic circumstances through reconstituted national programs, such as TSL (the "Trans-Siberian Line"), which may generate earnings and investment attributable to Russia's natural role as a telecommunications "transit" bridge between Europe and Asia;

4) To fully integrate Russia into the global cable and satellite grid, so that Russia may become a "player" in the world market;

5) To develop a technology base.

Russia's drive toward self-sufficiency in telecommunications and a more active global presence must continue to overcome several conflicting factors. Political fragmentation within Russia threatens the establishment of a stable economy, and economic disintegration could deprive the telecommunications effort of important economies of scale and coordinated administration. At the same time, Russia's dependence on western technology requires accommodation of western investment and maintenance of a stable climate for joint development. Furthermore, Russia's full international presence requires capital to acquire through capacity on interconnected facilities used to terminate traffic at distant destinations.

The Russian national carrier, Intertelecom[i] (formerly Sovtelecom), and its regional affiliates seek to preserve its front line status in this market as the major interface for Russia in the international realm. Beneath the surface, however, lies growing pressure for autonomy on the part of Intertelecom's local affiliates, and on the part of joint ventures. In addition, municipalities and regions are seeking their own independent status and identity in the realm of telecommunications. Moreover, Russia remains dependent on foreign partners (e.g., Japan and Korea) to whom it must hand off traffic for international termination. These partners, in turn, are competing for the primary right to provide this service.

The acid test will come in 1993 when the main enterprises are privatized. As structured, the privatization program will provide incentives to maintain centralized, nationwide establishments, but there is the potential of equal magnitude for fragmentation. The fragile balance between nationwide networks and new regional players, some with western investment support, will be played out, as will the opportunities for foreign interests to assert a role in the evolving development of Russia's telecommunications structure. At stake in the final analysis will be Russia's ability to command the global market in proportion to the potential scale and scope of its traffic and national economy.

3. HISTORICAL OBSERVATIONS

Before turning to the current situation, it is important to acknowledge certain historical features that have shaped the existing telecommunications baseline. Historically, the telecommunication sector was neglected in the former Soviet economy because of a prejudice against "nonproductive" activities. In the highly centralized economy, a public telecommunication network was not required for business purposes and Soviet leaders were wary of citizen access to communications facilities. The system was designed to serve official and administrative rather than consumer, needs. The Soviet network thus evolved as a rigid hierarchical structure that responded poorly to user demands.

Telecommunication development first appeared in the former Soviet Union's 1966-1970 Five Year Plan, which called for a unified automated system of telecommunication ("EASS"). The EASS was intended to be an integrated network with the capacity to carry voice, video, and data traffic. Little integration took place, however, during the five-year period.

The focus intensified when, in 1985, the Central Committee and the Congress of the Soviet Communist Party called for a restructuring of MinSviaz, the Ministry of Communications. The Prime Minister initiated a program for telecom growth and converted some military communications manufacturing to civilian production. The plan from 1986 to 1990 sought to incorporate 12.1 million new lines, initiate a move to semi-electronic exchanges, and introduce optical fibre and digital technology. The plan's emphasis was on residential systems, with 75% of the new installations to be residential lines. The goal of MinSviaz was to reach 90 to 100 per cent urban penetration and 50 percent rural penetration by the turn of the century. Attaining this goal would require the installation of 60 million lines during the 1990's.

Former President Mikhail Gorbachev initiated reforms of the highly centralized structure, and the administration placed telecommunication at the forefront of development and growth. One million new lines were installed each year from 1980 to 1985, and two million lines were added each year from 1986 to 1990. The network was altered to make residential service a priority.

While impressive, these developments did little to remedy the fundamental deficiencies in the public network. At the present time, it is projected by the International Telecommunications Union, for example, that completion of a core network will require the addition of 26.5 million lines at a cost of $39.9 billion over the next eight years.

4. RUSSIAN TELECOMMUNICATION TODAY

Despite the centralized Soviet structure, the Russian Republic oversaw telecom policies, procurement, and network installation within its own boundaries, and had its own technical research and development institutes. Today, Russia's control over its own telecom system has expanded further with the dissolution of the all-Union MinsViaz.

In Moscow, local communications are organized by MGTS, which serves 3.8 million local phones through a network of terminal and district PABXs. Interdistrict bridges are connection to nine intercity bridges under Intertelecom through a combination of satellite, microwave and ground cables. Calls are routed within the intercity network through 12 automatic switches, one for each NIS region. Special industry and department networks are connected to the 12 main trunks. Trunks exist between the various switches and the Moscow intercity network, which Intertelecom used for diverse routing. The international switches are the Intertelecom switch number 10, as well as the Kiev switch, which is operated with AT&T.

These will be replaced with high capacity, digital switches at Moscow and St. Petersburg, sized to handle the inflow of traffic from new international cables (e.g., Russia-Denmark) under project finance and revenue lease arrangements. Intertelecom, while ensconced as the gateway operator, must pay over a share of the hard currency earnings from the international settlements to (1) the lessor of the switches (U.S. West) and (2) the underwriters of the cable link. Similar arrangements will be implemented for other international trunk lines, switches, and connecting routes.

Intertelecom is a joint stock company formed initially on an all-Union basis. It is in the process of being reconstituted, and ultimately, it is slated for privatization. Russia holds 72 percent of the shares, with the remaining 28 percent allocated amongst 25 long-distance operating companies across the NIS. Seventy per cent of Intertelecom's facilities are in Russia, although the company owns equipment and installations in other former Republics.

The current Russian master plan anticipates the creation of a major backbone system, consisting of international fiber optic undersea feeder lines and land extensions in northwest and southwest Russia, and in the Russian Far East. A connecting microwave trunk among these lines will extend from Moscow across the Urals and Siberia, on to Khabarovsk. In 1992, the Russians began the construction of the Denmark-USSR undersea link through the Baltic, and the installation of land extensions to St. Petersburg and Moscow (via fiber to St. Petersburg and microwave to Moscow). The links' completion is expected in 1993. The southwest undersea/terrestrial cable link from Italy through the Black Sea to Moscow is entering the procurement phase, and there is a tender outstanding for the Russia-Japan-Korea undersea system that will link eastern Russia (Nakhodka, Vladivostok, and Khabarovsk) with Korea and Japan and, eventually, the Pacific cable grid. The final bridge, connecting all the other elements of the backbone, will be TSL ("Trans-Siberian Line") from Moscow to Khaborovsk, which is in its initial procurement phase with tenderers invited for the design, supply, installation and commission of a microwave link extending approximately 7500 kilometers and providing 8 X 155 Mega-bit traffic channels. Intertelecom plans to synchronize the start-up of TSL with the projected early 1995 service date for the Russian Federation optical fiber system in the West and the international gateway/Russia-Japan-Korea submarine cable project.

In sum, these projects represent a gross investment total of at least $500 million. The goal is to provide initially international connectivity by connecting these facilities via international switching centers supplied by U.S. West at St. Petersburg, Moscow and in the Far East. The associated revenue will cover the financing costs. Upon completion of TSL, Russia hopes not only to connect the far ends of its territory, but to also position itself to earn lucrative transit revenue stemming from Asian-European traffic. Russia would sell "droits de passage" ("DDP") and thereby fuel the cash requirements for further improvements.

Intertelecom is the sole Russian entity in these projects, and it has maintained a steadfast resistance to the participation of Western partners in the operation and direct earnings from the planned network, although foreign participants have been tapped to front the capital costs in exchange for a specified revenue share.

Significantly, this master plan for what will emerge as the "Vzamavyazanoy syetee svyazee," or "Integrated National Network," (known by the Russian acronym "VSS") does not and cannot address specific regional requirements and local line needs. Local networks remain under the jurisdiction of municipal phone companies, such as MGTS. Regional systems have been ceded to foreign joint ventures, such as C&W's "MCC" venture with Intertelecom in Tyumen and Golden Ring.

As far as immediate "fixes" to problems of international connectivity in major urban areas, "overlay" operators have been licensed to provide international calling service. Clients subscribe to special access arrangements to these operations' switching centers. These operators such as the GTE joint venture, "Sovintel," or the Belgium ATT venture, "Combellga," do not provide service to or from the Russian public at large, but they do fill an interim need for premium business customers. The companies also do not interconnect domestic Russian subscribers internally. The international service needs of these companies and the public at large will ultimately require the full-scale development of the national infrastructure under the "VSS" umbrella.

Other important potential network operators include various ministries that have access to nationwide rights-of-way grids, such as the Ministry of Railways and the Ministry of Electricity. The latter has already participated in a new line from Finland to St. Petersburg. The former, in theory, could provide a resource for a trans-Siberian crossing.

The legal right, however, to access of right-of-way for one purpose is not an automatic license to run a telecommunications operation. All such activities are subject to licensing. The licensing process determines not only the right to operate, but also the status of a facility in terms of its relation to the basic "VSS" network. Without proper and complete authority, there is no way that an operator can legally lay claim to participate in the international switched traffic revenue and associated toll settlements. Nor can an operator carry traffic to and from the public at large via the public switched network.

Absent such licensing, however, overlay "operators," may by-pass switches and provide international call-completion services to select clients (hotels and businesses) that are typically charged in hard currency. But such services require dedicated, separate international trunk lines organized by the overlay company (usually via satellite) and a contract or, at least, a billing arrangement with the local user. At the distant end as well, such operations may be limited in their ability to reach the called party destination. Usually operators "resell" the terminating segment which is operated by a licensed PSTN entity. Return traffic to Russia can only be routed to connected subscribers, and opportunities for such operators are very limited. Licenses must be obtained from Minsviaz, which is not at all bashful about shutting down unlicensed operators. In late October, for example, Telecom Finland acceded to Russian demands and closed international lines serving the joint stock company "SovAmer," which used Finland as a hub for completion of international calls to the West. In the Far East, a similar operator of OTC, which claimed local sanction in Vladivostok, was ordered shut down for want of a federal license.

5. PROVISIONAL REGULATION IN THE RUSSIAN FEDERATION

The diversity and complexity of the emerging telecommunication market within Russia has forced authorities to attempt a legal rationalization of various cross-currents operating within the telecommunication sector. The first approximation was the Presidential 31 July 1992 ukase (decree) which introduced the concept of the "VSS" and promulgated a comprehensive set of "provisional" regulations on telecommunication networks in the Russian Federation. Most recently, the Russian Parliament drafted a more comprehensive law that elaborates upon the general framework by 1) defining more clearly the distribution of regulatory powers assigned to national, territorial and local levels, and 2) clarifying regulations with respect to licenses, rates, and user rights.

The initial legislation attempts to impose order on an increasingly fragmented universe, while at the same time it encourages the participation of multiple suppliers in the construction of the "VSS". The state, while no longer able or willing to assert a monopoly over the supply of basic telecommunication services, nevertheless seeks to enforce network integration and national standardization through regulatory surrogates for collective ownership of basic facilities and networks. The recent law clarifies these objectives by providing a detailed break-down of each regulating body's role in developing an integrated, reliable and controlled network. The envisioned "VSS" will be a consensus of 1) the national backbone, coordinated by the President, Parliament and the Ministry of Communications (or a successor 'Federal Communications Agency'); 2) territorial or regional components, under the supervision of the oblast and other administrative units; and 3) local units, under the operating control of municipal bodies and individual enterprises.

A fundamental concept behind the emerging body of legislation is the basic recognition that the "VSS" is itself a complex of diverse networks which, with some key exceptions, must be subjected to regulatory discipline to ensure technical compatibility, fair pricing, and universal access. Detailed provisions are set forth pertaining to the establishment of separate networks serving the special interests of national defense, security and state administration. The legislation also reflects a very progressive notion of user autonomy, by which specialized "departmental" communication networks may be established by various enterprises, ministries, institutions, and legal and physical persons, including foreign joint ventures. Such networks would be comparable to Western private networks and, subject to compliance with technical compatibility standards, could be interconnected with the VSS and offered to the public, provided (as in the US) no harm is caused to the network. The law even allows resale of excess capacity to the general public.

In the scheme, none of the various elements of the "VSS" complex are permitted special privileges. The law declares that all communication enterprises are established and function on the basis of diversity, equality of forms of ownership, and free competition. There is equal treatment under the new law, irrespective of whether the provider is a state organization or a private company, including joint ventures having foreign participation in accordance with the general law -- providing, of course, that such parties obtain official sanction through the licensing process.

Regulators are charged with harmonization of the network through standards-setting and compliance programs supervised by the Ministry of Post and Telecommunications. In special cases, the Ministry can exercise some limited responsibility for the smooth operation of the integrated network. Fundamental powers are given to the Ministry to ensure that no new lines, expansion of old lines, or management of components of the integrated network may be undertaken without specific authorization. Naturally, the Ministry also enjoys traditional licensing authority over the use of the radio frequency spectrum and the assignment of satellite orbiting facilities. Provisions of the law also permit regulation of incidental electromagnetic interference of non-telecommunication devices.

The recent proposals imply that, for the most part, rates are under the control of the communications administration. Aside from services "of great social importance," however, the new law leaves it to the communication enterprise to establish its rate. In these cases the enterprise must inform the administrative body of its rates during the license application and when any subsequent changes are made. The legislation also reflects measures to combat corruption, although instances where providers engage in favoritism or rate discrimination are not expressly prohibited. In special cases, free or reduced rate services may be provided, under the condition that the administrative body whose constituency benefits from such dispensation makes the service provider whole in terms of overall revenue. Thus, the interim law attempts to balance public subsidization with an emerging "commercial" imperative. The owners of the communications enterprise must ensure that such dispensations do not undercut the overall commercial viability of the network; they must obtain contributions for the enterprise to offset revenue losses or reductions resulting from such discounts. In addition, the law provides a "consumer" bill of rights.

It is apparent that the Russians have attempted to derive a unique system to meet their own needs on the basis of models drawn from diverse sources in Western law and regulation. In fact, in some instances, the legislation transcends Western standards of progressive regulation; the diversity and competition model of the telecom network is also extended to encompass competition into he delivery of mail. The Russian market will thus be a very interesting one in which to operate, provided there is sufficient resolve to pursue the legal regime to its logical conclusion and establish an effective marketplace for basic and specialized services alike. Success will also require that the economy as a whole be transformed into a marketplace system.

6. THE ROLE OF JOINT VENTURES

Currently, the ultimate source of development funds and energies are Western carriers and their customer bases. The objective is for revenue to fulfill general economic goals at national and local levels, as well as those needs that pertain to telecommunications. Historically, traffic imbalances have yielded a net inflow of hard currency. This imbalance will be preserved even as the circuit shortage is relieved, which otherwise should make it easier, theoretically, to call out as well as in. Russia will probably suppress outgoing demand in favor of incoming traffic, or alternatively, Russia will encourage overlays to enable outgoing collections from procuring customers to be levied in dollars. On the Western side, the cost of using the international circuit will rise; an improved service will legitimize this price increase, and Russia will earn a higher percentage of hard currency from their ventures. Within Russia, costs to the customer will be kept at a minimum, as the government wishes to keep the service affordable to the general public.

In the new climate, business dealings are less complicated by an overtly political agenda, aside from the pressure placed on joint ventures to address social development priorities in designated zones whose commercial potential may require significant lead time to develop. To offset this problem, the Russians are prepared to offer long-term franchises and other concessions, but where short-term profits are at hand, licenses of short duration are normal. An example of the former is the Cable & Wireless joint venture, Metropolitan Communications Company, which operates in the Western Siberian region of Tyumen and the "Golden Ring" around Moscow. The latter is typified by the Sovintel venture which provides international voice services primarily to hard currency hotels and western businesses. Otherwise, the currency potential in major traffic corridors is such that over the past year, the emphasis has shifted from centralized structures towards diversity so as to increase the sources of foreign earnings. As concerns exclusivity, the Russians have begun to realize that multiple gateways may bring geometric increases in revenue. In the Far East, for example, various sponsors of fibre optic networks to Korea, Japan, and beyond are under consideration. As long as telecommunication is regarded as a reliable source of hard currency, however, it will be difficult to develop a viable, comprehensive strategy for structuring joint ventures. The Russian side requires sole possession of the hard currency earnings from international activities.

Given all of the changes, the role of project finance will be the key to investment. Utilizing a sort of nonrecourse financing, banks will obtain payments through the enterprise's hard currency profits, if the Republics do not pay the financiers otherwise. Other related issues include privatization and a new pricing model. All depends, however, on the macroeconomic transformation of Russia as a whole, including the construction of a convertible currency as the ultimate measure of asset and enterprise value.

7. PRIVATIZATION AND CURRENCY REFORMS

As the USSR disintegrated into its sovereign Republics partly overseen by the NIS, so the telecom infrastructure became a collection of various fragments of former all-Union, republic, and local oblast-level ministries. Conflicting and parallel interests are at work simultaneously, and many developments appear unplanned and ad hoc. It is not always clear to whom potential foreign investors should be talking, or who owns the assets in question. Irrespective of what may emerge on a cooperative basis, Russia has initiated substantive measures with broad economic impact and particular relevance to telecommunications. These measures include the recent edicts related to foreign exchange and privatization.

Under the privatization program, both the public and workers' collectives have the opportunity to participate in the ownership of large companies, such as Intertelecom, through statutorily reserved blocks of stock (35 percent for workers) or stock vouchers for the public. Managers can purchase a smaller (5 per cent) reserved block. A controlling block will be sold through tender or auction, unless the management and work force can organize a majority purchase at a price set by the privatization authorities. If no Russian buyer can be found for control of the existing nationwide enterprise, then there s a theoretical potential for break up. Conversely, there is the possibility that the telephone system may become subsidiary to foreign investment. Indeed, recent rulings have made it clear that vouchers, which have been distributed to Russian citizens for use in the purchase of phones in privatized entities, may be sold secondarily to foreigners of "pooled" in managed investment funds.

With respect to controlling legal standards, Russia is clearly attempting to take charge of its economic destiny. As a basic element of sovereignty, the November 1991 edict governing the liberalization of foreign economic activity establishes the primacy of Russian currency. This principle is intended to minimize the hard currency exposure of telecommunication and other joint ventures to local service organizations, thereby conserving foreign exchange for the importation of Western goods and services. Nonetheless, local jurisdictions will undoubtedly press for a stake in the hard currency earnings derived from international foreign exchange settlements.

Local telephone companies will be limited, however, in their purchase of foreign exchange for imports, as it is fair to assume a serious deficit of foreign exchange reserves until Russia is able to balance its foreign trade, hence there will be limited licensing. The ultimate regulations may impede the local telecos' ability to overhaul their systems without an import license for equipment and services. The granting of such licenses may be subject to uncertain foreign exchange availability at the Central Bank. The saving grace may be that telecoms is identified consistently as a priority sector; it may be granted, either formally or informally, special recognition in the context of any licensing regime.

Perhaps tensions surrounding the currency restriction on local operators will be eased by policies to link all joint ventures with a social improvement mission in local areas. Since its political reorganization, Russia has begun emphasizing the creation of "development zones." Telecommunication systems for such regions are being initiated through joint ventures. Recent negotiations with the Russian Ministry of Telecommunications indicate that, for proposed joint ventures seeking a long term concession, Russia will advocate the inclusion of a telecom branch to a targeted development zone.

1. To be renamed "Russcom" pursuant to its privatization.

Visions of the Information Age - 2021 AD

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1. Abstract

Summarizing a delphi research study, forecasts are presented on quality of life, quality of work, technology, economics, government, regulation, markets, corporations, security, education, energy and the environment.

2.0 Executive Summary

This research project was recommended by the National Engineering Consortium's executive council members. This paper is condensed from the "Research Study, included in the Consortium's publication, "2021 AD: Visions of the Future".

The Consortium has an ongoing initiative, "Creating Our Common Future", consisting of research, cooperative workshops, and symposia such as 2021 AD, TechNeeds 2000, and InfoVision.

Recognizing that day-to-day management presents many challenges, often distracting from developing and focussing on a longer term vision, these executives suggested a research study and symposium to help them look into the future.

By looking far enough ahead, many shorter term constraints are removed and visions of the future emerge. What might the future hold for the communications and information industry? Will today's impediments still exist? What will the world of 2021 AD be like?

Why 30 years? For many products, 30 years is about the time from research laboratory to broad marketplace acceptance. Touch tone deployment was offered to the marketplace nearly 30 years ago and today has over 80% penetration. Facsimile machines and VCRs have had shorter market penetration cycles but their underlying technologies began in the 1950s.

To develop forecasts for 2021 AD: Visions of the Future, the Consortium invited participation of executives, researchers and academics who are very knowledgeable in the communications and information fields. An extremely competent panel of 136 provided the forecasts.

The panel developed 235 scenarios of the future which were rated as to the likelihood of occurrence and impact on world, society or customers.

The experts predict improved quality of life and improved quality of work. Major forces forecasted include:

2.1 Global: World Right - Area Might.

Communications and better relations between world leaders will identify and focus on global problems resulting in agreements, regulations and laws. Regional areas will develop and mature including the European Economic Community, Pacific Rim, North America and potentially, the Middle East and South America.

2.2 Government: Fiscal Pain - Business Gain.

Dissatisfaction with U.S. federal government and congressional performance will result in required fiscal responsibility. The business sector will be encouraged to develop economic resources through relaxed antitrust laws and telecommunication regulations. New forms of pricing and open competition will stimulate the development of products and services.

2.3 Business: Market Needs - Corporate Deeds.

The business environment will be more competitive globally with highly demanding customers. This will force corporations to become market-driven and think globally while acting locally. Corporations will develop a longer term focus and improve their infrastructure. Information and robotics will be widely used to make individual custom products efficient to manufacture. Over 90% of the Fortune 500 companies will use ISDN.

2.4 Technology: Person Reach - People Teach.

Technology will permit contact with a person via a single phone number anywhere, anytime. Home entertainment systems with supercomputer power linked to information services will result in a blurring of highly-effective entertainment and education.

2.5 Quality of Life - Quality of Work.

Improvements in lifestyle, workstyle, security, education, environment, energy and communications/information will result in longer, more productive, and stimulating lives.

3.0 The World of 1961

To achieve a perspective of 2021 AD, it is interesting to look back thirty years to 1961. What was the world like? What were promising new developments? Could we have predicted the 1991 world? Some of the 1961 statistics provide interesting insights.

In the U.S., first class letters cost 4 cents and engineering graduates enjoyed hearty $7,000 annual salaries. Women engineering graduates were almost non-existent, numbering only 3 per 1000 graduates.

Just 16 years had passed since the end of World War II. The rebuilding of Germany and Japan was completed but neither was a major economic power.

Japan had a breakeven balance of trade while the U.S. enjoyed a surplus balance of $2.5 billion. The beginnings of Japanese automobile and consumer electronics were seen throughout the world. Small, uncomfortable, low quality cars and transistor radios offered only modest competition to market dominant U.S. automotive and consumer electronic companies.

Germany enjoyed success at the low end of the automobile market. The Volkswagon "Beetle" costing about $2000 offered reliable transportation and an air cooled engine. Americans bought the beetle in spite of its origin as Hitler's car of the people.

Transistors were new and finding applications in consumer and industrial products. In addition to Japanese transistor radios, Motorola and Philco introduced transistorized televisions. Thus, a major technological shift began reducing size and cost of consumer electronics.

Color television was showing slow progress. Only $100 million was spent on station equipment and color televisions in 1961. Most consumers balked at the high price and said "who needs it".

Television cameras and recorders were very large, restricting use to studio setting and requiring high wattage lighting. Richard Nixon's perspiration during the television debate with John Kennedy was attributed to these hot lights.

Portable camcorders and video recorders were not yet available. Consumer VCRs/camcorders were products that would probably not have been predicted. Of course, no one predicted the sensational success of walkman.

Transistors were making inroads into a relatively new area-digital computers. Some research laboratories were developing the predecessors to large scale integrated circuits.

The National Engineering Consortium held the 1961 National Electronics Conference in Chicago. Many of the 12,000 attendees were interested in a variety of papers on digital computers.

One particularly well attended session discussed discrete control systems, an area principally donated by analog technology. In fact, analog and digital computers received about equal emphasis.

A paper was presented with a title that could very well be billed today: Speech Recognition by Neural Networks. Also a new field called Synnoetics attracted capacity attendance. This was an early discussion of the current artificial intelligence/expert systems area.

At a plenary session, the young president of Motorola, Robert Galvin, spoke of the need for companies to expand their markets globally. How prophetic these words were is clearly seen thirty years later.

In looking into the future, could the personal computer have been forecast in 1961? It was somewhat uncertain that the digital computer would have such far reaching applications especially in science and engineering.

The microcomputer, required technological developments in silicon and integrated circuit technology, computer architectures and software. Entrepreneurial startups were necessary to exploit the personal computer, since mainframe manufacturers showed little interest. Improvements in disk memory and a wide variety of applications software were key ingredients.

Competition in the components industry including the Far East was necessary to fuel rapid development of the personal computer. All of these ingredients were necessary to achieve the present status of the personal computer.

Even more difficult would have been predicting the AT&T divestiture. Of the events prior to 1961, the Hush-A-Phone case was most telling. An FCC ruling that the cup-shaped mouthpiece would "harm the network" was overruled by the District Court of Appeals. This ruling was a small but significant change in AT&T's complete hold on the network. The Hush-A-Phone decision was soon followed by the Carterfone and MCI decisions.

As this research project looks to 2021 AD, there will be many factors unseen at this time which could have even more significant impact than the personal computer and divestiture. It is with this spirit of venturing into the unknown that we assembled the expert panel and sought collective visions of 2021 AD.

4.0 2021 AD Study - An Introduction

The National Engineering Consortium's council of executives recommended a study and symposium on the future.

A 30 year time frame was chosen as typical from research laboratory to broad deployment of product. Touch tone telephone service was at the research stage in the 1950s. Today, nearly 30 years later, touch tone has over 80% telephone subscriber penetration. Both black/white and color televisions had similar penetration patterns.

Although the video recorder and facsimile experienced shorter consumer penetration cycles, their research origins were in the 1950s. Today's research may result in similar new products in 2021 AD.

The project scope looked broadly at the

communications and Information fields including media, broadcasting, publishing, newspaper, printing, computer, telecommunications and semiconductors.

Invitations to leading corporations, research laboratories and universities sought panel members willing to participate in a two wave, delphi-like research project. A total of 136 panel members provided thoughtful contributions to the study.

The first wave questionnaire asked seven open end questions:

- What major scientific advances do you forecast to have the largest impact on your organization and what do you envision the impact to be?
- What global changes and or events do you predict and what will be their impact?
- What will your customer of 2021 AD be like and want?
- What changes do you envision in the competitive environment?
- What regulatory or government changes do you envision and what will be their impact?
- What changes do you envision in your industry's products and services?
- Other changes you believe important? What major events do you see as possible that would significantly alter your answers to prior questions?

The richness of the responses provided the basis for the second wave questionnaire. A total of 235 future scenarios were developed within nine categories:

. Applications
. Competition
. Corporation
. Customer
. Education
. Energy and Environment
. Government
. International
. Technical

For each scenario, panelists were asked to judge the likelihood of occurrence by the year 2021 AD together with the impact on world, society or customers. Comments on each scenario were solicited.

Scenarios were plotted on a likelihood/impact grid for each of the nine categories. The grid axes were the mean of the data for each of the two coordinates.

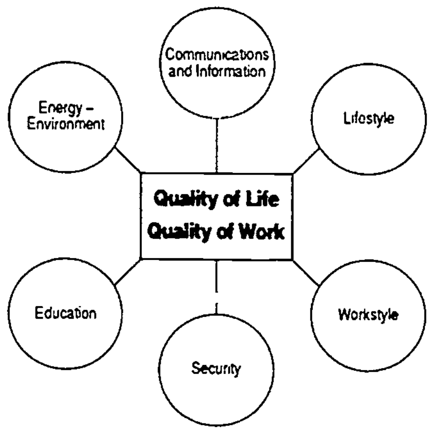
This provided four quadrants:

3 High Impact Low Likelihood	**1** High Impact High Likelihood
4 Low Impact Low Likelihood	**2** Low Impact High Likelihood

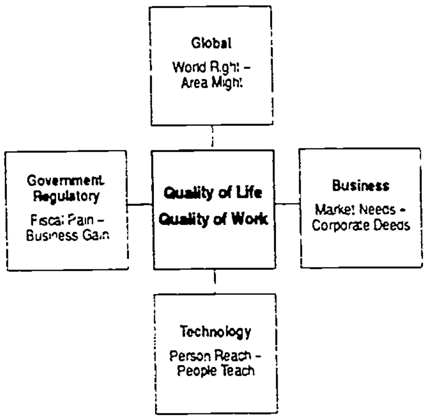
Quadrant 1 is most important since panelists judged the scenarios both higher than average likelihood of occurrence and impact. Quadrant 2 also was higher than average likelihood but less than average impact. The high impact Quadrant 3 scenarios were judged to have lower likelihood. Finally, Quadrant 4 scenarios were rated to be both low likelihood and impact.

Analysis of both questionnaire waves and their implications produced very interesting visions of the world of 2021 AD.

A logical model was developed centered on the individual. What will the quality of life and quality of work be 30 years from now? The major impacts on the individual are shown in below.



In a broader framework, society will have macro-forces which are reflected in the following model.



5.0 2021 AD Macro-Forces

Examining each element of the Macro-Force Model, the major impacts forecast by the panel are woven into a vision of 2021 AD.

5.1 Global: World Right - Area Might

The global forecast for 2021 is basically upbeat. World Right presents a picture of improved relationships, communications, cooperation and international agreements. Area Might forecasts world economic development and area development, as ideology is replaced by pragmatism.

Communications and better relations between world leaders will identify and focus on global problems resulting in agreements, regulations and laws. Regional areas will develop and mature including the European Economic Community, Pacific Rim, North America and potentially, the Middle East and South America. In other words, global competition and alliances will be less on a country basis and more on an area basis.

5.2 World Right

Leaders of major countries will meet frequently to focus on world wide problems. This communications will further understanding and prevent major conflicts.

Global warfare will not have occurred, principally because nations and leaders communicate more freely. Also, there is low probability that a war will take place in which nuclear arms are used. In short, warfare will be localized and swiftly contained similar to what happened in the recent gulf war.

On the other hand, there is a high likelihood that war between the Arab states and Israel will have occurred. Such a conflict will involve the United States. Panelists from outside the United States rated the likelihood and impact of this occurrence highest, possibly because of the Iraq invasion of Kuwait and the formation of U.N. Alliance.

Increased communications will highlight disparities in living standards. Countries who have standards of living lower than the aspirations of their populations will see increased national tensions and revolutions.

Governments will find it more difficult to maintain poor standards of living as the inexpensive free flow of information informs both their populations as well as overall world opinion. Terrorism will most likely continue but not have a major impact on society.

Nuclear, biological or other environmental disasters will become more important to the nations of the world. Global regulations and laws will be developed to curb future disasters. The twenty first century will be preoccupied with protection of the environment on a global basis.

Growing world populations will be more concentrated in urban settings. Ten cities will likely have populations in access of 20 million and an additional ten cities will have 10-20 million people. Global hub cities will be formed for the free flow of products, services, money, people and information. The growing world population will result in major problems in the food supply environment. Our panel considered this trend to have one of the highest impacts on the overall world society.

5.3 Area Might

National economies will depend more and more on interrelationships with other countries in the world. Over the next thirty years, worldwide markets will be more open. Reduced trade restrictions and impediments will stimulate trade among nations.

The world will be united into specific geographic areas having collaborative relationships similar to the European Economic Community. Examples include Asia, North America, and possibly Latin America in addition to 1993 Europe.

The Pacific Rim is seen as highest likelihood to become a major political, economic, industrial and cultural power. Within Pacific Rim countries, China is unlikely to become a democratic country.

The European Economic Community will continue to unite and will remove nearly all transnational barriers. The EEC will have a common currency which will further trade and communications.

The remaining western European countries will join the EEC. It is also forecast that eastern European countries including Russia will become members.

The United States, Canada and Mexico will develop a cooperative consortium to compete with the European Economic Community and Pacific Rim Consortium. Within the world, the United States will continue as a political and economic power, but its leadership role will be shared with other superpowers.

5.4 Government: Fiscal Pain - Business Gain

Dissatisfaction with U.S. federal government and congressional performance will result in required fiscal responsibility. The business sector will be encouraged to develop economic resources through realized antitrust laws and telecommunication regulations. New forms of pricing and open competition will stimulate the development of product and services.

5.5 Fiscal Pain

The U.S. government will undergo substantial change over the next thirty years. Lack of leadership and inability to curtail massive spending will trigger major crises.

As Americans become more dissatisfied with the federal government and congress, sweeping changes will occur. Americans will demand congressional term limitations and more accountability.

Closely linked with the dissatisfaction of government will be a rebellion and significant change in the U.S. legal system. The large burden on our economy forced by legal actions and liability claims will be reduced.

Americans will demand forced fiscal responsibility from congress. Most likely, this will have resulted from the U.S. government's inability to curtail spending. Also, U.S. deficits will seriously affect both the value of the dollar and economic stability.

Citizens will have to pay significantly higher taxes but it is unlikely that the U.S. personal tax rate will be greater than sixty percent.

As a response to these economic pressures, the United States will emphasize fiscal policy to control the economy, industry and social programs. Privatizing government functions may be one of the answers. Our panel predicts that the U.S. Post Office will have been privatized by 2021 AD.

The United States will become much more socialized in the areas of medicine, retirement and education. It is not clear how the economics of these forecasts will develop. Potentially, the government will work more closely with the private sector in cooperative social ventures.

5.6 Business Gain

As the global market place becomes more of a reality, the U.S. government will recognize that cooperation between corporations will be vital to market success. The government will encourage intercompany cooperation to achieve global competitiveness.

This will require working relationships between competitors. Anti-trust laws will be relaxed so that more economic power can be applied for global competitiveness.

Government and regulatory bodies will also realize the importance of global competitiveness within the information industry. A new Communications Act will have been enacted providing a coherent policy that fosters advances in all aspects of communications services and products. The panel did not foresee a new federal government regulatory agency for the telecommunications industry.

Overall, a more cooperative environment between federal government and industry will exist because the public will require economic gains that the government is unable to provide except through the private sector. Also, the significant financial pressures facing the U.S. budget will require growth in gross national product to generate added tax revenues for government programs.

5.7 Business: Market Needs - Corporate Deeds

The business environment will be more competitive globally with highly demanding customers. This will force corporations to become market-driven and think globally while acting locally. Corporations will develop a longer term focus and improve their infrastructures. Information and robotics will be widely used to make individualized custom products efficient to manufacture. Over 90% of the Fortune 500 companies will use ISDN.

5.8 Market Needs

The customer of 2021 will be more demanding and purchase only those products and services which effectively meet their specific needs. Information and communication products and services will be much more readily available on competitive offerings; thus, customers will purchase the best value.

As the world becomes more complex and a broader range of products are offered, emphasis will be on simplifying customer choices and meeting their needs.

Publishers and information providers will form alliances to serve customer needs. Working agreements between cable, satellite, entertainment, publisher/information providers and telephone companies will be structured to offer effective customer delivery of products and services.

Government deregulation and subsequent removal of regional holding company restrictions will permit both competition and cooperation between major industry groups.

The demand and competition will foster continual updating and new generations of products. Product lifetimes are predicted to average half of current lifetimes. The impact on the corporate research, development, manufacturing and marketing will be significant.

Companies will be forced to develop unique organizational structures, processes and market delivery mechanisms to achieve these objectives. A current example is the personal computer industry where product life times are measured from months to a maximum of only a few years.

As technology becomes increasingly more available to all, service will become a major distinguishing feature between competitors. Service competition will intensify. Globally, deregulation and open markets especially within trading groups will mean that the safety of protected home markets will be significantly lessened.

Competition will be on a worldwide basis. Market differences between nations will blur due to homogenization of cultures. Art, music, entertainment, fashion and potentially language will become similar in most parts of the industrialized world. Even lesser developed countries will have access to inexpensive communications and begin emulating the western way of life. At the same time, market differences within a nation will increase as demographic diversity increases.

This will result in products and services that will be designed globally but customized locally. Marketing, sales and services will still be major local issues and of more importance than the product.

There will be several competitive worldwide networks with interconnections to a network of networks. Competition between the networks will be fierce with commodity-like pricing. In the information industry, significant competitive trends will result from cable, telephone and broadcasting companies all competing to provide entertainment-information services to the home.

5.9 Corporate Deeds

Global competition will force corporations to assume the strategies of the most successful worldwide companies. Successful U.S. corporations will emphasize long term business and technical strategies similar to Japanese corporations. The intense concern for quarter-to-quarter financial performance will be lessened. The financial community will respect and economically value corporations maintaining long term strategies.

Regarding corporate structures, the panel projected that both large conglomerates and niche market focused corporations will compete as they do today. There will be mergers, restructuring and acquisitions.

Mergers will occur between cable and telephone companies. At least two of the regional holding companies will be merged or acquired. The high volume printing industry will incur a major shakeout and consolidation of companies.

Independent telephone companies will continue to be acquired, although it was less likely that these acquisitions would be principally by regional holding companies.

Major telecommunication companies will not specialize but will provide broad services in several of the following areas: local exchange, interexchange, customer premise equipment, central office equipment, and wireless.

Today's emphasis on quality will result in most corporations imbedding total quality concepts throughout their organizations. Quality will no longer be an organizational unit but rather a way of life for all employees.

The variety of products and services available will be significant. Through distribution channels, customers will be able to select products customized to their individual needs.

Corporations will offer both custom and customizable products. An example of custom products might be individually styled newspaper/newsletter for specific market niches. Customizable products might include a customer developed newsletter based upon the person's current and changing interests.

Demographics will continue to put a premium on human resource management. The work force will become more distributed with telecommuting widely used.

5.10 Technology: Person Reach - People Teach

Technology will permit contact with a person via a single phone number anywhere, anytime. Home entertainment systems with supercomputer power linked to information services will result in a blurring of highly-effective entertainment, education and communications.

5.11 Person Reach

Customers will no longer be bound to the wireline network as they are today. Wireless personal communications will be commonplace. People will be able to be reached anywhere, anytime.

A single phone number will be assigned to a person. Communications will shift from calling a place to calling a person.

This easy wireless access will require socially acceptable methods of achieving privacy. Call screening, redirection, storage and answering will all be part of personal communications systems.

Personal communicators of the future will use computer and electronics technologies and be small in size, possibly wrist watch configurations. The technologies within the communicator will perform basic communications and also help organize and provide information in harmony with the network.

Wireless personal communications will become part of worldwide intelligent networks which will maintain person-location data bases. Many of the services desired by the customer will be made available through the intelligence in the network.

Nearly unlimited personal and data communications will be available because of new modulation techniques and spectrum allocations. Also, wireless access to local area networks and private telephone exchanges will be preferred.

Improved battery performance resulting in a 10-50 times increase in watt hours per kilogram will enable smaller portable phones with longer communications talk time.

Personal communications may link to pocket sized computers having workstation performance capabilities.

5.12 People Teach

The title of this section is very much customer oriented rather than technology driven. People Teach was chosen since our panel envisions a substantially different home communications environment than exists today.

Undoubtedly, a new word will be added to the English language which defines the integration of personal computers, communications and entertainment systems.

These systems will be more advanced than today's supercomputers. Inexpensive, multi-terabyte storage will permit these systems to store extremely large amounts of information.

High speed data transfer to these mass storage devices will permit downloading of video, audio and multi-media information. Playback by consumers will be on demand.

Education will be delivered to the home. Communications will permit interaction between a student and teacher, other classmates or computers.

Panelists from telecommunications companies forecasted that broadband switching and delivery of information to over 50 percent of the households will occur by 2021.

Customers will have access to an enormous amount of information. Many more media channels will be available specializing in news, sports, comedy, cooking, home repair and a variety of other subjects.

Newspapers will be delivered electronically to the home in printed or video displayed formats. There will be a blurring between entertainment and information. Interesting and entertaining formats will make education fun.

People will communicate with their home systems by voice. The new home systems will have builtin information agents to easily find specific information and handle many administrative chores.

A majority of entertainment and information usage will be when the customer wants it as to opposed to current direct broadcast schedules. People will be able to interact, play, communicate and have teleconferences using the new systems coupled to broadband networks.

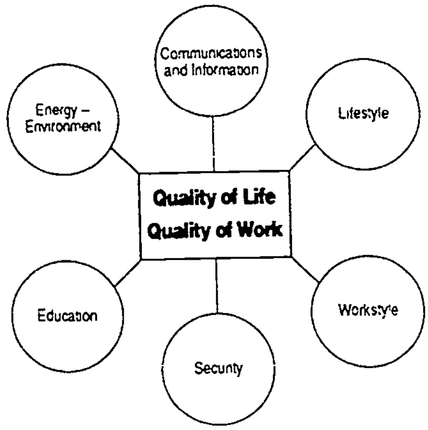
Information will be easily available anywhere at anytime much like electric power and dial tone are today. Customers obtain customized information, sophisticated analysis and fast answers to questions.

Throughout the U.S. people will communicate by real time video.

New computer/communications/entertainment systems will have life sized video displays which will be flat, picture-like and three dimensional. These new displays will be the next generation after high definition television.

5.13 Quality of Life - Quality of Work.

The hub of the macro-force model is quality of life -- quality of work. Improvements in lifestyle, workstyle, security, education, environment, energy and communications/information will result in longer, more productive, and stimulating lives. The following is the quality of life -- quality of work model:



5.14 Lifestyle

Aspects of lifestyle were discussed in the section: Person Reach -- People Teach. Technologies will play an important role in communicating, educating and enriching lives.

In the year 2021 AD, life expectancy will be substantially higher than it is today. Medical research will have made major strides. Diseases faced by the population today will be of lesser impact. Devices will be implanted in the body to help provide medical diagnosis. Electrical stimulations of auditory nerves will allow many hearing impaired people to hear.

The increasing life expectancy will present economic challenges. Needs-based social retirement programs will be in existence. Other social institutions may be organized to serve the aging population. There may be a return to the extended family unit, possibly by adult children returning home to live with their affluent parents.

Of high impact but judged 50 percent likely is the demographic shift, where the proportion of U.S. middle class will shrink with growth in both rich and poor population segments. This scenario would result in the U.S. population becoming more "have and have not."

The population will be more computer literate and reasonably comfortable with information technology. Technology will interface more easily with people so that a comfortable relationship will exist between persons and their machines.

People will value services that simplify their lives. Technology will be an important supporting resource. People will request information in voice, written, graphical and video forms.

Talking to the intelligent agent (computer valets) within home systems will be much the dealing with a trusted assistant who can help in many ways.

Barriers of language communications will be reduced as automated translation systems become a reality. Communications will be voice-to-computer-to-voice translation.

The pervasive amount and depth of information will make privacy and security important issues. Laws will be enacted with strict penalties.

Personal communications will permit private times during which contact with other persons will be conducted effectively through screening and messaging.

5.15 Workstyle

The work environment of 2021 will change from today. Competition for highly skilled employees will become more intense. Companies will value their employees more. Increased training, education, security and incentives will be more commonplace than today.

Lower level supervisory and managerial jobs will change. Computer technologies will replace many of the functions. These management levels will emphasize employee and customer relationships rather than information handling and processing.

Intelligent systems will offer support to management at all levels. This capability will make analysis, risk assessment and decision making much more computer assisted than today.

Training will be very important. The accelerated pace of business, changing technologies and global competition will require a commitment by corporations and employees to lifelong learning.

Employees will work about the same number of hours per week as they do today. The most dramatic change will be where they will work.

Corporations will encourage telecommuting or distributed office environments. Work at home will increase for many people especially those in the creative and external contact segment parts of the business. Effective person-to-person communications including teleconferencing will enhance work-at-home environments.

Engineers will perform design functions utilizing home work stations and telecommunications. Service representatives will effectively interact with customers using corporate data bases.

There also may be work centers geographically dispersed in communities. Employees will work in small group environments.

5.16 Security - Economic and Personal

By valuing employees more, corporations will be increasingly concerned about their security. Retirement plans will become more important.

As the government restructures social retirement programs, individuals will have to plan one or more careers so that they might have sufficient lifetime incomes.

Although taxes will most likely increase, they will be at manageable levels. Government programs to encourage retirement savings will be necessary to shift the economic burden from federal to personal retirement programs.

Additional government social programs will be needs based. It will become evident that the government is unable to solve many of the country's social problems. Local community groups and corporations will tackle problems such as education and social services.

Privacy and security will be further facilitated through the wide use of physiological identification technologies including fingerprints, voice or retina. A variety of security systems will be available for both personal and home use.

5.17 Environment - Energy

Over the next thirty years, there will be increasing concern about energy and the environment.

The growing world population will result in major environmental problems. Even in countries having lesser population growth rates, risk management, pollution and other environmental effects must be handled.

The U.S. government will have enacted laws specifying a variety of environmental actions. These will affect corporations and consumers.

Concerns about the environment will result in a wide variety of programs. Conservation, recycling and environmental controls will be effected in industrialized countries. As problems become more global, third world nations will follow.

Manufacturers will emphasize products and packaging which will minimize environmental effects. Most products and packaging will be biodegradable. Over 50 percent of products and packaging will be recycled.

The panel forecasts a serious oil crisis which will accelerate the further development and implementation of alternate energy sources. Potentially a major redirection towards solar, nuclear and electric power will occur. Electric vehicles will be commonly used. We believe this forecast may have been influenced by the gulf crisis at the time of study.

5.18 Education

The quality of the U.S. kindergarten through twelfth grade education system will still not be world class in 2021 AD. The panel forecasts that there is less than 50 percent likelihood that the U.S. K-12 system will be one of the best in the world. The present education system will probably fail in its attempts to improve K-12 education.

Private initiatives offer the best hope to improve elementary and secondary schools. Local citizens, corporations, businesses, and professional organizations will work together on this critical national problem.

Most states will require K-12 teacher certification. Good teachers will be recognized and rewarded.

There is greater than 50 percent likelihood that students and parents will be able to choose their public K-12 schools. Competition for students will foster improved education.

Electronic technology will be increasingly important in improving educational environments. Communications and computer systems will be widely used in schools. Teachers will guide multi-media learning experiences.

There will be a blurring between entertainment and education. Information technology will present learning environments that will be both effective and fun.

Since over 50 percent of the U.S. households will have computer-communications systems, education in the home will be an extension of the school experience.

Simpler methods of video publishing will encourage entrepreneurs to offer learning information products. There may well be a similar phenomenon in multi-media learning products as exists today in computer games.

Students will be encouraged to enjoy group communications as well as person-to-person through life sized wall video displays.

5.19 Communications and Information

Under Macroforces: Person Reach -- People Teach, many of the technology trends applied to Quality of Life -- Quality of Work were explored. Impacts on persons, families and society beyond the technology will be very significant.

The ability for a person to be always in contact through personal communications has simple but very significant ramifications. Contacts and actions can be handled whenever a person feels so inclined. These contacts do not have to be person-to-person. They could very well be person to messaging centers or to an intelligent agent for handling.

Even when a person desires privacy, a person could be reached by loved ones and professional colleagues. Alerts would occur in case of an emergency. Timely interactions will improve both the quality of life and quality of work. Decision making will be easier and relationships between people will be improved.

Within home environments, artificial intelligence, fuzzy logic and advanced sensors will detect abnormal operation, diagnose and cause repair of most home products.

The captivating computer-communications-entertainment systems described before will be a focus for a rich set of interactions and services.

Entertainment and education will be blurred in the future. Many opportunities will be available to play, learn and create.

Interactions between individuals or groups will be commonplace. Electronic family gatherings will occur to share experiences and see each other. Competitive games such as bridge may very well be played among four people in remote locations.

The drudgery of food shopping will be handled by the intelligent agent. Just in time delivery of groceries will minimize home storage and inventory costs.

Since corporations will have to adjust to this new environment, focused marketing will emphasize effective techniques. Direct marketing will present products and services not only to people but also to intelligent agents. The agent may well screen offering sand make known only those that have possible interest.

All of these impacts on quality of life are possible. There may well be other, even more powerful opportunities. As the macro-forces of economics and deregulation permit increased competition in the information field a large variety of affordable services will be available.

Since the presentation of information on demand is so new, the specific roles of advertisers, suppliers and consumers have yet to be established. Pricing levels will change radically as marketing learns more about consumer price elasticity. Also, competition will drive prices close to costs.

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The Principal Investigators thank the 136 participants who developed and evaluated the 235 scenarios. Their insights and visions provided the rich forecast presented in 2021 AD: The Research Study.

DEVELOPING STRATEGIES FOR PACIFIC COMMUNICATIONS

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1. ABSTRACT

Trans-Pacific telecommunications is growing at a rapid rate, with the development of both Satellite and Submarine Cable Systems. However, few of the Pacific Islands have derived real benefits. This paper reviews the issues involved, both technical and societal, and considers the basis on which a regional strategy could be developed.

2. INTRODUCTION

2.1 SCOPE OF PAPER

This paper considers the way in which strategic thinking can be applied to the development of communications in the Pacific Region. In particular it looks at some of the issues relating to the Pacific Island states, both with regard to the rapid development of technology and to infrastructure requirements.

The paper considers the particular needs of the islands, with special consideration of their size and geographical remoteness. This is also set against the requirements of the region as a whole.

Effective strategy should be closely tied into action and the need to further develop technology and to provide adequate resourcing is examined.

2.2 PACIFIC ISLANDS

The precise definition of the extent of the Pacific Region and hence the number of Pacific Islands varies from one authority to another. Table 1 lists the islands which have been the primary focus of this paper.

Seven of these island groups - Fiji, Kiribati, Marshall Islands, Solomon Islands, Tonga, Vanuatu and Western Samoa are Pacific Island member countries of the World Bank. The Bank noted (1) that the average growth rate of these countries was lower than other comparable countries and that their substantial growth potential was not being achieved. Four reasons were put forward as impediments to growth:

* Natural Disasters
* Political issues (in some countries)
* Concentration on building economic and social infrastructure
* Lack of private sector investment

Whilst most of the Pacific Islands are independent, a number prefer to remain as dependencies. Tokelau is one and is currently debating its position. One factor is that of aid packages (2) - a key component in the economy of many of the Pacific Islands.

2.3 TECHNOLOGY ISSUES

The development of new telecommunication systems is primarily targetted at large users having complex operational requirements. Economically their complexity and high development costs can be justified by increased capacity. This means that the cost per circuit actually reduces in real terms. Submarine Cable Systems are a good example of this. In 1983 ANZCAN represented the latest (analogue) technology. Now current systems such as NPC (using fibre optics) offer capacity over an order of magnitude greater. Costs have not increased by anything approaching this level. For the future systems with substantially greater capacity are in development.

However, when considering a Pacific Island with even a population of, say, 100,000, these capacities are irrelevant (NPC can provide around 8,000 circuits per fibre). Special developments to meet the particular requirements of the Pacific Islands are, however, impractical from a manufacturers viewpoint as such systems would have to bear an unreasonable R&D conponent in the final equipment price.

2.4 SOCIETAL ISSUES

If the Pacific Islands are to keep in step with the rest of the region then continuing investment will be needed to maintain that position. Failure will result in a widening gap. The real issue for communications development is firstly how that development can be co-ordinated across a number of independent countries and secondly, how it can be supported in financial and political terms. The Acapulco Declaration (3) covering Latin America and the Caribbean demonstrates one pattern - through national objective setting.

One factor that should not be forgotten is that improved communications may not

	Status	No of Islands	Population
American Somoa	US unincorporated T	7	36,260
Cook Islands	NZ self-governing T	12	17,185
Easter Island	Chile	1	2,060
Fiji	Republic	110	727,104
French Polynesia	French	30	188,814
Galapagos Islands	Ecuador	6	7,994
Guam	US unincorporated T	1	130,400
Hawaii	USA	7	1,053,900
Kiribati	Republic	21	63,883
Marshall Islands	Republic	12	43,755
Niue	New Zealand	1	2,531
New Caledonia	French	6	164,173
Nauru	Republic	1	8,100
Northern Marianas	Independent - US T	16	20,591
Palau	US Trust Territory	26	14,106
Pitcairn Island	British	1	54
Solomon Islands	Constitutional Monarchy	20	285,796
States of Micronesia	Federation	607	86,094
Tokelau	NZ	3	1,690
Tonga	Kingdom	169	95,200
Tuvalu	Independent	9	8,229
Vanuatu	Republic	80	142,630
Wallis and Futuna	French	2	15,400
Western Samoa	Independent	4	163,000

N.B.
1. No of islands indicates populated islands
2. T is abbreviation for Territory
3. All information is indicative only

TABLE 1: Profile of Pacific Island Countries

be universally welcomed! The main con-concern is that of the smaller and remoter areas who consider that good communications will lead to greater, but remote, bureaucracy. The place of the subsistence sector is important in many of the islands, indeed a study (4) of this sector in Tuvalu, the Solomon Islands, Kiribati, Western Samoa and the Federated States of Micronesia indicated that 50 to 80 per cent of the population still get a major part of their basic need from non-monetary subsistence. In these areas it is perhaps worth emphasising the other benefits that telecommunications can bring such as facilitating improved health and educational services.

3. TECHNICAL INNOVATION

3.1 MIXED TECHNOLOGIES

In considering the development of telecommunications technology it is important to recognise the fact that almost all systems will comprise a mixture of both technology and standards. Currently both analogue and digital transmission systems frequently co-exist. In the area of switching various technologies are likely to be utilised and a variety of inter-exchange signalling protocols implemented. Whilst these items are under the control of the local administration the interface with International Circuits will not be and in terrritories with small populations this is a more dominant factor than in most of the world.

An additional issue is the use of radio systems reaching the further, and less populated, islands and which can inhibit their integration into the global village concept.

3.2 SATELLITE SYSTEMS

The development of satellite systems for the region is discussed in detail elsewhere. Such systems are becoming increasingly appropriate as the cost and size of earth terminals decrease whilst ease of use increases.

Communications is not limited to voice contact but can be extended to a wide range of applications and it is possibly this area that offers the most interesting possibilities. PEACESAT (Pan-Pacific Education and Communication Experiments using Satellites, a joint project between the University of Hawaii and NASA is an example of the potential for such systems.

However it must be recognised that, even by satellite coverage standards, the Pacific is a vast region and providing services targetted solely at the Pacific Island countries is not likely to be a self-financing operation. Thus Pacific Rim countries are likely to continue as prime instigators of projects.

3.3 SUBMARINE CABLE SYSTEMS

Over recent years dramatic strides have been made in the development of long-haul systems moving to fibre-optic systems using, for current systems, regenerative repeaters but with optical amplifiers being in the advanced state of development for trans-oceanic systems and with more advanced devices in the research phase. However the main effort is focussed on increasing capacity per fibre for long-haul systems. This has resulted in the cable capacity within the Pacific being the prerogative of the Pacific Rim nations, with cables being routed directly across the Pacific. The primary reason for the direct routing is that the cables are most at risk of damage in shallow water where there is a risk of damage from fishing activity and at landing points.

The use of unrepeatered cables is becoming more attractive as spans are gradually increasing. This approach to linking island chains is also more practical with the development of synchronous technology as 'rings' and 'drop and insert' facilities are available with little extra complexity. However more studies are needed before such schemes can proceed.

3.4 RADIO SYSTEMS

The use of radio systems is widely used for communication in the region and covers a range of systems.

Microwave systems can provide 'backbone' links between fairly close islands. As they are effectively Line of Sight systems they are more suited to use in the mountainous islands, rather than atolls where range will be more restricted. As with other frquency bands, the propagation characteristics need local survey as the Region does have some anomalies.

HF communication can provide fairly reliable medium to long distance communications but with restricted channel capacity. However it does give low cost linkages to remote areas.

Potentially there are a range of new techniques that could be investigated in the Region. The pressure on bandwidth that exists in most of the world is much more relaxed. Therefore studies could be carried out into the use of various forms of digitally based radios.

3.5 SYNCHRONOUS SYSTEMS AND STANDARDS

Within the telecommunications world there are effectively 3 groupings, European, North American and Japanese. Each has an interest in the Pacific. The latest set of standards for telecommunications transmission were published by CCITT in 1989 as G.707, G.708 and G.709 and are known as the Synchronous Digital Hierarchy (SDH). In North America ANSI published its SONET standards which are compatible with SDH. Variations still exist at the lower levels but mapping to higher levels can, in theory, be mixed.

Synchronous systems are designed to accept existing, plesiochronous, interfaces and will support future services such Asynchronous Transfer Mode (ATM), Broadband ISDN and Metropolitan Area Networks (MAN). However the main benefit is that it is possible to extract and/or insert part of the capacity without having to demultiplex the whole. In addition a degree of network management functionality is integral to the system and this permits the systems to be designed with inbuilt and automatic protection.

The impact of this technology is of mixed advantage to the island nations. On the credit side is the fact that it is possible to conceive of networks embracing many islands, providing routings over satellite, submarine cables and radio, being remotely managed and providing resilient services. On the debit side is the problem that probably no one country on its own would be able to justify such a scheme purely for its own needs (this is based on the traffic needs that can be deduced from Table 1). A solution depends on a co-operative venture as is discussed later.

3.6 NETWORK MANAGEMENT

Modern equipment is both complex and reliable. The inbuilt facilities of SDH further mean that if a fault occurs then there is a high probability that it will be automatically recovered. In such circumstances Network Management providing a friendly user interface to the system is essential.

Definitions of network tiers within a Pacific Island country will be on a different basis to that normally considered. From a pure networking viewpoint it could be advantageous to treat the entire grouping of the Islands as a single entity. As will be seen from Table 1, the population and hence traffic levels could be readily accommodated in this manner. However the implications on sovereignty of the nations is considerable.

A factor that impacts on this area is the possibility of utilising the regional network for enhanced services as is discussed later. Network management is by no means mature and the issues of managing global networks are by no means insignificant. Even managing a corporate network across a number of countries gives rise to a number of challenges (5). To manage a Pacific wide network with interfaces to the Pacific Rim countries is even more demanding.

4. DEVELOPMENT OF INFRASTRUCTURE

4.1 THE NEED

In considering the requirements for telecommunications the most frequent basis is to take existing usage and to project future demand from this. This forms a reasonable assumption for the situations where services and facilities remain at similar levels. However when a significant change occurs then demand increases by a step and growth continues from this new base. The introduction of direct dialling is a good example.

An alternative approach is to look at the areas where telecommunications can be developed in a wider sphere. This is effectively exploring the possible discontinuities in demand for capacity and consideration is given in the following paragraphs to applications benefiting the region as a whole. The rationale behind this approach is that traffic originating from person to person calls is limited by the population whereas other applications have effectively no limit on their requirement for capacity.

4.2 WEATHER FORECASTING

The issue of weather forecasting has received an added impetus with the debates on global warming. Three areas can be identified as being pertinent:

* Improved Regional forecasts
* Monitoring of global warming factors
* Monitoring the impact of regional weather on the rest of the world

The impact of severe storms on low lying atolls can be devastating. Substantial damage to other islands also occurs from time to time plus the effect on those involved in fishing and transport between islands. Provision of a weather forecasting system of the sophistication of those in Europe or many other parts of the world will be a complex task but may well be achieved, especially in view of the following factors.

The recent, high profile, international gathering on climate change and global warming has had a major impact on thought across the world. Within the Pacific this has an importance on two fronts. Firstly some of the predictions indicate that global warming could result in a number of atolls, including Tokelau (3), becoming permanently submerged. This moves the issue from the academic to the practical! The second area is the value of measurements in the Pacific where it is possible to make measurements unimpeded by industrial pollution.

Weather is not isolated to a particular region but is now recognised as a global system. It is now recognised that a meteorological event in the middle of the Pacific can have a major impact and lead to effects around the world. There is therefore value in increasing the amount of monitoring throughout the Pacific.

4.3 HEALTH

Despite the image of the Pacific being an idyllic paradise, the reality is that for many of the countries the health prognosis is not good. Life expectancy in Kiribati, for example, is 52 years. Whilst considerable variation exists between the islands it is clear that there is a real need. This is not to imply any criticism of those providing health services in the islands. The problem is that of scale and distance. Tuvalu with its 8,229 population is an independent country with a 36 bed hospital and 4 doctors (7) covering 9 islands. Larger islands are better off in having greater number of medical personnel but the problem remains that in smaller countries it is almost impossible to provide the level of health care that is enjoyed by larger nations. The reason is that whilst primary health care is available the higher levels are very restricted.

In studies of these issues (6) the need for 'remote' tertiary health care provision is recognised. The use of telecommunications for supporting island health care teams is already recognised as a possibility and can be illustrated in the potential of transmitting an X-ray image for remote diagnosis. Obviously there are more complex applications.

4.4 TRANSPORT

As air traffic increases across the Pacific so does the need for air traffic management systems. In a similar way shipping looks increasingly to the use of communications and navigational aids. Both of these activities are closely safety related.

Aircraft and ships carry both cargo and passengers, indeed, in the commercial sector profit margins are such that high load factors need to be achieved if the operation is to remain in business. To achieve these targets computerised reservation systems are key and these are supported by reliable communications. Many of the islands states now have their own airlines and are seeking strategic alliances to build their operations. This is then likely to be tied in to the national tourist operation and the hotels.

4.5 EDUCATION

In a similar way to health care, education can be restricted by the small communities within the Pacific. Whilst basic educational (primary) facilities are good, bearing in mind the rural situation of the islands, provision at secondary levels and above can vary. The University of the South Pacific, based at Suva, Fiji provides excellent facilities for the 11 countries it serves. Its special importance is that it recognises the difficulties of the countries it serves.

The potential for distance learning has increased significantly as both technology and technique have developed over recent years. This provides the opportunity of developing advanced education facilities within the islands but without significant organisational overhead.

4.6 BUSINESS DEVELOPMENT

Earlier in this paper (Para 2.2) reference was made to the fact that one inhibiting factor in the development of the Pacific islands was the lack of private sector investment. Modern business is heavily dependent on reliable communications and this is likely to be an area of their focus.

5. POLITICAL AND FINANCIAL INITIATIVES

5.1 REGIONAL CO-ORDINATION

One of the features of the region is the plethora of intergovernmental organisations, each of which provides a different perspective on the region. However, whilst many of these organisations have a direct interest in the development of communications none of them is able to provide a comprehensive regional overview. The South Pacific Forum, with its 15 member states (Australia, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, New Zealand, Niue, Papua New Guinea, Republic of the Marshall islands, Solomon Islands, Tonga, Tuvalu, Vanuatu and Western Samoa) provides the best representation of the South Pacific region but does not pretend to look at the Northern and Eastern boundaries of the Pacific.

The World Bank and the United Nations bodies can provide a independent (i.e. non-aligned) stance. However to maintain this independence requires a careful balance to keep a consensus. "Sometimes social and cultural factors may outweigh sound economic reasoning in the development of public policy" (8). This principle can be applied to both Pacific Island countries and also to Pacrim countries.

Other major bodies include the APEC (Asia-Pacific Economic Committee) working group on telecommunications, COTAT (ASEAN Committee on (land) transportation and telecommunications, APT (the Asia-Pacific Telecommunity established under the auspices of the Economic and Social Commission for Asia and the Pacific, not forgetting CCITT (Consultative Committee on International Telegraphy and Telephony) and INTELSAT (International Telecommunications Satellite Organisation).

5.2 AID

Aid is an important component of many of the Pacific Island budgets. Tokelau received some US$1,420 of New Zealand aid per person compared with export earnings of US$222 per person (2). Whilst this is extreme many islands receive levels of aid amounting to several hundred US dollars per capita from a variety of nations with interests in the Pacific.

The current world recession means that aid packages are under more stringent review than previously. What the outcome will be over the next few years remains to be seen. It may well be that the cash will be more tightly tied into development objectives and that could be beneficial in the long term.

5.3 PRIVATE INVESTMENT

It seems unlikely that, apart from the tourist industry and possibly some mineral extraction, major, direct private sector investment will be made in the region. However the possibility of joint ventures between one or more of the islands and the private sector is more likely. Joint operations between Continental countries and the Pacific islands are also possible. Care will be needed to ensure structured development between the islands.

5.4 TECHNOLOGICAL DEVELOPMENT

Earlier in the paper it has been noted that dramatic strides have been taken in developing communications technology. Equally it has been observed that the technology has not been focused on either "long thin" routes which constitute the island links or on systems for countries that do not have a tiered network structure. There is scope for driving telecommunications development in this direction. Some work has been funded by the European Community but there is a need to look in more depth at the Pacific requirements. Commercial demand for such facilities are unlikely to be recouped in sales and therefore adequate funding is required.

6. CONCLUSIONS

6.1 SUMMARY

The objective of this paper has been to look at some of the new technology that is available for Pacific Communications It has been observed that this may not always be appropriate for the needs of the Pacific islands.

The potential uses of the technology were then explored, recognising that conventional telephony alone will produce a rather different set of needs from consideration of the wider issues. Broadening the review also offers the potential of a wider funding base.

Having established the potential for development and also the fact that action is needed to keep the Pacific islands in step with the rest of the developing world, a brief look was taken at the political and financial initiatives that are needed to move the concepts forward.

6.2 A SYSTEMS APPROACH

There are a wide range of viewpoints within the Pacific. Each country, both island nations and Pacrim nations, have particular national interests, and rightly so. However it is believed that a long term solution, that will enable the whole region to keep in step, will be a systems solution, i.e. one that has been derived from a top down analysis. It will take into account the interfaces with the major countries surrounding the Pacific and derive a coherent approach to inter-island linkages.

The view is taken that a piecemeal approach to the issues of developing strategies for communications in the region will not produce the optimum solution and will not allow the Pacific Islands to benefit from the potential investment in communications within the region.

6.3 THE WAY FORWARD

This paper has developed the view that the Pacific Region has specialised requirements in terms of telecommunications development. Success will be aided by planning within a strategy that takes full account of all potential users, that facilitates suppliers developing suitable equipment and that promotes a systems approach at both local and regional level.

Development of that strategy will require co-operation between the nations and agencies involved. Once developed this strategy must be underpinned by political resolve and appropriate financial backing.

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IS MULTIMEDIA READY FOR PRIMETIME?
STUMBLING BLOCKS TO MULTIMEDIA DIFFUSION

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1. ABSTRACT

Misunderstanding of multimedia in the computer industry, the confusion of consumers, and the lack of understanding of technology in the human context provide an impetus for examining and speculating on the future of multimedia. "What can a multimedia technology do?" is not a sufficient question for consumers until we add "for whom" and "how" and possibly "when." Both how the relevant techology is likely to develop and how human choices would be made are examined with a focus on historical trend in media technology adoption.

2. Problem

2.1 Rosy Projections

Multimedia has received a great deal of press in the past years as the hottest technology in the computer industry. Multimedia is claimed as one of the top five developing technologies that will drastically influence corporations in the following years, according to a report by Anderson Consulting (Alexander, 1991 Sep.). IBM is investing $100 million in microcomputer-based multimedia systems, and forming cooperative ventures with Apple [1] and Time-Warner.[2] Microsoft is spending $15 million on
multimedia research and products in 1992 (Sullivan, 1992). Apple is aggressively moving into multimedia products by introducing a new kind of personal computer that John Sculley, CEO and chairman, refers to as the 'personal digital assistant.'[3] At the same time, several Japanese manufacturers and US corporations are pursuing multimedia as co-adventure (See Figure 1].

Furthermore, there have been many technical such as Apple's Quicktime,[4] Intels' Digital Video Interface (DVI) - video compression technology, and Motion Picture Experts Group (MPEG)'s compression standard which was finalized in 1991. Consequently, many rosy projections have been made. Technology Futures forecasts that the domestic market for multimedia products is expected to exceed $20 billion in 1994 (*FHTN*, 1992). Sales of multimedia PC equipment to the corporate sector are projected to increase from $4.7 billion in 1991[5] to $22 billion in 1995, according to Inteco Corp., an industry reseach firm (Kim, 1991). Insight Research estimated that 77% of all industrial and educational workstations or microcomputers shipped in 1997 will come bundled with communications functions, and 21% will be outfitted for networked multimedia applications, compared to 4.8% in 1992 (Booker, 1992).

A great demand for MPEG chips and the introduction of basic outline of MPEG 2 were expected to be in place by the end of 1992 (*VTN*, 1992, Jan. 6). The installed base of CD-ROM drives used for multimedia application should reach 6.8 million units in 1997, and a cumulative average growth rate of 46.4% for the installed base of CD-ROM drives between 1992-97 (See Table 1). If it happens as projected, finding a PC without multimedia will be like trying to find a new car in Texas without air-conditioning, as some industry expert said (Kim, 1991).

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[1] Apple's joint venture with IBM is not only intended to create an object-oriented operating system but also a multimedia - Kaleida Kaleida pitched its Bento plan to representatives of 15 companies at a meeting in Cupertino, CA, in late April 1992 (See *Inforworld*, May 11, 14/19, pp. 1-2, Parker, 1992, July 6; Quinlan & Sdanell, 1992, May 11)

[2] IBM made a $500 million offer for an equity position in Time-Warner Entertainment in an attempt to make a place for itself in new markets for consumer electronics products that combine text, data, voice, and images for home (See *Electronic News*, 1992, May 11, 38/1911, pp 1-2).

[3] While John Sculty painted a vivid picture of the Personal Digital Assistant (PDA) last January, it is now clear that it won't be available until 1995 (See Rebello & Arnst, 1992, Nov 30)

[4] Quicktime extentions for the Macintosh let users display movie files on their machines with no additional hardware

[5] About 2 million multimedia units will have been sold by the end of 1992, mostly to business users, according to the Optical Publishing Association (Potts, 1992, October 25). This figure is a 30% increase from 1991

2.2 Skepticism

While marketers see multimedia computing as the spark for sales of new PCs and upgrade-kits, several questions persist about whether multimedia will ever catch on with the buying public. Some feel that the benefits of multimedia systems have been exaggerated (Blackwell, 1991). Zackmann (1990) pointed out the lack of a standard and applications and high cost. Rick Warren, a syndicated audio-visual columnist, disputes industry predictions by declaring that "We have passed the era of revolutionary products." (Wood, 1992, Jan. 23). At a cultural level, Postman (1992, Nov. 1) argued that Americans are obsessed with what technology can do, rarely even interested in what it may undo. He further claimed that when it comes to technology, "our defenses are weak, our need insatiable, our judgement unreliable, and our perspective short-sighted."

2.3 Research question

Considering that the rosy projections appear to be driven more by technology/industry push than by consumers' needs, a systematic examination of the stumbling blocks to multimedia diffusion is of importance. Despite the industry push, consumers would not 'snap up' these products solely for the love of technology; they need and want to know what the technology can offer them and how. Therefore, "what can a technology do?" is not a sufficient question until we add "for whom" and "how" and possibly "when." In this context, we attempt to provide answers for the following questions: What are possible scenarios for the US multimedia market in the year 2000? Will there be a mass market for multimedia or not? If not likely to emerge, why not? If it will be some time, when will the time be and what will it look like?

In order to investigate both how the relevant techology is likely to develop and how human choices are made, historical analogy will be employed. We will first look at what multimedia can do based upon technological functions (i.e. hardware), followed by how the industry approaches the market (i.e. software), and how consumers have responded to the media technologies in the past. Then, finally, to foresee the future of multimedia in the following years in the US, both technological dimension will be synthesized together, and speculations will be projected.

3 Technology Push: Hardware

3.1 The concept

In a sense, defining multimedia only limits the scope of multimedia. At its simplest, multimedia means the addition of sound and video to personal computers. At its grandest, it means the melding of different media technologies such as PCs, TVs and telephones, as well the melding of the computer, consumer electronics and telephone industries (Johnson, 1991). At a working level, a multimedia system comprises a powerful processor, frame-grabber and full-motion video boards, audio circuitry, data and video compression technology, large-capacity storage devices, high-bandwidth networking equipment and customized software. So, the concept can be defined at two different levels. First, any personal computer equipped with a CD-ROM drive and sound capabilities so that it can run programs or access data that contains sound and still and moving pictures at the hardware side. Second, a program or data source that includes sound and still and moving pictures at the software side (Nicholson, 1992, Nov. 1).

Generally speaking, the term multimedia refers to any newer way of combining television monitors and computers with the promise of education, information, and entertainment (Wood, 1992, Feb. 18). Then, multimedia becomes a vague word, conjuring up different meanings for different people because of its multiple characteristics of functions (Seymour, 1992, June 8). According to Zachmann (1990), multimedia is a 'buzz-word' that vaguely covers any software or hardware that helps create audio-visual presentations. Unlike other consumer electronic products, it is difficult to explain exactly what a multimedia interactive system does.

3.2 Technological trends

3.2.1 Digitization

In the past, different forms of information have all been traveling on different tracks. There is no single standard that they will all fit, nor are the existing tracks wide enough to accommodate so much traffic. Now, digitization of data means conversion of text, numerics, sound, and visual images to binary signals that can be manipulated, stored, transmitted, and reconverted to its original form for delivery (Coates, 1992). In other words, digitization of data makes inevitable convergence between competing and complementary transmission technologies - microwave, cellular radio, fiber optic cable, and satellite transmission - and between telecommunication systems - telegraphy, telephony, radio communications, and broadcast. This makes possible integrated service digital networks (ISDN) that can carry voice, data, text, and video signals simultaneously.

Accordingly, the continued blending of communications and computer technology will eventually blur the distinctions between the computing and communication, entertainment and news industries. It is therefore uncertain whether the new market will be led by computer companies, telephone companies, entertainment companies or toy companies (Press, 1990). While the long-range trend toward technological convergence is clear, to users it can seem a longway off. According to Coates (1992), it is delayed by segmented markets, by the failure to achieve interoperability, and by the persistence of obsolete regulatory categories.

3.2.2 Compression and Storage

An ordinary telephone line can transmit data at between 1,200 bits per second (bps) and 4,800 bps.[6] An uncompressed color television picture uses 75-90 million bits per second (Pool, 1990, p. 20). In short, a television picture takes about 1,000 times as much bandwidth as a voice phone. AT&T's Videophone 2500 which squeezes video signals so much that they can fit over a standard telephone line is a example of the progress of the video compression technology. Bell Atlantic's 'video dial tone' by using Asymetric Digital Subscriber Line is another example of the progress. The SkyPix Corp., which was formed to provide up to 80 pay-per-view TV channels by direct broadcast by satellite, would have not been founded if the compression technology were not available. The cable television industry has also been backing up the research on the video compression.

Picture quality on the multimedia is worse than VHS. Full-motion video integration in multimedia technology is lacking due to limitations to memory and speed, which requires 30 images or frames per second (fps). A 1,280-x-1,024-pixel image has approximately 1,310,720 pixels. each of which requires one byte for eight-bit color or three bytes for 24-bit color. Compression is a partial solution to the storage problem, but there is no simple answer (Name & Catchings, 1992, May 18).

CD-ROM [7] players for personal computers have been on the market for years, most at premium prices, and have found a strong niche for storing huge amount of text and other data. The disk's huge storage capacity (560 megabytes of data can fit on a single one. an amount equal to the contents of several large personal computer hard-disk drives) allows computer programmers to write complex applications that combine many kinds of media with which a user can interact.

While compression techniques can reduce the bandwidth required for full-motion video to 1.5M bit/sec. today's networks still have difficulty supporting multimedia information because of the different ways data, audio and video consume bandwidth on a network. Most users today run parallel networks in which data, video and audio run on separate networks.

3.2.3 Speed

More processing power based on microchip design and more storage capacity provided by CD-ROM have become technological trends in the industry. Engineers have moved from simple integrated circuits to large-scale-integration (LSI), then to very large-scale integration (VLSI) which has made it possible to put millions of components on a chip, and we are now poised to move toward ultra-large-scale integration (ULSI) (Gazis, 1991).

More specifically, early microprocessors had about 2300 transistors. Today's most popular microprocessor chips have about 300,000 transistors on a chip, and a performance of a few millions of instructions per second (MIPS) - the standard measure of computer performance. Intel's new 486 personal computer has 1.2 million. The 586 computer, with about 4 million transistors, should be able to perform billions of instructions per second (Coates, 1992). In short, we are able to quadruple the density of memory chips roughly every three years (See Figure 2).

Consequently, between 1980 and 1985, the average MIPS declined in cost from $250,000 to $25,000. From 1985 through 1990, the average price per MIPS fell from $25,000 to less than $2,500 (Rappaport & Halevi, 1991). Put another way for comparison, the $2,665 that IBM charged for its first generation PC in 1981 today buys a computer with 35 times the processing power, 1,200 times the disc capacity, a high quality monitor, and more (Schlender, 1991). Speed of processing already exceeds the speed of input and accessing. According to Gazis (1991), we can expect billion-bit chips around the year 2000.

3.2.4 Networking

According to Information Strategies Group (Eckerson, 1992), most companies by the turn of the century will be implementing multimedia applications that pull digitized audio, full-motion video, image and text information from distributed servers across an enterprise network. The report predicts that network-based multimedia applications will make the same inroads into corporations that desktop publishing did in the 1980s. It is further described that four applications will accelerate the growth of networked multimedia: education and training,

[6] If conditioned, it may operate at somewhat higher rates, such as 9,600 bps

[7] The terminology used to describe data storage in computer systems can be applied to traditional consumer goods (Miles, 1988) Printed materials and conventional audio records - and now compact discs - are ROM (Read Only Memory) devices the data they contain may be degraded, but they cannot be modified in any useful way Audio and now video tapes are RAM (Random Access Memory) in that data may be recorded and released repeatedly on the same medium -rather like a chalkboard. Less familiar are WORM (Write Once Read Manytimes) media, which allows users to add data up to the limits of capacity of the medium, but not to rewrite it A conventional notebook is effectively a WORM system, as photographic film Where the information is not such as to require rapid and frequent updating, optical ROM systems have provided a viable approach, especially as cost of CD-ROM systems have come within the reach of even small businesses

personal communications, kiosk and business presentations, and information repositories, such as electronic catalogs, libraries and manuals.

The emergence of high-speed networks based on fiber distributed data interface (FDDI) and asynchronous transfer mode (ATM) standards will enable companies to distribute multimedia information on demand from network servers instead of physically distributing CD-ROMs to every desktop. IBM has developed technology that creates high-speed network that can transmit data faster than a billion bits per second [8] (Markoff, 1992, May 22). The regulatory branches are moving toward more competition between the cable television industry and the telephone industry to accelerate the construction of information highways via fiber optics. So, it is not surprising to find that workstation companies are likely to push into multimedia with videoconferencing in such areas as multimedia online help screens. Local area network (LAN) and wide-area network (WAN) companies will be eyeing multimedia offerings.

Thus, Insight Research Corp. projected that sales of high-speed data communications equipment and public network services will be encouraged by the penetration of real-time multimedia and transmitted multimedia files (Booke, 1992). Markoff (1992, May 1) agrees with Insight Research by projecting that mass marketing of integrated services digital network (ISDN) and broadband fiber optic cables will help usher multimedia technology into the mainstream.

4. Market Push: Software

4.1 Hardware vs. software

Once any medium technology is introduced into a market, the space or time of the medium must be filled up with different forms of information. That is why the recording industry was the prerequisite for the development of FM radio, as the movie industry was for TV and the VCR. Cable television did not take off until HBO started in 1975 to provide a variety of programs via satellite link. VCRs started to take off during the mid 1980s when alternative programs began to be offered through video rental shops. Japan's efforts to sell its high definition television (HDTV) as the next generation TV set are impaired by its inability to produce compelling programs again (Jones, 1992, March 16), as Sony experienced when it introduced Betamax to the US market.

In many fields, the biggest bottleneck to abundance of communication is not the hardware but the software. It is particularly true in the multimedia industry. Unlike radio and television industries which have been able to take advantage of other existing software industries such as recording and Hollywood for their mediums, all new computer models must be followed by a variety of applications software. John Scully said in Tokyo last February that hardware-based consumer electronics firms need to understand that the industry is now driven mainly by developments in software (Jones, 1992).

4.2 Applications

It appears that multimedia can do everything for all. By presenting a message in various media, multimedia computers can be used to enliven lessons in school classrooms. In business, it can be used to create presentations, train employees and provide data to consumers through interactive store kiosks. And in the home, they would be used for entertainment, learning and at-home work. The NBC Desktop News, the latest advance in multimedia technology, will be tested with an unidentified group of corporations in New York area through 1993, and is going to be introduced to subscribers in 1994 (Skrzycki, 1992, Nov. 10). Thus, it is not surprising to find that the "four multimedia gospels" - Commodore, Apple, IBM/Intel, and Sony/Philips - take a different technological approach to introduce multimedia capabilities in their product lines.

For example, the Commodore Amiga pioneered multimedia by using custom processors for graphics, multichannel audio, and fast input/output (I/O) to create a video-compatible architecture. Apple sees multimedia as the logical next step for its Macintosh line after the development of desktop publishing and presentation-graphics systems based on Hypercard and new peripheral-control standards. IBM and Intel are using DVI compression technology to move from today's authoring software to full -motion digital video. And Sony and Philips hope to create a new market with compact-disk interactive (CD-I) technology.

While the industry's marketing strategies are various, the overall markets can be classified into four main groups: 1) the business market with focus on training and presentation capabilities; 2) the educational market with emphasis on classroom instruction; 3) the consumer market with emphasis on entertainment value; and 4) the forgotten market including museums, libraries, and customized customers at home.

4.2.1 Business market

In the business market, training and presentations as well as desktop publishing and electronic mail are seen as key areas where multimedia technology is likely to shine (Scannel & Picarille, 1992; Alexander, 1992; Making, 1992; Laplante, 1992 May). For example, police departments in California are using multimedia to

[8] Experiments are being done with Rogers Cable, Canada's biggest cable company. The first system will be deployed in Toronto, where banks will be linked for various applications, such as videoconferencing and electronic mail.

minimize training expenses (Wiegner & Schlax, 1991). Multimedia training is particularly cost-effective in blue-collar worker training (Alexander, 1992). One home improvement firm has watched sales increase because of a multimedia home-decorating application by using touch-screen terminals.(Wiegner & Schlax, 1991). In addition, Karpinski (1991) projected the increasing popularity of integrated multimedia voice processing - a combination of voice messaging, interactive voice response, and facsimile, data, and image technologies - during the 1990s.

IBM is planning a major rollout of multimedia hardware and software products as well as an intensive marketing campaign aimed at selling multimedia to corporate America. A new PS/2 Model 57M will include many multimedia features. Acer introduced the Personal Activity Center, a $2,300 multimedia IBM clone, that includes alarm clock, answering machine, speakerphone, facsimile machine, compact-disc player, and AM/FM radio. Stenograph Legal Services introduced the DiscoveryVideo system. The $4,700 desktop video software allows stenographers, lawyers and judges to automatically synchronize the court transcript with the testimony of the witness in a video of the proceedings. Personal Travel Technologies is developing a software package that functions as a travel guide for various cities, which offers detailed directions for users to follow by car, subway, or foot (Bhargava, 1992).

4.2.2 Educational market

Michael Swaine (1991 August) projected that the popular acceptance of computer video will be educational and home-based rather than business-based. For example, Kentucky recently required that all public school classrooms have a telephone line for computer hookups. In some school districts around the country, principals have begun setting up fax lines for parents and 'homework hot lines.' According to a member of the design team of the Edison Project, a proposed chain of private schools that are to be equipped with the latest technology, some schools aound the country already have dazzling equipment (Jordan, 1992). The East Lansing, Michigan, School Distict raised $6 million via a three-year bond to initiate an educational program of buying personal computers and multimedia equipment for use in classrooms and libraries (Amthor, 1992 April). The $2 billion market for schools and libraries (Winkler, 1992), the largest commercial sector in 1992, appears to support Swaine.

However, while magnet and other specialized schools may have changed, the typical classroom has not. In schools, there is only about one computer for every 20 students. And many of those are obsolete or rarely used. In the District of Columbia, the school district typically spends slightly more than $1 million on computer hardware and nearly $150,000 for software each year, depending on the availability of the school system's annual budget which is more than half a billion dollars. According to Perelman (1992), over 93% of the $4.[illegible] billion on education in America goes to pay education's bureaucrats while only 1% goes to hands-on tools and materials students can use for learning.

A new visual encyclopedia by CEL Educational Resources, consisting of 11 videodiscs that store film footage and the text of historic 20th century events, costs $11,000. IBM's PS/2 25SX, targeting educational environment at $1,249, comes with 1 megabyte of system memory expandable to 16 megabytes. But the 25SX does not include components needed for running multimedia programs: sound cards, CD-ROM drives or videodisc players have to be added. Further, an 80386 SX microprocessor with 1 megabyte RAM is an absolute minimum configuration for running multimedia applications. To run IBM's Columbus and Ulysses programs, a more powerful microcomputer is needed. That is why IBM recommends its PS/2 57 SLC which includes everything needed to run multimedia program. Then, the basic education price for the bundled product will be $8,240. With a read/write optical drive, the product will cost educators $9,317 (Brady, 1992 March).

In addition to the economic issue, the interpretation of the role of communication technologies in education is another concern. Lewis Perelman claims that the role of modern technology in education is precisely the same as the role of the automobile in the horse economy: replacement. So, a growing new wave of technology will totally replace education. In contrast, Neil Postman argues that it is a billion dollar American illusion that the application of computers will make a significant difference in what happens in the classroom. At practical level, time-consuming program development jeopardizes the realization of multimedia use in classroom (Jacobs, 1992, May 11). As Susan Goldman at the Learning Technology Center at Vanderbilt University notes, each educational software package has to be evaluated and each teacher trained to use it (Jordan, 1992, Nov. 28).

4.2.3 Home market

Three incompatible CD-ROM platforms aimed at the average consumer were introduced to the market: Commodore's CDTV; Philips's CD-I; and Tandy's Video Information System. All of them are consumer versions of interactive hardware to pair with television sets and offer dozens of titles of software from paint to sports, arts, and gardening.

Commodore earlier in 1991 repackaged its Amiga multimedia computer as the CDTV Multimedia Player, designed to be part of a home entertainment center.

Commodore's CDTV (about $800) is run with an Amiga 500 computer that can expand into a home video-editing system, print hard copies, and interface with music composition equipment. Commodore was the first to enter the consumer end of multimedia offerings with Amiga 500, which is owned by 3 million people worldwide.

According to the preliminary technical specifications from the Philips Consumer Electronics, their player will carry a 6-inch color LCD display and will be compatible with PAL or NTSC, and will be able to read Photo CD discs as well as CD-I discs and CD audio discs (*FHTN*, 1992, July 13). Philips is pushing its CD-I Imagination Machine (about $800) as the hardware that would become the world standard, already followed with prototype from Matsushita, Sony. Technics, Sanyo, Toshiba, and Yamaha (Wood, 1992, Feb.). The industry estimates that Philips has invested $500 to 700 million in CD-I.

Tandy Corp. introduced its Video Information System (VIS), which is an interactive videomachine that plays compact discs and plugs directly into a television set. The new product incorporates specially designed microchips and a version of the Microsoft Windows graphical user interface (GUI). According to a spokeperson for Tandy, the new product is a user-friendly, and 50 companies have promised to develop more than 100 programs that will run on the VIS (Pope, 1992, Aug.28).

In addition, Nintendo Co. and Sony Corp. announced an agreement under which Sony will make and market a new home video game system combining Super Nintendo Entertainment System game with a CD-ROM drive. Sony's Electronic Publishing Co. unit will develop software for the new system; Nintendo will make and market a CD accessory for attachment to the Super NES (Nintendo, 1992, October 14). IBM made an a $500 million offer for an 12.5% of equity position in Time-Warner Entertainment, which involves two-way interactive television (Collier, 1992, May 11).

4.2.3 Forgotten market

Despite its potential, the library market was being ignored even at the 1992 International Conference on Multimedia and CD-ROM (Rogers, 1992, Apr. 15). Similarly, interactive museums as a niche market has not been seriously considered. For example, a new exhibit at the American Museum of Natural History features four interactive multimedia programs including 'Global warming' (Wertheim, 1992 May). Paul Allen, the co-founder of the Microsoft, plans to build a Jimi Hendrix museum in Seattle by featuring interactive technolgy designed to bring Hendrix and his perfomance to life (Yang & Rebello, 1992, Nov. 30; Johnston, 1992, July 27). In South Korea, the general public will enjoy a variety of cultural perfomances and displays in their living room via ISDN by the year 2000 when the construction of the Information Center for Culture and Arts is finished. A variety of cultural arts will be stored in the multimedia format at the center (All performances, 1992, Oct. 24). In addition, customized, home-entertainment installation for those willing to spend about $15,000 on simplicity and aesthetics has been ignored. Though the high price tag does not appeal to the masses,[9] the high-end segment is much larger than people think (*FHTN*, 1992, June 1).

5 Consumer Pull: Human Context

5.1 Leisuretime use [10]

Leisure time has been increased in the US in the long term. For example, an American worker now puts in 1,800 hours a year as compared to 3,300 hours in the early years of the century (Bennington, 1989, p. 56). John Robinson (1991 September) also found that free time of Americans has increased significantly over the past quarter century, from about 35 hours a week in 1965 to about 40 hours a week in 1985.[11]

While being entertained is an important part of their leisure time (Liberman, 1991, p. 60), very little of the new leisure is used for intellectual pursuits (Drucker, 1989, p. 178). Much of that extra free time has gone into increased TV watching, physical exercise, and sports activities. Robinson estimated that 40%, or 2.2 hours of the 5.5 hours of daily free time of Americans is devoted to television viewing. Kubey and Csikzentmihalyi (1990) arrived at the same estimate, falling somewhere between 2 and 4 hours per day. Reading has stayed about the same, with the exception of newspaper reading, which has gone down considerably. Recordings may be up a bit, and radio may be down a bit, but they are not large consumers of time. Using these non-TV media is usually done as a secondary activity.

Then, how will leisure-time-choices be made as we head into the 21st century? If current trends are any indication, home-based activities will likely characterize American entertainment preferences in the future. While out-of-home entertainment grew only modestly in the 1980s, in-home entertainment spending exploded during

[9] Despite improvements in quality and relative decreases in prices, the market penetration of hi-fi audio component systems is less than that of console stereo in the '60s.

[10] Leisure or free time has been differently perceived and used based on different societal situations and ideological predispositions. Generally speaking, leisure as a concept arises out of a dialectical opposition to obligatory work (Dumazedier, 1974; Gunter & Gunter, 1980). According to a recent Roper poll, leisure has replaced work as the most important thing in most Americans' lives.

[11] Ironically, a recent study found an increased amount of working time among the American public. For example, according to Schor (1991), time on the job for the average employed American increased by 163 hours a year, or an extra month between 1969 and 1987,despite the expectations about the would-be-increased leisure time toward postindustrialization

the same period. For example, film box office revenues increased by 3%; attendance at professional sporting events grew by 5%; and revenues for Broadway theaters were actually down by nearly 4%. In contrast, half of all Americans find their at-home entertainment options more appealing than the traditional "night out at the movies" (Liberman, 1991).

A recent survey by the Electronic Industries Association (EIA) also found that the percentage margin between people preferring to stay home to be entertained and those who prefer going out has widened in the past two years (Tuyl, 1992). "Go to nightclub to enjoy music", for example, decreased from 39% in 1989 to 21% in 1991, while "Stay home and listen to music" increased from 48% to 68% during the same period. "Go out to a movie" declined from a 38% to 22% against the increase "Watch a movie at home" from 50% to 67%. As for sports preferences, "Go to sports event" shrunk from 33% to 27%, "Watch sports on TV at home" gained from 49% to 56% during the same period.

Watching TV is not one of people's favorite ways of spending time, even though it has been one of the major gainers in free time. While socializing is one of the most enjoyable things that people do during the course of the day, interpersonal get-togethers have declined between 15% and 25% over a 20-year period (How Americans, 1991). At the personal level, people have a strong tendency to spend more time on activities that they like to do.

5.2 Spending on the media

We can describe the economic support of mass media as falling along a continuum ranging from direct to indirect consumer support (Jeffres, 1986, p. 73). At one end we have 100% direct support through consumer purchases. Here we can find both the book and the film industries which derive most of their revenues from public purchases. At the other end is the broadcasting industry - both radio and television - where most of the support is indirect through either advertising or institutional support such as that given private foundations or the government. Magazines and newspapers can be positioned in between these extremes. We now should add computers, VCRs, cable television, and stereos - whether it is CD- or LP- or tape-player - to an extreme end of the 100% direct support. As we are moving toward the pay-per-society, virtually all media use are turning into utility-like services.

Considering a transition from industrial to information societies, it seems naturally assumed that expenditure on mass media will increase more rapidly than other expenditure. However, the pattern of economic support for mass communication is approximately constant relative to the general economy. McCombs and Eyal (1980) found that spending on mass communication is highly constant during the period of 1927 and 1968, and remained the same between 1968 and 1977. According to McCombs and Eyal (1980), while spending on newspapers and magazines nearly tripled, spending on books and maps did not even double during 1968-1977. Even with the proliferation of audio-visual media devices and services over the same period, the historical patterns of spending on print and other mass media in terms of constant dollars remained stable. Thus, the Principle of Relative Constancy concluded that society's use of mass communication seems remarkably resilient in the face of rapid technological change.

Werner (1986) also supports the Principle with his recent research in Norway during the period of 1958-1982. He has shown that low-consumption households spend only a small proportion of what high-consumption households spend on mass media, even though expenditure on mass media accounts for a considerably higher proportion of total expenditure in low- rather than high-consumption households. Whereas expenditure on the "necessary" media, such as radio, TV and newspapers, accounted for 72% of the low-consumption household's media expenditure, in high-consumption households it only comprised 32%, even though the latter spent twice as much on such "necessary" media. As for the "exclusive" media, such as books and records/ tapes/cassettes, in contrast, the former spent only 8% on these as against 40% for the latter.

It is projected that the percentage of expenditure on media will be likely to rise more rapidly in high-consumption households as new media technology are being introduced. A common finding in research on new communication technologies is that only 10% of the users present 50% of all uses, with the other 90% of users making up other 50% of uses (Rogers, 1987, p. 125).

5.3 Behavioral patterns

5.3.1 Simplicity

At the 1992 Summer Consumer Electronics Show, strategic planners in both the consumer electronics and telephone industries about the new technologies warned that simplicity, not rampant product proliferation, is the key to success (*FHTN*, 1992, June 1). How simple is simple enough to the critical mass of consumers?

In the past. even the job of a telegraph operator was generally regarded as a highly skilled occupation (Aronson, 1977, p. 17). The telephone users were said to suffer 'stage fright,' an anticipation of microphone and television devices (Briggs, 1977). Matsushita's VCR based on supermarket bar codes. VCR Plus by Gemstar, Insight Telecast, and Sony's double-sided controller are just few examples for easing VCR programming (Johnstone, 1992, July 23).

The print media had to wait longer than 400 years to be accepted by the general public who had to learn the skill to use them - how to read. In contrast, both radio and television which did not require any specific skill except turning them on and off and listening or watching, reached 30% of the general public within 5 to 7 years of introduction. Communication via computers still requires not only the ability to read or write but also the capability to operate the machine, including typing skills. Great efforts have been made to go into the elimination of input devices that tie the user to the technology in ways that impede other movements and activities. As available processing power increase,[12] we expect that today's input devices will give away to more convenient modes of interaction with computers, through natural language input, touch-screen computing, eye-tracking interface, and handwriting.

If the computer industry can advance the handwriting-recognition technology, a wide range of companies and government agencies are sure to be interested. The IRS plans to award a $1 billion contract for technology that will enable it to scan all tax forms by computers by the year 2000. The US Postal Service handles 555 million pieces of mail a day, 20% of it with handwritten addresses (Levyn, 1992, Dec. 7).

In fact, considerable progress has been made in this area since 1970 by Fred Jelinek and his colleagues at IBM Research. Their prototype can recognize a vocabulary of 20,000 words with an accuracy of at least 97%, and it does this in real time (permitting immediate correction of mistakes). It is thus expected that some version of sophisticated speech input will be using during the 1990s. For $5,000, Dragon Systems offers software package that it claims enable a computer to record with 90% accuracy what is dictated by a human operator. Verbex Voice Systems for the Wall Street traders and Bell Lab's prototype system for translation are similar examples (Burgess, 1992, Nov. 11).

At the practical level, however, many people shy away from the still quirky machines, finding them too prone to mistake or just too hard to use. Most systems recognize only slow, clearly enunciated speech or have a limited vocabulary. Despite the technological developments achieved in the computer industry, the current simplicity is not likely to be a widely accepted practical reality by the year 2000. Then, maybe, people would rather just watch television.

5.3.2 Portability

As computers become a primary means of communication beyond telephones, cellular phones, faxes, and even live video hookups, portable personal computers are expected to reshape American business in the 1990s. The PC evolution is classified into three groups in terms of size: desktop, laptop, and palmtop. A number of new smaller-than-laptop computers currently encompasses three basic types again: notebook laptops, pen-based computers, and pocket or palmtop computers. Rappaport and Halevi (1991) predicted that opportunities for meaningful hardware differentiation will virtually disappear.

NEC even envisions a future in which people will wear personal computers like clothing, and they have designed a gaggle of prototypes to help PCs leap from desk to neck. According to a NEC premise, electronic miniaturization over the next 10 to 15 years make computers highly portable devices to recognize voice and handwriting, and to incorporate keyboards, telephones, display screens, faxes, CD memories - even cameras and satellite transmitters (Kirkpatrick, 1992). However, computers cannot be truly portable until they can be folded and crash-free from dropping as the print media are, which is hardly to be achieved in the following 10 years.

5.3.3. Improvements or Newness

Media history appears to support a modest view of acceptance of new media.[13] The older media merely adapted themselves to new market pressures, finding new ways to appeal to audiences. Motion pictures, for example, have tried several strategies: specializing (Black films, the youth market) and demassifying the audience (pornography, wilderness films), graphic violence, and special effects (Jeffres, 1986, p. 46). As we know, TV did not kill radio or cinema as radio did not kill newspapers. VCRs did not kill TV or motion pictures. Also, the rapidly adopted media technologies are add-ons to already existing hardwares such as TV (for VCRs), telephone (for answering machines) and stereos (for CD players show).

From a newer medium's perspective, however, each new medium must provide its own special quality to get into the existing media environment to survive. Radio added speed to newspapers; TV gave picture to radio and convenience to motion pictures; cable television provided more channel choice and better picture quality; VCR freed people from the primetime with privacy; and Nintendo games added more fun through frustrated

[12] Most of their processing power is used to present a convenient interface to the user with improved quality of presentation and improved modes of computer interaction. Today's input/output devices are driven by processing power well under 1 MIPS (Gazis, 1991)

[13] This trend is not limited to media. We can see from the example of the classical Industrial Revolution, old technologies do not immediately die, nor do they quickly fade away. Instead, the new technologies are superimposed upon them and in many cases are used to augment the older capabilities (See Kranzberg, 1989, p. 26).

excitement. CDs not only improve the conventional record player in terms of sound quality and size but also provide new levels of programmability via random access capability. In contrast, current multimedia products are merely improvements on old media and lack the excitement and originality that was present on past generations of media (Rosen, 1991 September). Then, what can a multimedia add to the current media environment?

The elements of multimedia technology have been available for several years, but a system of linking them all together has been lacking. This packaging trend is not new. We have long been aware of tndencies to put different devices together, often in one box - ranging from the integrated music center to the TV-VCR combo to the simple combination of a clock and radio in the same housing. The use of microelectronics and digital controls not only makes it more feasible to consider relating together the operation of devices that are in the same box, but also increases the utility of interrelating devices that are not in the same box, by getting them to communicate with each other through the home. The rationale for this integration may be convenience.

5.3.4 Compatibility

5.3.4.1 Hardware

The incompatibility among personal computers including CD-ROM players reminds us of a historical lesson from both the US recording industry and the VCR industry. During the battle of the speed when Columbia introduced 33 rpm record in 1948 and RCA brought out its 45 rpm in 1949, records sales dropped to $50 million below the 1947 level as people waited to see which format would dominate. During the late 1970s consumers, uncertain to which of the two systems would be adopted, bought neither VHS nor Beta. Later, they showed their preference of VHS over Beta more based on machine universality than on technical superiority.

There were as many as 10 different hardware standards were introduced to the 1992 International Conference on Multimedia and CD-ROM (Hilts, 1992, April 27). While the Interactive Multimedia Association (IMA) has started the Compatibility Project which aims at developing multimedia software-compatibility standards, it is unclear whether software developers catering to these hardware standards would rewrite their products once the project is completed (Filipczak, 1991 August). A group of leading computer firms, including DEC, HP and IBM, are working on a project that could standardize application program distribution via CD-ROM. But Apple and Microsoft have decided to proceed with their own separate hardware standards for multimedia (Bits & bytes, 1992, Sep. 14). Currently, multiple standards in file formats, communications protocols, disk-storage formats, and full-motion video schemes, and the necessity of addressing more than one these at the same time, is preventing multimedia technology from progressing at significant speed (Curran, 1992 March; Scisco, 1992 May).

5.3.4.2. Software: Business versus consumer market

In addition to hardware incompatibility, different applications for different purposes remain the markets separate. For example, when videotex was born in the mid-1970s it was seen as primarily a domestic rather than a business service. The recent revival of videotex interest can be attributed to more business applications. The failure of residential users to embrace the instrumental aspects of Prestel as well as Captain led to the shift in its marketing toward business users. Even Teletel, the largest videotex services in the world, has shifted its emphasis toward business users, who pay higher rates. In fact, interactive text in the form of online data-bases in the US grew rapidly as commercial information vendors joined government and non-profit agencies in the production and marketing of highly specialized electronic information services, most of them directed toward business, science, and the professionals, instead of homes.

It seems historically and cross-culturally common that information as news or data is the first concern of the business sector, whereas entertainment value is strongly preferred by the general public. For example, the television industry itself suffered in the early days from lack of programming and crude presentation but it lived to become the highest consumption medium ever with the quality of convenient, cheap, and 'novel entertainment' (Bennington, 1989, p. 155). Consumers' fun-orientation in their videotex use was already found in Prestel in Britain, Captain in Japan, Gateway trials in the US, and Teletel in France.

Business customers are willing to and, most times, have to pay for goods and services that save time and money because they need (rather than want) to be competitive. While personal users also value time and money, they, in addition, seek (whether need or want) entertainment, physical security, and alternative ways spend large blocks of leisure time. It is the lack of compatibility between a specialty market and a mass market which keeps them apart.

Telephone use has two dimensions: the instrumental (getting things done as in ordering an airplane ticket) and the intrinsic (talking on the telephone for its own sake) (Keller, 1977). Classie and Rowie (1987) distinguish between relational (intrinsic) and functional (instrumental) calls, but also add mixture of these two categories. An ethnographic study of telephone uses revealed that people tend to differentiate very much between business and pleasure calls.

5.3.5 Functional alternatives

According to an estimate based on 94.6 million US households by the Electronic Industries Association, radio is owned 98%, color TV 97%, audio system 94%, VCR 77%, answering machine 46%, CD player 35%, home computer 33%, color TV with stereo 31%, video game systems 31%, and camcorders 17% (Wood, 1992, January 23). So, the main reason for the failure of videotex in the US has been related to the abundance of alternative information sources (Kramer, 1991). Commodore's CDTV and Philips' CD-I have not done well in the marketplace mainly due to the popularity of Nintendo and Sega. The share of the Big Three networks has declined from 92% in 1979 to 64% in 1991. Since previewing Newton, a prototype of the first Apple personal digital assistant, introduction of the PDA from Apple has to step back.[14] Many specific technologies can have regretful consequencies not because the technology is "in the saddle," but because of the ways in which users quite reasonably employ new devices (Fischer, 1992, p. 271).

In addition, the consumer industry already has digital processing inside the TV set (picture-in-picture). The Froxvision multimedia system creates high definition images for home use. The system, a video-processing computer, is marketed as a television (Gottschalk, 1992, April 6). Features include user interface, movie-quality images, on-line information and single-button control. Currently, big sellers are rear-projection televisions and laser disc players.

5.3.6 New Use

William Ogburn (1964) postulated the concept of cultural lag in terms of human response to technical capabilities, by saying that cultural systems and human institutions tend to lag in responding to new oportunities offered by technological innovations. Similarly, almost all technological progress begins with a breakthrough in some form of basic hardware, followed by a period before software appropriate to the hardware is invented. At the point progress takes form in the development and perfection of products in which both the software and hardware are applied, while the humanware is still being cultivated (Sakaiya, 1992, p. 231).

Given the cultural lag, it is common for some of the general applications to be quite different from those anticipated at the time the particular hardware was invented. For example, a phonograph recording was assumed to be used as a record of speech. So the first recording made for a practical purpose after the invention of the gramaphone was of a speech by Bismarck. It took 15 years for records to become a medium for music. Early fims were newsreels or photography of moving objects. So, the early motion picture makers had spent twenty-some years before they produced dramatic films. The telephone as a means for 'trivia gossip' was not envisioned by the telephone industry but was invented by the users (Marvin, 1988; Fisher, 1988). The VCR was introduced for recording from TV or cable TV. Until the mid 1980s, use for recording versus replaying prerecorded videotapes was approximately half and half, with only 3% recording today (Johnstone, 1992, p. 26).

This trend is known as the Kranzberg' First Law: Technology is neither good not bad nor neutral. This means that technology's interaction with both the social and cultural milieus some times lead to developments themselves that are far removed from the original goals of the technical elements themselves (Kranzberg, 1989). Marvin (1988) simply stated that people use communications in new and unpredictable patterns if it is to their advantage and will even change their ways to do so. Rogers (1983 & 1986, p. 121) explains this process as 'reinvention in diffusion theory' which refers to the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation. In his extensive study on the telephone use, Fischer concludes:

> we might consider a technology, such as telephone, not as a force impelling 'modernity,' but as a tool modern people have used to various ends, including perhaps the maintenance, even enhancement, of past practices (1992, p. 272).

In short, we invariably think of a new piece of equipment in terms of expanding the range of functions of equipment already in existence. Soon, however, the technology itself create new spheres utilizing functions unique to it.

In this context, computerized communications are currently conceived of as extensions of postal services, telephones, or television sets. In 10 or 20 years, these systems, with appropriate improvements, will give birth to completely new areas of application. In other words, the various functions that multimedia serves suggests that their consequences will be mixed, unevenly distributed, and diffused, assimilated, and modified at uneven rates, as the tool goes far beyond the task of number-crunching and instantaneous communication of data. Therefore, no one can guess what these new applications will be. One thing clear is that they are tools for storing, processing, and communicating (Sakaiya, 1992, pp. 222-3). Again, people utilize the multimedia technology for their different purposes as people do with

[14] In 1990, experts were predicting that sales of new portable computers, which can read hand printing, would hit $800 million in 1992 and pass conventional PCs by the year 2000. Sales this year will hit $100 million. Recently, analysts have reset their projections, saying PDAs will inch into the market next year with sales of $28 million, according to BIS Stategic, That is substantially different from the $125 million revenues that one Apple bull on Wall Street predicted for Newton alone (Rebello & Arnst. 1992, Nov. 30)

TVs and VCRs now.

6 Speculations

6.1 The primetime for the multimedia has not come yet and will not even by the year 2000. Despite the aggressive introduction of the interactive media, the most passive media will remain among the most popular. lit may make some difference if future generations grow up with devices at hand that allow them, at an affordable effcrt, to actively invlove themselves in meaningful endeavors rather than simply accepting a mass product.

6.2 In order to make it happen, the multimedia system will need to be something of exceptional value, compared with what the consumer has in 1993. The product needs to be radical enough that consumers see the difference, and yet offer tremendous benefits including easy handling, stellar sound, impressive picture, resistance to shock and great mobility.

6.3 Applications driving the popular acceptance of computer video appear to be home-based rather than business-based. Despite the diversified applications of multimedia, however, consumers and business, the two ends of the multimedia spectrum (entertainment versus niche market), will likely remain distinct. Libraries and museums are more likely to be popular users of the multimedia than classrooms.

6.4 While consumers are more likely to stay at home to be entertained, home entertainment will maximize the consumer's enjoyment with quality while minimizing the inevitable "downtime" of planning, organizing, and arranging the entertainment event.

6.5 The percentage of expenditure on the multimedia will likely rise more rapidly in high-consumption households as new media technology are introduced. However, overall society's use of mass communication appears remarkably resilient in the face of rapid technological change.

6.6 Industry's unrealistic near-term expectations could turn CD-ROM into a consumer electronics disappointment. The technology is still in its infancy - with several competing and mostly incompatible machines.

6.7 The next generation multimedia computer may no longer look like a home computer. The Japanese electronic giants could edge out traditional PC leaders in the US when multimedia turns personal computers into consumer electronics because people would rather just watch television.

6.8 Any clearcut prediction as to the use of multimedia cannot be made when it comes to considering the Kranzberg's First Law, or Roger's reinvention process of diffusion theory, or simply describe it as uncertainty as Marvin did. People simply do not change their media habits or keep on considering a technology as a tool modern people have used to various ends - maintenance or enhancement of past practices. Human beings do not stop talking when they learn how to write.

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Table 1 Forecast of CD-ROM drives for multimedia applications

	1992	1997	CAGR %
Installed base (000s)	1,012	6,800	46.4%
Shipped units (000s)	415	3,150	50.0%
Unit price	$650	$390	-9.7%
Shipped value ($millions)	$270	$1,229	35.4%
CD-ROM disks, shipped units	680,000	15,000,000	85.7%

Source: *Future Home Technology News*, 1992, August 10, p. 7
Note: End-user prices for pressed CD-ROMs in 1992 were less than $1.90 in volume.

Figure 1 The map of multimedia development

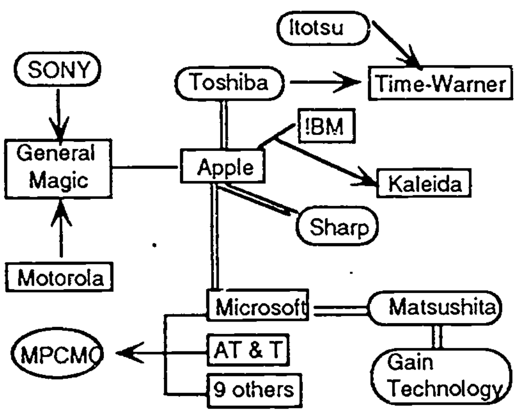
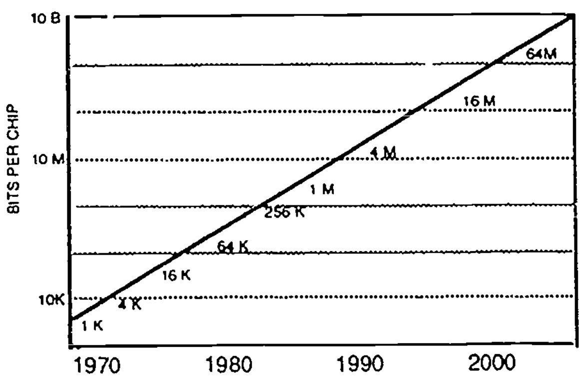


Figure 2 Progress in MOS memory chips



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PECC Triple-T Port (Teleport) for Developing Economies

Second Phase Report -- Case Studies

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The following report contains the conclusions and policy recommendations that emerged from an investigation trip to Indonesia and Thailand carried out by the international project team of the Pacific Economic Cooperation Council (PECC) Triple-T Port (Teleport) for Developing Economies Project.

Introduction

In September 1990, the PECC Triple-T Task Force initiated the Triple-T Port (Teleport) for Developing Economies project (hereafter referred to as the Triple-T Port (Teleport) project) as one of its task force action plans.

In December 1990, a survey of the development of the Triple-T Port concept (as described in the full Second Phase Report), some examples and some locations illustrating the concept, was carried out in Indonesia, Singapore, Thailand and Malaysia. The survey formed the basis of the first phase of the Triple-T Port (Teleport) project.

In this survey, it became clear that in each development project, telecommunications infrastructure in particular lags behind, so the development of telecommunications infrastructure became the main focus of the project. Based on the results of this survey, the First Phase Report was presented to the Triple-T Task Force Seoul Conference in March 1991.

Having received this report, the Triple-T Task Force decided to carry out case studies as the second phase of the project. In the second phase, the number of participants grew, an international project team was organised from interested parties in the respective PECC member economies and work continued on the project. A JANCPEC (Japan National Committee for Pacific Economic Cooperation) study team supported the activities of the International Project Team.

It was decided that the Batam Island Development Project in Indonesia and the Eastern Seaboard of Thailand, which were recognised as illustrations of the Triple-T Port concept during the first phase, should be the case study areas for the second phase. In September 1991, the sites of these two development projects were visited and a video was made about their development.

The first meeting of the international project team was held on November 18, 1991, in Bali, Indonesia. The video was shown to introduce the sites, and members of the project team presented reports. From March 3 to 11, 1992, the international project team sent an investigation group to Indonesia and Thailand to interview those responsible for government policy as well as to survey the two development project sites.

1. The Triple-T Revolution and the Triple-T Port

The Concept of the Triple-T Port

To illustrate the concept of the Triple-T Port, we formulated two conceptual diagrams, Concept A and Concept B. According to Concept A, shown in Figure 1, Triple-T Port development plans organise Triple-T infrastructure. Here, the construction of housing, seaports, airports, teleports and resort areas will become part of the Triple-T Port project. Such a development project requires vast amounts of capital investment and time, therefore limiting the areas where it can be carried out.

So we then developed Concept B, shown in Figure 2. Here, a teleport is included in a Triple-T Port development plan with effective access (roads, railways, etc.) to residential areas, seaports, airports and resort areas ensured. With the introduction of Concept B, the possibility of constructing Triple-T Ports may be extended to many of the existing or planned industrial parks in the developing economies.

Of the industrial park projects we investigated, the development project in Batam Island in Indonesia (Figure 3) is an example of Concept A. The Batam Industrial Development Project contained a plan for a harbour and an airport, but none for the construction of a teleport at the time we undertook our first phase study. We pointed out in our First Phase Report, "If a teleport is included, this could become a Triple-T Port plan fulfilling the concept described in Concept A." When our international investigation team visited Batam Island in March 1992, however, we found that Indonesia's third international gateway exchange was under construction by PT INDOSAT.

An example of the type of Triple-T Port indicated in Concept B is provided by the joint Communications Authority of Thailand (CAT)/Telephone Organisation of Thailand (TOT) Teleport Project that covers the area of the Eastern Seaboard Development Project in Thailand, as shown in Figure 4. According to this plan, an international switchboard will be located in the satellite earth station centre of CAT in Sri Racha and will then be linked to the telecommunications centres to be built in Laem Chabang and Map Ta Phut Industrial Estates.

A local network will be constructed in both estates with optic fibre cables and a digital microwave system as its main links.

2. Fundamental Aspects of Teleport Projects in Developing Economies

As already noted, we have focused our study on the development of telecommunications infrastructure, which lags behind the development of infrastructure for the other two Ts. Our two case study projects are models of strategic point development projects to promote the growth of the national economy for the governments of both Indonesia and Thailand.

In our First Phase Report, we recommended that the construction of teleport-type telecommunications infrastructure is most suitable for such strategic point development projects. This idea was also carried over to to our second phase study.

A teleport is defined in the constitution of the World Teleport Association as "...an access facility to a full-scale telecommunications medium incorporating a distribution network and telecommunications business services to serve the greater regional community and associated with, including or within a comprehensive related real estate or other economic development" (Article 4).

More than seventy teleport projects exist throughout the world at present and, of these, more than twenty are actually in operation. Teleports are found in London, Amsterdam, Paris, San Francisco, Toronto and Osaka, as well as in New York, with the majority located in the metropolitan areas of developed economies, and are undertaken as part of city redevelopment projects or plans for new industrial locations.

The World Teleport Association has indicated, however, that "to develop methods to enhance opportunities for teleports in developing countries" is one of its objectives. The actualisation of teleports in developing economies is anticipated.

We concluded that developing economies that build teleports must take into account the differences between their construction and that of existing teleports in developed economies.

The fundamental aspects of teleport in developing economies are as follows:

i. Such teleports must combine basic telecommunications infrastructure with enhanced and value-added network services capability.

ii. Construction of national telecommunications infrastructure and strategic point regional development must proceed in unison.

iii. International telecommunications gateways should be constructed to provide domestic users with direct access to international gateways.

iv. The latest telecommunications technologies should be used to best meet the needs of developing economies.

Basic Elements to be Considered for Teleports in Developing Economies

When constructing a teleport in a developing economy based on the fundamental aspects described above, it is necessary to consider the following points to determine the most appropriate system:

i. The organisation of market-oriented management functions

ii. The evaluation of the existing state of Triple-T infrastructure and existing plans for development

iii. The design of a compact, low-cost and reliable system requiring minimum initial investment

iv. The design of a flexible and expandable system according to the level of area development, telecommunications traffic and new services needs

v. The ability to adapt to future global networks (ISDN)

3. Analysis, Policy Recommendations and Conclusions

i. Telecommunications Demand Forecast and Development of Facilities

According to the demand forecasts for telephone traffic on Batam Island and taking 1990 as a starting point, a growth over the previous year of 15% in domestic traffic and of 20% in international traffic is forecast for each year. There are no statistics available for comparison of domestic traffic, but as for international telephone traffic, the growth rate for Batam is estimated as being lower than the 30% increase in international telephone traffic for the whole of Indonesia over the last three years.

When placing greatest importance on the profitability of teleports, it may be considered sound planning to make conservative estimates of low growth in traffic; but when planning from the point of view of telecommunications facilities, conservative estimates result in a high possibility of those facilities becoming inadequate sooner than predicted. To make flexible demand forecasts in this kind of situation, rather than following one narrow line of demand forecasting, it is preferable to forecast demand in a long, broad strip, like forecasting the route of a typhoon, and when planning the timing of reinforcement of facilities to match actual demand, it is also best to be flexible. The same also applies to the Eastern Seaboard Development Project. Flexibility and expandability are important elements in planning teleports.

ii. Evaluation of Demand for Value-added Services in Case Study Areas

There is little demand for value-added services in either Batam Island or the Eastern Seaboard development areas. This is because these development projects are still at their initial stage. There will, however, be rapid growth in value-added services needs.

There is an idea to introduce an EDI (electronic data interchange) system at the Laem Chabang port to expedite customs procedures. The need for such value-added services will become a reality in many fields, such as automated warehousing systems, tourist information and reservation systems.

Recognising the importance of EDI, the APEC Working Group on Telecommunications agreed in July 1990 to establish a project on EDI as one of its long-term projects.

iii. Expansion of Teleport Functions to Reach Wider Territorial Areas -- Efficient Utilisation of the Small-scale Model

There are many private industrial estates in the Eastern Seaboard development area, such as Chonburi Industrial Estate, Bangpakong Industrial Estate, Eastern Industrial Estate and Sri Racha Industrial Estate. These industrial estates are also suffering from inadequate telecommunications infrastructure. If efficient access from these private industrial estates to international gateways and domestic telecommunications centres is achieved by using the small-scale model system shown in Figure 5, the status of these industrial estates will be improved markedly. In addition, to gather more international and domestic traffic from these small-scale teleports will contribute to the business feasibility of the teleport project as a whole. Therefore, we recommend application of the small-scale model in a wider area of the Eastern Seaboard.

In the case of the Batam Island development project, we recommend application of the same concept. To gather international and domestic telecommunications traffic from other islands in Riau Province, such as Bintan Island, by using the small-scale model system will enhance the role of the Batam Industrial Development Project. Bintan Island Development Project will follow the development of Batam Island.

iv. Technology Transfer, Human Resources Development and Financing

Technology transfer, human resources development and financing are the three biggest problems to be solved in the development of telecommunications infrastructure in the developing economies.

As regards financing, during the fifth and sixth Five Year Development Plans (FYDP) in Indonesia, PT TELKOM's capacity for internal financing is 20 - 25%. Both Indonesia and Thailand are suffering from over-borrowing from foreign countries, including ODA loans. ODA resources from developed economies are also limited.

However, financial needs for the development of telecommunications infrastructure will increase rapidly. For example, the amount of investment needed during the fifth FYDP is estimated by PT TELKOM at 3 billion US dollars and during the sixth FYDP at 8 billion US dollars.

Under such circumstances, both governments have been inviting private sector investment in the development of telecommunications infrastructure since the late 1980s. The Indonesian government introduced a revenue-sharing scheme known as "PBH" in the fifth FYDP, and is currently considering the introduction of the BOT and/or BOO formula during the sixth FYDP. In Thailand, concession contracts based on the BTO formula have been introduced into the development of telecommunications sectors.

a. Benefits to Developing Economies of Private Sector Investment

- To solve financial difficulties without increasing government loans

- To introduce efficient construction and operation methods using state-of-the-art technology

- To expedite the development of telecommunications infrastructure

- To realise technology transfer and human resources development

- To create new opportunities for employment

b. Problems Facing Developing Economies

- Private sectors will focus their investment on lucrative areas, leaving behind the development of remote areas.

- There is uncertainty about the revenue from telecommunications networks constructed under the above-mentioned formulae. The estimation and sharing of revenue remain problematic issues.

- There may be conflict in setting telephone charges. Private sector investors wish to set a higher rate, while the governments of developing economies wish to keep lower charges for universal telephone services.

- The above-mentioned formulae are still premature and their applications differ from country to country, and sometimes from industry to industry. Investors require a consistent policy.

c. Necessities and Benefits for Private Sector Investors from Developed Economies

Private sector investment from developed economies is essential to eliminate the disparity between developed and developing economies. ODA requirements. such as environmental problems, are increasing rapidly while ODA resources are limited.

- For the development of telecommunications-information networks throughout the Asia-Pacific region, it is essential to develop the telecommunications infrastructure of the developing economies in the region. Private sector investment is essential to expedite the development of telecommunications infrastructure in developing economies.

- Private sector investment using the above formulae will promote international cooperation in the fields of technology transfer and human resources development to a far greater extent than plant exports do.

- Private sector investment will create expansion of world trade.

d. Problems Facing Private Sector Investors from Developed Economies

- Inconsistent policies in developing economies

- Money transfer from developing economies

- The necessity for close investigation and careful feasibility studies

- Country risk

- The risk of exchange rate fluctuation

In order to promote private sector investment, it is crucially important to seek and to find solutions to the above demerits. Related parties, including the governments of both the developed and the developing economies, should make sincere efforts and give careful consideration to means of overcoming these problems.

An example of such a solution under consideration by the government of Indonesia is the introduction of PBH project packages. According to this idea, each package consists of a combination of lucrative area development and rural area development projects.

e. Expected Benefits of Triple-T Port (Teleport) for Developing Economies

As a conclusion to our second phase study, we wish to stress the expected benefits of the Triple-T Port (Teleport) for Developing Economies as follows:

- To ensure the global and regional connectivity of Triple-T networks and to realise efficient flows of people, goods and information;

- To support respective national goals of economic development;

- To encourage the expansion of international trade by creating new opportunities;

- To enhance a highly amenity-oriented urban environment;

- To create opportunities for employment; and

- To accelerate technology transfer and human resources development from developed economies to developing economies.

We believe that the Batam Industrial Development Project and the Eastern Seaboard Development Project, which we adopted as case studies in our second phase study, will function as models of Triple-T Port (Teleport) for Developing Economies and that many Triple-T Port projects will follow in the Asia-Pacific region.

4. **Follow-up Activities**

While the project leader has stated that the project will not proceed to a third phase, follow-up activities are under consideration, thus:

i. Consideration of Triple-T Port (Teleport) application in China and Russia, or in any other Triple-T Port project, in response to requests from PECC member committees and with the project team in an advisory role

ii. Consideration of a "Concept C" Triple-T Port applicable to small economies, such as Pacific islands, with a focus on tourism-related applications rather than industrial development projects

iii. While project activities may be concluded at Phase Two, progress of the two case study areas (Batam Island in Indonesia and the Eastern Seaboard of Thailand) should be monitored and reassessed by the project team in two or three years' time.

CONCEPTUAL DIAGRAMS OF TRIPLE-T PORT

Figure 1
Concept A

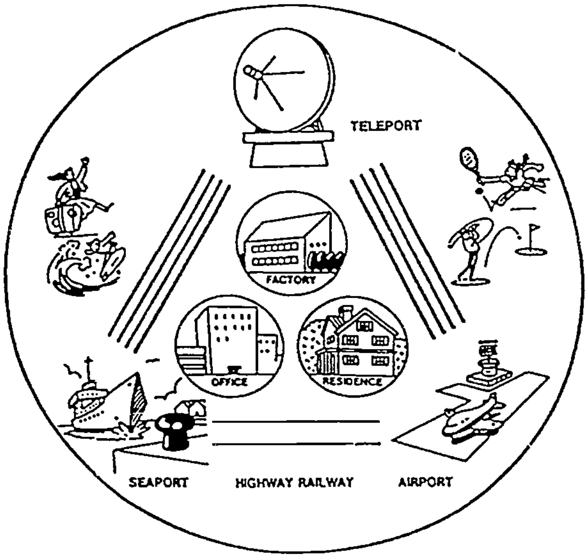
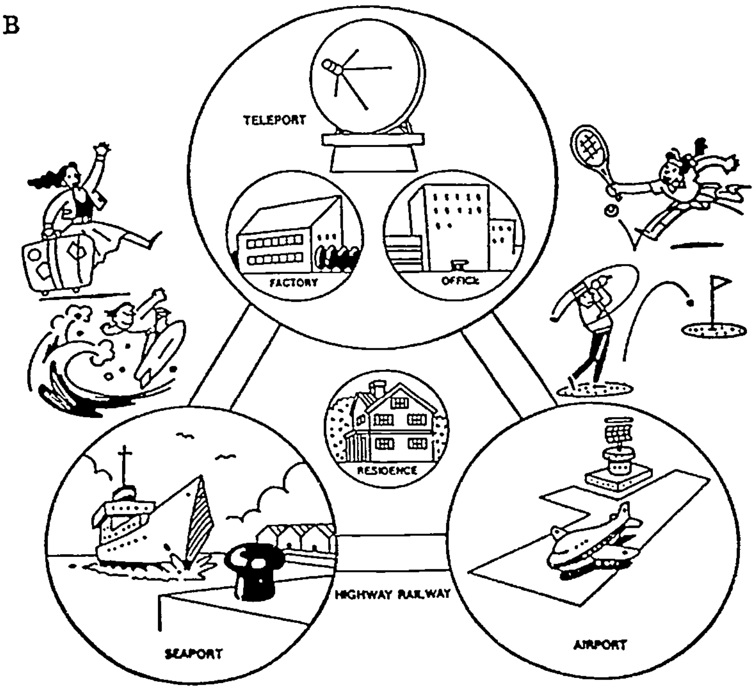


Figure 2
Concept B



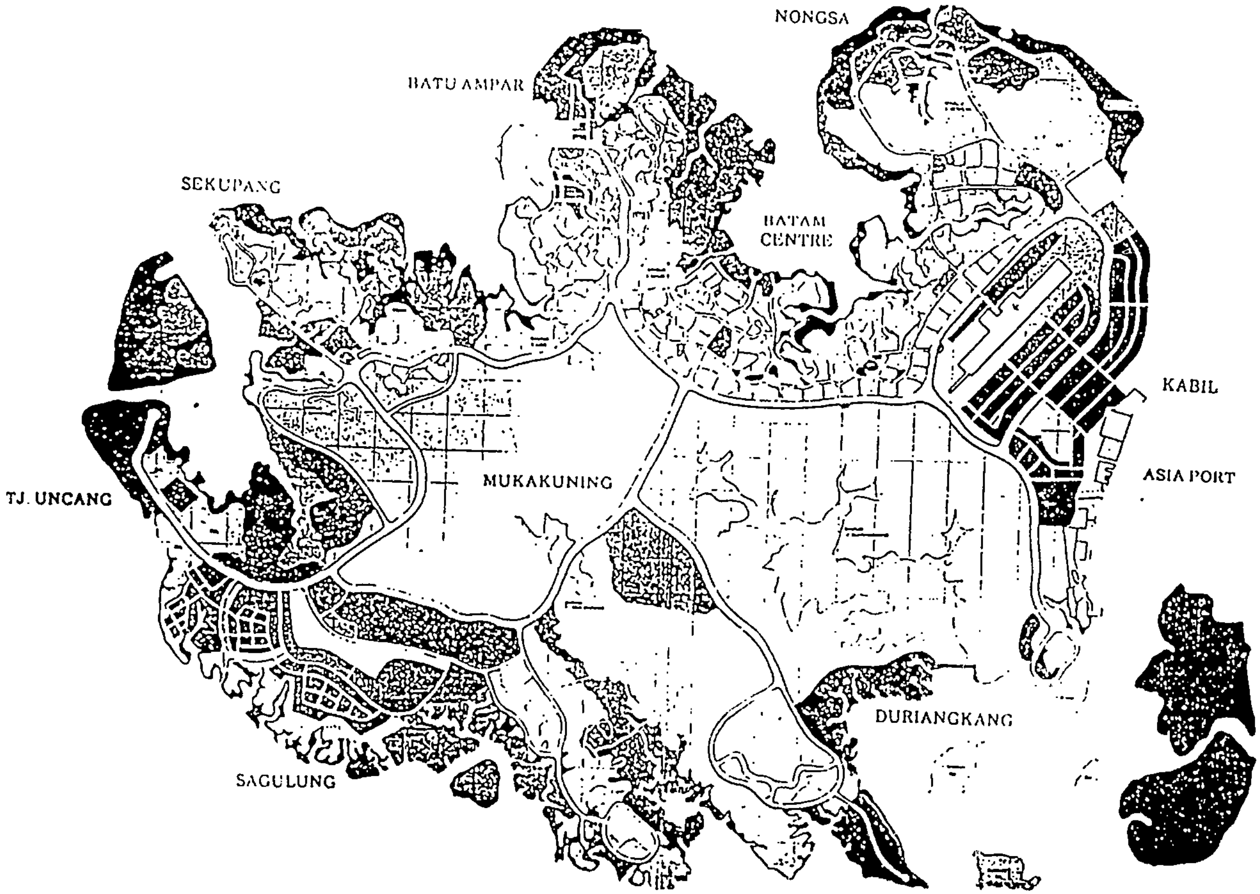

NONGSA
BATU AMPAR
SEKUPANG
BATAM CENTRE
KABIL
ASIA PORT
MUKAKUNING
TJ. UNCANG
DURIANGKANG
SAGULUNG

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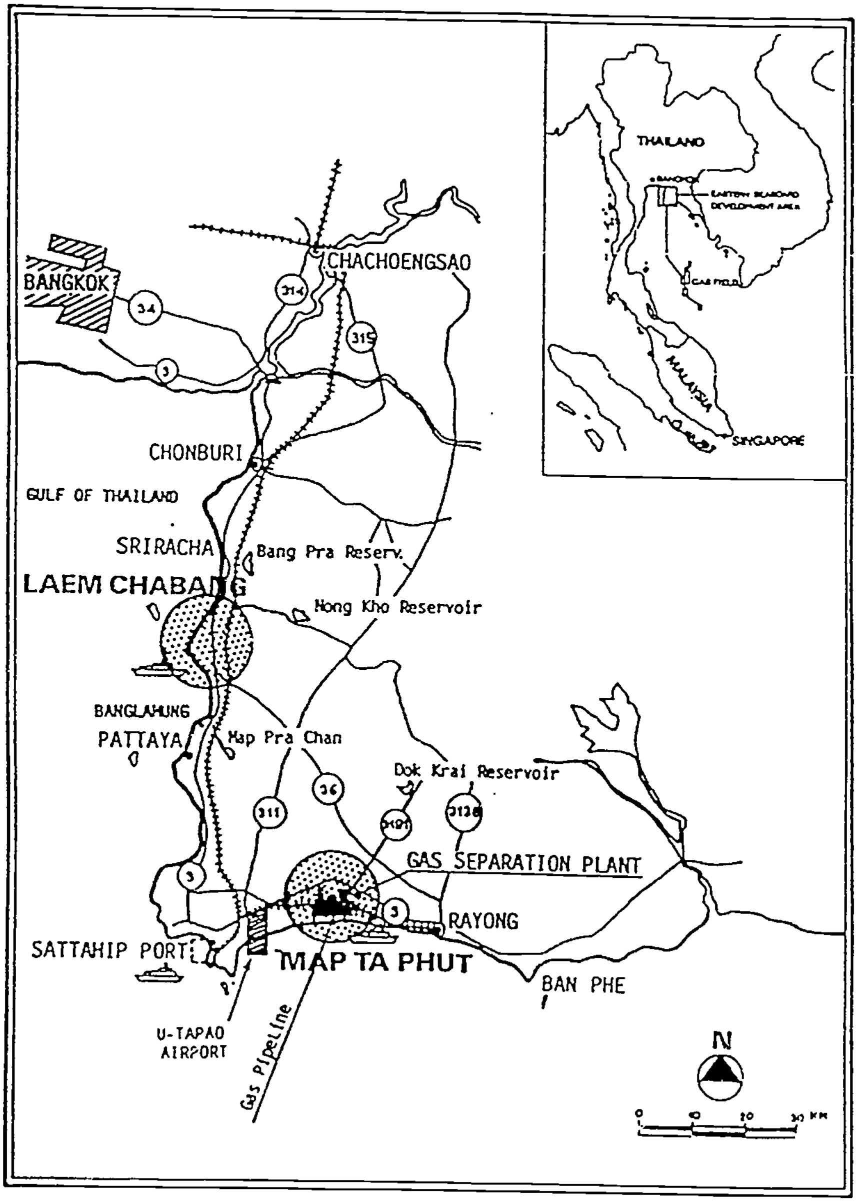
Figure 4

EASTERN SEABOARD DEVELOPMENT PROJECT



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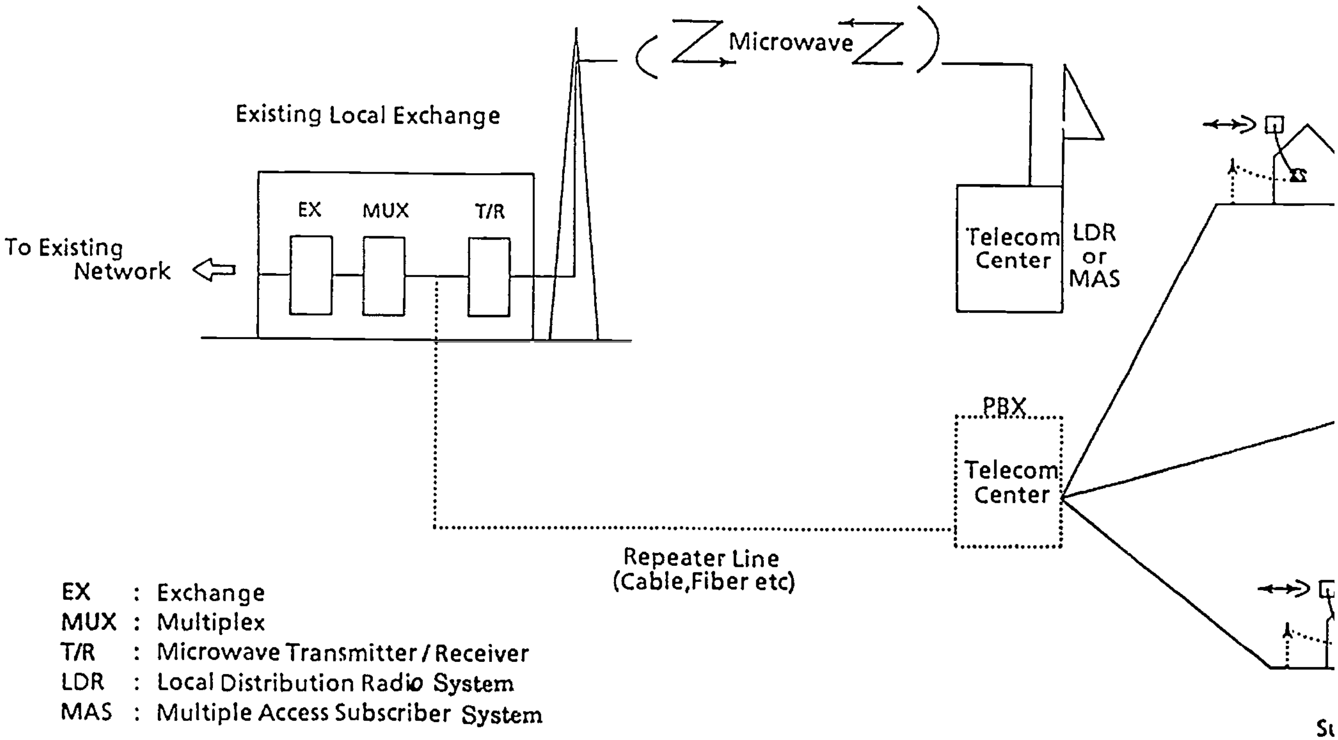
Teleport - Small Scale -

Small Scale Local Companies

- Not so Large Capacity
- Small Calling Rate
- Wide Area and Scattered Demand



EX : Exchange
MUX : Multiplex
T/R : Microwave Transmitter / Receiver
LDR : Local Distribution Radio System
MAS : Multiple Access Subscriber System

Video Dialtone Access to Multimedia

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Video dialtone is a video transport servic hich transmits video programming both intrastate and interstate via private line or point to multipoint arrangements over the existing public switched narrowband netwtwork currently operated by local exhange carriers and interexchange carriers in the United States. The concept of video dialtone and its deployment issues are discussed as they relate to the United States infrastructural changes which affect provisioning and operations of shared access facilities which allow multimedia applications.

1.0 INTRODUCTION

Advanced Technological opportunities have brought about change in the human interaction process with respect to information access methods, contents, and ethics. As new technologies are discovered, and as additional applications and usages unfold, man kind will continue to battle the cause and effect methods endured by the natural phenomena associated with change. Phenomena can be described as problems associated with change, it can be theoretically capsulated by using principles of reasoning models found in textbooks.

However, the economic, political, social, and cultural impacts caused by the adoption of new ideas (technology) under the cause and effect models, do not result in balanced changes. The ingenious invention of one person will effect another person and it is important to understand the climate and try to balance the consequences before a determination can be made regarding what is best for the man-kind.

The introduction of video dial-tone is a direct result of the evolution of information processing and new telecommunications practices, world-wide. The United States decision to divest the American Telephone & Telegraph, AT&T, Bell System, has attributed to the advancement of new technologies such as video dialtone which provides access to multimedia applications by a diverse number of suppliers. The United States decision to divest continues to influence telecommunications today. Several developing countries have referenced the United States paradigm shift (divestiture) as a model promoting privatization and liberalization practices in regards to achieving greater economic and national empowerment.

Advocacy for and against divestiture, privatization or liberalization processes can take years to finalize, however according to the author, the 1984 AT&T Bell System divestiture was not an overnight decision. The United States House of Representatives and The Senate of held hearings and testimonies concerning the ramifications of Bell System's divestiture dating back to the mid 1970's.

The divestiture brought about change that affects the entire United States. The telephone industry was the primary focal point during that period. The AT&T Bell Operating Companies were, as a result of the divestiture, divided into seven individual companies that provide services which are restricted to regional jurisdictions providing local services. The long distance phone service component of the Bell System was granted to AT&T to provide competitive inter exchange carrier service in a market with other carriers which include for example, MCI and Sprint. Several ramifications continue to impact functional components of telecommunications such as a)regulations and policy, b)implementation and provisioning, c)infrastructure and design, d)marketability and service, e)pricing and competitiveness.

The intent of this paper is to recognize the importance of the ramifications of the needed paradigm shift as exemplified by the United States when it introduced video dialtone.

2.0 VIDEO DIALTONE AS PROPOSED BY THE FCC

"Video dialtone is a video transport service which transmits video programming both intrastate and interstate via private line, or point to multipoint arrangements over the existing public switched narrowband network operated by Local Exchange Carriers, LECs, and Inter Exchange Carriers, IECs,(e.g., AT&T MCI, Sprint etc. common carriage). Video Dialtone experimental switched access is currently being tested using the narrow band facilities."[1] The deployment of integrated broad band networks, (IBN), offering video dialtone is anticipated after the initial implementation of video dialtone technology because it means building a new network infrastructure which will ultimately replace many narrow-band applications.

The Federal Communications Commission, (FCC), proposed the video dialtone policy to provide telephone company cable television cross ownership. Under the proposed video dialtone policy neither the LEC, which would provide the video dialtone, nor a video programmer, who would use the LEC provided dialtone, would need to acquire a cable franchise.[2] Under the Cable Communications Policy Act of 1984, there may be three tiers of cable television regulation: local, state and federal government policy. This paper primarily examines the local regulatory practices and does not go into detail about the other tiers because the issues surrounding the franchise procedure is very important to understand the total impact which the video dialtone policy will have on the cable industry. Regulation of cable operators at the local level is accomplished through the franchising process. The franchising authority is usually a local municipality and requires an annual operating fee from the cable system provider. In addition, the franchising authority may have some interest in the subscriber rates charge by the cable provider.[3]

Franchises are typically contracts which contain the terms and conditions under which franchises are awarded. Franchise regulations determine the criteria and requirements for the cable companies' operations which include the provisioning of facilities and equipment. The requirements include a broad range of video programming and other services which adhere to copyright laws and national technical standards specified by the federal agencies as they relate to equipment and facilities.[4]

In its Further Notice of Proposed Rulemaking on the video dialtone proposal, the FCC requests comments on specific issues, including:

1 The investment and development cost associated with LEC deployment of video dialtone.[5]

2 A minimum broadband switching requirement should be enforced and if it is feasible for the LECs to be able to implement such a requirement.[6]

3 The development of a single transport facility (voice, video and data).[7]

4 The cost of constructing a system with broadband switching capability.[8]

5 The technological advances and benefits of competitiveness.[9]

6 Public opinion about LECs acquiring the facilities of a cable franchise and operating facilities under the video dialtone regulatory structure, with its attendant nondiscrimination obligations enhancing competition among service providers.[10]

7 The impact fiber-based and other transmission technologies might have on the evolution of advanced networks.[11]

8 The nature of services and markets that may develop as the advanced network emerges under the video dialtone model.[12]

9 In Section 613 (b) (1) of the Cable Act, addresses potential difficulties which may arise in the future in applying video programming as new service development.[13]

10 On inter LATA restriction which may restrict BOC provisioning of video dialtone if separate facilities are required for each LATA[14]

11 On regulatory distinctions between video and non-video services which may become problematic as technologies converge.[15]

This paper will identify industries which have an interest in the video dialtone policy. It will discuss specific comments on the FCC's proposal submitted by industry representatives and interpret the tactics used in argument for and against the telephone company/cable company cross-ownership rules. The FCC's proposal, if adopted in some form, can provide advantages for all communication and information providing industries. The primary focus will be on the impact of the proposed policy, if adopted, on the cable industry.

3.0 CABLE TELEVISION IMPACT-BACKGROUND

The FCC's video dialtone policy initially poses a threat to the cable industry. Cable was borne in 1948, when the first community antenna television, CATV, systems was built to provide better quality television reception for broadcast television signals in rural areas. The first CATV systems carried 3 or 4 broadcast signals and subscribers were charged $3 - $5 per month.[16] By contrast, today, cable operators offer as many as 100 channels of video programming, most of which is delivered by satellite, and cable service is no longer confined to rural communities.

According to a household subscriber study with basic cable service from 1965-1990 conducted by A.C. Nielson Co. in 1990, "Cable television is available to nine out of ten television households in the United States. Six in ten households, or more than 53 million subscribers, have chosen to subscribe to cable, with the average subscriber receiving over 40 channels."[17]

Since its beginnings the cable industry has expanded and continued to provide more and more programming opportunities, which greatly enhanced its popularity and attracted many subscribers. Today, the cable industry is threatened by the elimination of telephone company - cable company cross-ownership rules, which will not only force the cable industry to become competitive, but will also change all communication, media and information industries. Fundamental operational changes will occur regarding program content and program access, if the cable industry is to stay afloat and be competitive. Cable organizations raise excellent points as to the validity of the FCC's authority and jurisdiction to propose services related to intra-lata, intra-state boundaries although video dialtone may not be limited to those boundaries and may cross inter-lata, intra-state connections as well as inter-state connections.

4.0 VIDEO DIALTONE REGULATORY ISSUES

This section will focus on the important issues which are represented in the comments made by representatives from the following industries. Telecommunications service providers such as inter-exchange carriers, local exchange carriers, Regional Bell Operating Companies, computer information providers, local governments, broadcast industry associations and the telephone industrial associations. Note that the cable industry commentors did not go into detail about regulatory issues in response to the Further Notice of Proposed Rulemaking, FNPRM. The cable industry commentors maintain focus on the LEC entry into video dialtone and other business related issues which will be discussed later.

The National Association of Regulatory Utility Commissioners, (NARUC), comments state "NARUC continues to note that the provision of video dialtone service, on an intrastate basis, is subject to State regulation pursuant of the Communications Act. To the extent BOCs can provide an interstate video dialtone service, under the current jurisdictional scheme of the Communications Act, the rules concerning jurisdictional separations must be examined."[18] The NARUC comments indicate that States should be allowed to regulate the allocation of costs between the telcos regulated telephone service and cable television services, including the right to order structural separations where necessary.[19]

Cincinnati Bell Telephone's External Affairs office reports that there is a need for a certain level of regulatory symmetry in order to promote effective competition between LECs and cable operators. Since LECs are already heavily regulated, cable operators would have a tremendous competitive advantage if their current status remains the same. Cincinnati Bell's comment suggests that a greater level of regulatory symmetry could be achieved by increasing the regulations applicable to cable operators to the extent that cable operators are involved in the business of video common carriage. In essence, Cincinnati Bell feels that the cable operator should be regulated to the same extent as any other common carrier.[20]

[The FNPRM presents two regulatory approaches for implementing video dialtone. The two level approach offers better protection against LEC's use of discriminatory practices. As interpreted from comments by the National Association of Broadcasters, NAB, (CC Docket No. 90-623, filed March 8, 1991, at 7-8, Computer III Remand), other industries have experienced discriminatory practices which could be used by telephone companies to impede competition in enhanced services. For example, a federal court recently determined that some companies in the airline industry engaged in anti-competitive activities in connection with the display of flight information on computer services provided to travel agents. (In Re Air Passenger Computer Reservation System Antitrust Litigation, 946 F. Supp. 1443 (C.D. Ca. 1988)). The companies engaged in a practice, known as "display biasing," whereby the flights of one airline were always displayed first, with flights operated by competing airlines often being difficult to access. The result, the court found, was that consumer choices were not always based solely on the merits of a particular flight, and the value of the vendor airline's flights was artificially inflated. Display biasing, the court found, results in a fraud upon the consumer and an unreasonable restriction on competition. Because the video dialtone concept involves integration of video and non video services, similar practices could be used by LEC's to give an unfair advantage to their non video services over those of competitors. If these services were to be offered through menus accessible through communications controlled by the LEC, there would be an incentive for the LEC to give its own services preferential menu placement, to the detriment of competitors and consumers.][21]

[Video program suppliers may be connected through interstate communications, with dial up video tape rental libraries. The potential movement of services steering away from the traditionally territorial basis for its jurisdiction, the Commission should determine offerings that are subject to Section 203 and 214 and which are not.][22]

5.0 INFRASTRUCTURE CONSIDERATIONS

The video dialtone model represents a change to all interested parties, particularly the telephone companies and the cable television companies, whose current infrastructures are different from each other. The public telephone network is structured in three layers. The physical layer supports infrastructure for telephone services. It is the facility or physical wire used to send electronic signals. The transport layer provides passage for switched traffic information. It is the data which is converted into messages sent (voice conversations). The value-added services or applications layer stores, retrieves, and generates or processes the information that was transported. This is the information which contains where the message is going to and who sent it.[23]

By contrast, the cable television infrastructure partly consists of transport distribution of information to subscribers. This is the ability to send information to masses of receivers. The cable television network also consists of a value added television programming services which provisions entertainment or other information. [Whereas telephone companies ordinarily do not control the content of information sent over their network, cable operators typically control, the content transmitted over their networks. Unlike telephone companies, cable operators know what is to be transmitted in advance.[24]

The two infrastructures are therefore, very different. It is important to note that the telephone infrastructure in its present matrix form and its future packet form is a two way communications exchange. The matrix form allows calls to be inter connected from one point to-many points as well as point to point or multi point. By contrast, the cable system is built on a point to multipoint, one way communications network.

It is important to note that the FCC's call for comments seek information regarding the LEC incentives for updating current infrastructures to accommodate fiber optics and more advanced broadband applications. The concern is that by allowing LECs to enter into the programming arena, they would have more incentive to invest sooner in the infrastructure upgrades.

Many political issues are involved in the infrastructure changes required to offer video dialtone in the suggested manner of the Final Notice. The position on Capitol Hill is very controversial. For example, an infrastructure issue, H.R.3515, Sec. 101, Title I, (h) Telecommunications Act of 1991: Infrastructure Development: Network Standards: Study;

No later than 279 days after the enactment of the Telecommunications Act of 1991, the Commission shall initiate an inquiry to examine the effects of competition in the provision of telephone exchange access and telephone exchange service on the availability and rates for telephone exchange service furnished by rural exchange carriers.

The bill was approved by The House of Representatives however did not gain approval by The Senate. It is suspected that the ramifications of investigating the effects of provisioning access and services can be enlightening at this preliminary stage. However, United States citizens may be concerned about the deployment of this bill resulting in higher taxation.

The cable infrastructure as previously mentioned, transports over a coaxial cable and optical fiber networks. It uses antennas constructed on high ground to pick up signals from broadcast airwaves, microwave transmitters, or satellites and transfers them to headend sites where they are converted into pulses and transmitted via terrestrial cable (coaxial or fiber) underground until they reaches the channel to the television set in the home.[25]

Cable services are typically divided into two categories, "basic" and "premium/pay", although the boundaries have begun to blur. Basic service consists of a general package of television channel access including the local affiliates of the major broadcast studios and at least one PBS station and a local independent broadcast station. Advertiser supported, satellite services such as CNN and ESPN, as well as not-for profit religious networks, are also included. Local origination community and public, government and educational access channels programmed by members of the community, government officials or educational institutions are also typically available as part of basic cable service. Premium services include movies, sports and made for cable specials as well as national premium services like HBO, Showtime, and The Disney Channel which are commercial free, and also known as pay services. Pay services are typically available for a monthly charge in addition to the monthly charge for basic cable service. Many subscribers can purchase cable programming on a pay per view basis. Channel capacity on cable systems range from 12 to about 100 or more depending on where the cable system is located. The older systems are much more limited. Most of the advertising-supported satellite delivered cable networks are made available to cable operators at a specific fee per basic cable service subscriber(e.g. 10 cents).[26]

If the telephone companies can expand their markets to provide service to the rural areas that are currently serviced by the cable industry, by nature of their networks and infrastructure, the public would undoubtedly want service from the best quality service provider.

Ultimately, the FCC's forecast is that video common carriage could be offered over a broadband network analogous to the existing nation-wide narrowband telephone switched network. Such a network would enable any subscriber to transmit and receive a video signal to or from any other subscriber. Broadband video common carriage networks might run parallel to the narrowband networks, or they might be integrated with switched narrowband communications.[27]

Cable industry officials say that the cross-ownership restriction is strictly for telephone companies involvement in providing programming content, not in transmission facilities. Cable officials feel that the deployment of fiber by the telephone industry has already begun and is not dependent on whether telcos are permitted to provide program content. "When people talk about a broadband local network, they often refer to 'fiber to the home', which one day may be the preferred technique. Meanwhile, Ameritech and the other regional companies have been experimenting with ways to transmit broadband signals to residences without using fiber the entire length."[28]

S.1200 is a bill introduced by Senators' Burns, Gore and Dole which proposes that the United States allocate funds to modernize the communications infrastructure to include a nationwide, advanced, interactive, interoperable network to satisfy the information handling needs of our citizens, now and in the future. The United States has led the increased deployment of fiber optic cable to date. Projected fiber optic sales between 1991 and 2000 show North America currently at 1.29 billion dollars and 3.41 billion dollars by year 2000. It also shows Europe at 1.23 billion dollars now and by year 2000 Europe is expected to lead the world with 6.21 billion dollars in fiber sales.[27]

The goal of S.1200, cited as the "Communications Competitiveness and Infrastructure Modernization Act of 1991" is "To advance the national interest by promoting and encouraging the more rapid development of a nationwide, advanced, interactive, interoperable, broadband communications infrastructure on or before 2015 and by ensuring the greater availability of, access to, investment in, and by ensuring the greater availability of, access to, investment in, and use of emerging communications technologies, and for other purposes."[28] This Bill has currently been referred to the Senate Committee on Commerce, Science, and Transportation.

Highlights of the Legislation include:

1. Economy is becoming more dependent on provision of services that require transport and distribution of information.
2. 50% of US workers are currently employed in information intensive service industries heavily relying on communications
3. Manufacturing companies are as affected by change as are the Service Industries.
4. Communications has become a highly visible and valuable measure of information distribution and dissemination.
5. The communications infrastructure of the future will be as important as the transportation infrastructure has been to the industrial economy.

In 1990, the cable industry invested 18 million dollars installing fiber optics throughout the U.S. existing Cable Systems according to the NCTA.

5.1 MULTIMEDIA ACCESS OVER EXISTING TECHNOLOGY

HDSL/copper twisted pair

Bellcore is exploring a preliminary view of an initial set of generic requirements for High-bit-rate Digital Subscriber Line, HDSL, transmission technology. Currently, the existing copper twisted pair of wires that are used in most residential areas to provide basic telephone service transmit signals within a spectral range of 0 - 4 khz. The narrow bandwidth is directly attributable to the intrinsic properties of the electronics that are used to transport signals. HDSL technology utilizes recent technological advancements in echo-cancellation techniques and tighter tolerances in component devices to expand the usable bandwidth of the embedded copper twisted pair to 1.54mbps. Although the bandwidth capability with HDSL still falls below high broadband speeds, it far exceeds the narrow bandwidths currently available over copper twisted pairs. This technology can allow many interactive and interoperable applications as a stepping stone to the future. HDSL will provide an alternative to repeatered T1 lines for Bellcore customers to support repeaterless DS1 rate access over copper loops that conform to Carrier Serving Area design rules. A repeaterless HDSL will allow DS1 access within a CSA environment. An optional outside plant HDSL repeater would allow extension of the coverage beyond a CSA on non-loaded loops. The overall operations approach for HDSL systems must consider the existing environment into which HDSL will be deployed.

ADSL/copper wire

Asynchronous Digital Subscriber Line, (ADSL), can be used for a variety of image and audio based services that reach into the education, entertainment and home business realms. Videoconferencing will be made possible with computer workstations that the customer can receive full motion video and from which still frames can be transmitted back through the network.

The ADSL line is slightly higher than the DS1 rate of 1.544 Mb/s but is used to carry 1.544 Mb/s DS1 channel, a 16 kb/s control channel from the network to the customer and about 10% overhead for forward error correction prior to QAM coding. Today, video conferencing applications are being transmitted from Rollabout codec units and desktop video applications over BRI ISDN at multiple rates of 2B plus D. There are some systems which are still costly that are available over PRI ISDN which transmits 23 64 kbps type channels simultaneously to achieve a full motion picture quality.

6.0 PROPOSED IMPLEMENTATION STRATEGY

The FCC's video dialtone model is comprised of two levels. Level one: At this level LECs merely offer basic transmission service to a service provider enabling them to reach homes. LEC's will also provide service providers with access to what ever information is needed to perform billing and collection for their service. LECs will further provide access for the subscriber to reach the service provider and provide a basic menu with tutorial and help functions which will be useful to subscribers as they use the platform.

Level 2 : This level will allow the service provider and the LEC to both offer value added services , which are referred to as advanced gateway services. This level allows the LEC to become the agent or broker for the service provider. The LEC handles the operations and maintenance of the service which is owned by the service provider. The LEC provides advanced video gateway and related services, which are considered unregulated services, subject to competition from other gateways and video services for which the LEC acts as agent. It is this level that the LEC can enter into the competition of providing its own programs which will be offered to the same potential subscriber base, as with its clients, the service providers.

6.1 COMMENTERS VIEWS ABOUT IMPLEMENTATION STRATEGIES

As already noted, the FCC has asked for public comments on the implementation and deployment of the video dialtone. The main issues on which the FCC seeks comments include: The cost of constructing a system with broadband switching capability; The nature of services and markets that may develop as the advanced network emerges under the video dialtone model; Whether its video dialtone proposal is consistent with Section 613 (b) (1) of the Cable Act and address potential difficulties which may arise in the future in applying the policy as new services develop.

The FCC should provide clarity in the billing provisioning issues, service collections, CPE and wiring when referencing non-common carrier offerings in the interest of direct conflict to the Cable Act.[29]

AT&T supports the Commission's proposed two level video dialtone gateway. The AT&T comments state that a two-level gateway reduces the risk of LEC discrimination against enhanced service providers which compete with the LECs' own enhanced services that use the gateway. They urge that the LECs would provide tariffed access services and menus in the first level of the gateway. The service menus in the first level would not contain any LEC enhanced service offerings. AT&T suggests that the LEC enhanced services would only be available to the second level gateway. "A clear demarcation between enhanced and basic services is important because the FCC's present non-structural safeguards, such as Open Network Architecture and joint cost accounting, apply only to enhanced services, not basic services. Independent enhanced service providers such as CompuServe need protection against the RBOCs' demonstrated ability and incentive to cross-subsidize and discriminate."[30]

The National Association of Broadcasters, NAB, contends that the prohibition against telephone companies providing content for video programming within their telephone service areas should be retained. Further, any limitation short of an outright ban would be unworkable or constitutionally suspect. Adequate safeguards are not in place to protect LEC competitors from anti-competitive activities. NAB also argues that LECs already have sufficient incentive to further the Commission's video dialtone goals without generating content for video programming within their telephone service areas.[31]

If video dialtone service is to generate the maximum public interest benefits, LECs should not be allowed to favor their own information services over those of their competitors, and accessing the service should be easy for the subscriber to use. The implementation of video dialtone would allow more interested parties, the opportunity to provide video programming to the home.[32] Northern Telecom indicated that current open network architecture pricing must consider the marginal cost when providing services and equipment to make video dialtone a reality. The LEC will be expected to provide excellent quality transmission facilities for the lowest possible price.

LEC's would be permitted to provide on behalf of any video service providers order processing, billing and collection, customer installations, and customer premises equipment for the unregulated video services, pursuant to existing commission regulatory provisions. To the extent LEC's provide these services to their own video programming service, they should do likewise for the rest.

Disadvantages associated with LEC offering service provider order processing, billing and collection, customer installations and CPE for unregulated video service:

1. May be difficult for them to maintain objectivity in working on behalf of a competitor's service.

2. May cease opportunities to use comparative information such as billing and pricing schemes to solicit service provider's subscribers to change their minds and subscribe to LEC's service instead.

3. Unless existing commission regulatory provisions include the regulating and monitoring of the LEC's involvement with service provider service handling, there will be no way to tell if the LEC is truly handling the processing of the order fairly and without offering its own service.

4. LEC has direct contact to the customer under this model. The service provider should have more control.

Advantages associated with LEC offering service provider order processing, billing and collection, customer installs and CPE for unregulated video service:

1. Customer may want to use more than one service provider and the LEC provides for one point of contact.

7.0 MARKET SEGMENTATION

a. Consumers- Receive competitive programming and ease of use for video and non-video services to the home. Quicken the deployment of fiber optic transmission. Lower cost to entertainment programming and increase home marketability.

b. Businesses- Video conferencing, desktop applications, ease of transitioning to fiber technology. Higher bandwidths at greater speeds provide for increased data flow and file transfer applications.

c. Not for profit organizations-Competitive pricing on public audiences and access to information and dissemination of information.

Economic Development

(A) Current reports focus on the deliverance of integrated broadband networks, (IBN), switched, and interactive video for the residential market. Although residential markets are the primary focus for the dissemination of information and services available through use of the IBN technology, it is argued that due to economic and social forces, advertisers will cater new product and service promotions to preferred markets. This is known as market segmentation.[33]

Traditionally, network television programming has been primarily considered a vehicle for delivering sponsors' advertising messages. Programming differentiation and quality has not been a major concern, since the television audience has been seen to be a mass market. However, with cable television, satellite communications, and home video options, the television viewing market is becoming segmented. Viewers are no longer captive audiences for network programming and their advertising messages and now have a wide range of programming options to satisfy their entertainment and information needs. Trends toward television market segmentation suggest that the networks will need to develop programming targeted to consumer tastes. Ratings data will be inadequate for programming and advertising decision making because they lack qualitative detail. Segmentation research into the characteristics of television viewers and their programming preferences will be necessary to make effective programming and scheduling decisions, as well as to determine which programs will be effective vehicles for different types of advertising.[34]

(B) Penetrating broadband applications and new markets such as video dialtone will aid the advertising industry by providing product promotions, in most cases which are more effective than its traditional presentation. The advertiser will benefit by getting specific geographical and financial information about the viewer from the service provider or agent that provides billing to the residential subscriber. As billing agent for the service, there is a lot of statistical information available to determine a particular market penetration. ANI "caller identification, (caller Id)" features are available today on the public switched telephone network. It is currently being offered on application interfaces such as Call Path/400, IBM, in conjunction with major Private Branch Exchange, (PBX), vendors. Call Path/400 provides a broad application program interface, (API), which integrates voice and data communications functions and information into the AS/400 applications.

To date, the Call Path/400 application allows capability for ANI/DNIS features. ANI is the ability of the interstate telephone network to trap and transport a record of the phone number originating a call. This transport is part of the telephone network's billing and control function and is also a specific element of the ISDN standard which cannot be stopped by subscribers.[35] The local delivery of a caller's number to a receiver's telephone is a billable telco service generally called "caller id" which can be blocked if the telco allows it. Statistical information provided by caller Id would be the advertiser's database to a new rating scheme. This information is valuable to researching methods in that the level of accuracy in identifying markets will become greater. Unfortunately, the new technology and surge for information access is forcing all communication media to enter into new ranges of information offerings even if it isn't their traditional business.

In the newspaper industry, editors finally are learning to serve the needs of readers. Although household growth has been rapid in the last few decades, daily newspaper circulation has been flat for 45 years. In a fight for survival, news executives are changing to reach more households. Newspapers are beginning to understand that they cannot survive unless they compete in the information industry against such rivals as television, radio, and computers. If a redefinition of newspapers catches on, more options will become available for newspaper customers. Newspapers already are being delivered by facsimile machines. Other options include: 1. videotex, 2. on line access to a newspaper's library, and 3. a daily catalog page that allows readers to shop by telephone from local stores. The goal is for newspapers to reposition themselves as the leading news source in the market. Market research is providing newspapers with information on subscribers want.[36] A dangerous aspect in obtaining this information by way of market segmentation temptations of both the advertiser and his client. Video will be viewed as a threat to magazine advertising because of two obvious realities:

1. Visualization: This medium of communications has the power to simulate the practical applications of the product or service being promoted. IBM suggests "that video wouldn't replace magazines but that advertisers will shift certain products to video particularly where they are well matched to program content and audience profile."[37]
2. Loss of marketing resources: The shift to video will decrease the customer list for marketing and research for publishers. This may also be true for video providers because customer access methods may be designed in ways to limit private demographic and financial information.[38]

Market segmentation can be dangerous if advertisers are making broad assumptions about what subscribers are like. A subscriber can not be assumed to be within a certain income bracket just because they subscribe to IBN services. If for argument sake, consumers find that the values of the available programming and services do not reflect their life style, wants, needs and desires, they will make choices to seek subscriptions which meet their needs, else where.

It is projected that, by the year 2000, minority consumers will constitute a majority of population in 1/3 of the US' 50 largest cities. The top 3 minority groups - African Americans, Hispanics, and Asians - represent a $300-billion market now, according to Deloitte and Touche and Impact Resources. The size and power of the minority market is not reflected in strategic thinking and planning in most businesses. Efforts to provide products and services to minority segments will fail unless businesses know and understand, respect, and correctly address minority needs and wants. Some commonly held myths about minority segments are 1.Minorities are monolithic groups. 2.Companies do not have to target minority markets because they can reach them with general media. 3. Language is a minor consideration. 4.Minorities are low-income consumers. Those seeking marketing opportunities among minority segments must show a sensitivity to their culture, values, and lifestyles.[39]

8.0 CONCLUSION

Advancements in technology and the divestiture of the telecommunications industry continues its cause and effect impact. Deregulation of the Cable industry was passed in accordance with the Cable Communications Act of 1984 and became law in 1986. Today, the industry is facing a re regulation which will bring its efforts in a 360 rotation. The year 1992 marks a presidential election year to the United States government. Major issues are before Capital Hill. Unfortunately, the cable industry has not been able to fair well in the press, and instead, receives continuous remarks about its rate increases and poor customer service.

Since 1986, when deregulation became law, cable operators raised rates and did not educate the public about the reason why rate increases were necessary. Basic service increased 56% between 1986 to 1991. Enhanced or popular cable service increased 61%.

The public was not informed about the increases in programming cost, nor were they aware that the increase in accessing channels also increases the cable operators cost for providing free access to additional basic service channels to the public.

The cable industry has indirectly competed with other industries such as national television, PBS, movie theaters, and home entertainment video's which are also programming alternatives available to the consumer. It has also competed with the print medium which includes, magazines, books, and newspapers.

Actually, the competition doesn't stop there, depending on the individual interests and hobbies, other electronic media can be included. The cable industry has yet to educate the public that using cable services is more than a value added service, that it is a necessity. Only recently, attributed to project 'Desert Storm', cable television subscribers were faced with identifying that CNN, a cable provided broadcast channel, had the best coverage of national and international news. Understanding the value of the technology is very important to the public. The telephone companies continue to raise prices. The public continues to pay for telephone services. One could ask why is telephone a necessity opposed to using other media. Actually, the teleco's public relations strategies include long range planning which the cable industry hasn't yet begun to visualize the value of cable service offerings to the public.

There are a multitude of issues surrounding the impact on the cable industry as it relates to the adoption of video dialtone. As the champion of providing reception and quality to rural and urban subscribers, the cable industry must stop and look at its market and re evaluate its mission. Markets are changing and as stated above the flow of information is segmenting. The major concern of the cable industry should be that it knows how to identify and reach its market. Advertising strategies are not going to continue sponsorships in its traditional manner, instead it will adopt new ways to reach the right market for its offered product or service. Eventually, consumers will be sophisticated enough to seek advertisements based on need. This will become an evolution in the advent of "advertisement on demand", a prodigy for the educated consumer.

The comments presented above reflect interested parties of two industries which are destined to combine. Transformation is difficult however, the beginning is the best time to air concerns and to take the best qualifications from each side to provide the video dialtone service in the most appropriate and cost effective way to the American consumer.

There are financial considerations which will determine if offering this service in the way in which the FCC proposes is the most beneficial for the future of the technology. It is also proposed that the LEC incentives for deploying the infrastructure for the video dialtone platform will be the leading resource for providing other broadband services.

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[1] FCC Docket 87-266 Further Notice of Proposed Rulemaking First Report and Order and Second Further Notice of Inquiry (FNPRM): pg.7: "Our view of video dialtone is that it is an enriched version of video common carriage under which LECs will offer various non-programming services in addition to the underlying video transport. Video common carriage encompasses the transmission of entertainment video programming and other forms of video communications, both interstate and intrastate. Video common carriage may be a private line, or point-to-multipoint offering; or it may be switched, although switched systems still are largely experimental."

[2] Further Notice of Proposed Rulemaking First Report and Order and Second Further Notice of Inquiry, (FNPRM): Docket No. 87-266; Adopted: October 24, 1991, Released: November 22, 1991 by the Commission: Commissioners Quello, Marshall, Barrett and Duggan issuing separate statements.

[3] National Cable Television Association, (NCTA), A Cable Television Primer Part V Franchising Authorities pg. 41: "Under the Cable Act, franchising authorities generally may not regulate rates, except that the rates for basic service tiers may be regulated by local officials in those communities where the cable system is not subject to effective competition as that term is defined by the FCC."

[4] NCTA, A Cable Television Primer Part V Franchising Authorities pg. 41;

[5] See, FNPRM: pg. 9. No.13. (a) Infrastructure Considerations, "We invite comments on the nature of LEC incentives and the likely infrastructure benefits and costs of proceeding with video dialtone at this time."

[6] ibid pg.10

[7] ibid pg.10

[8] ibid pg.10

[9] ibid pg.10 No.16

[10] ibid pg.11 No. 17. C. Diversity Considerations

[11] ibid pg.12 Part 2. Video Dialtone and Advanced Network Design, No. 18

[12] idid pg.12 No. 19

[13] idid pg.13 No. 21 "Section 613 (b) (1) of the Cable Act (33) states that it is unlawful for a common carrier subject to Title II to "provide video programming directly to subscribers in its telephone service area."(34) While the term "provide video programming directly to subscribers" It is nowhere defined in the Act, a review of the legislative history evidences the Congressional concern behind the prohibition: to bar local exchange carriers from becoming cable operators in their service areas.(35) This ban was intended to ensure that LECs do not provide video programming directly to subscribers in the same manner as traditional

cable operators in order to prevent the development of local media monopolies and to encourage

[14]ibid Part 3. Authority to Implement Video Dialtone Section (b) Modification of Final Judgment. No..22. "We solicit comment on the way such services may develop and the applicability of this restriction to video dialtone".

[15]ibid Section (c) Implementation of Video Dialtone No. 23 "We invite parties to comment on this tentative conclusion and to suggest alternative ways in which video dialtone could be implemented."

[16]National Cable Television Association: A Cable Television Primer: Chapter 1 Cable TV:Coming of Age. pg. 6-7;1990 "During its first decade, cable grew at a modest pace, largely due to a FCC ban from 1948 to 1952 on the establishment of new broadcast television stations."

[17]ibid. "This dramatic growth reflects both the cable industry's willingness to seize new technologies and the government's decision in 1984 to deregulate the industry, creating an environment that bolstered new investment in technology and programming."

[18]National Association of Regulatory Utility Commissioners: Comments In the Matter of Telephone Company - Cable Television Cross-Ownership Rules: 2/6/92; pg. 7

[19]ibid

[20]Stonebraker, Barbara J External Affairs Cincinnati Bell Telephone Comments In the Matter of Telephone Company-Cable Television Cross -Ownership Rules, Sections 63.54 - 63.58 pg2-6

[21]National Association of Broadcasters, (NAB), Comments In the Matter of Telephone Company-Cable Television Cross-Ownership Rules, Sections 63.54 - 63.58; pg 17-18

[22]National Telephone Cooperative Association, (NTCA), Comments In the Matter of Telephone Company-Cable Television Cross-Ownership Rules, Sections 63.54-63.58 pg.3-4

[23]Datapro Information Services Group, Delran NJ 08075 USA Datapro Management of International Telecommunications, Regulatory Hurdles in Realizing Broadband Convergence, 6/91; pg. MIT 40-250-502."Multiple suppliers can compete to provide value added service (and to a lesser extent transport services) in the telecommunications environment, and subscribers have the capability to choose freely between them."

[24]ibid "A single operator provides the cable network, transport and broadcast programming services to the subscriber although the supplier generally constructs a multi-channel package of TV programming material from many competing sources."

[25]National Cable Television Association: A Cable Television Primer: Chapter 1 Cable TV:Coming of Age What is Cable Television. pg 11 - 14

[26]ibid

[27]Datapro Management of International Telecommunications: Fiber Optic Cabling, pg. MIT20-600-402; "Fiber component sales have increased with cable growth. North American component volume projections estimates by industry market segment illustrate the market's shift; Telecommunications (year 1991) 67% - (year 2000) 34% ; CATV (year 1991) 5% - (year 2000) 6%."

[28]ibid

[29]BellSouth Corporation and BellSouth Telecommunications, Inc. Comments In the matter of Telephone Company -Cable Television Cross Ownership Rules Section 63.54 63.58, February 3, 1992; pg.30 "BellSouth concurs in the core objectives which the Commission tentatively concludes should guide the implementation of its video dialtone policy. In particular: (1) that access to video dialtone for video program and other service providers should be on a non discriminatory basis to encourage competition and to promote diversity; (2) that video dialtone should be easy for the average person to use in accessing a plethora of video

[illegible] that the video dialtone regulatory framework should be sufficiently flexible to [illegible] new technological developments [illegible] pg. 4

[30] [illegible] Comments In the Matter of Telephone Company Cable Television Cross-Ownership Rules, Sections 63.54-63.58 [illegible]

[31]National Association of [illegible] (NAB) Comments In the Matter of Telephone Company-Cable Television Cross-Ownership Rules Sections 63.54-63.58

[32]"National Telecommunications and Information [illegible] U.S. Department of Commerce Comments In the Matter of Telephone Company-Cable Television Cross-Ownership Rules Sections 63.54 63.58 pg.5 "Implementation of video dialtone would create opportunities for new entry in the provision of video programming to the home. In turn, increased competition would produce lower rates, better service, and a wider range of programming choices for consumers. NTIA also agrees with the Commission that LEC construction of the transmission facilities used to provide video programming services would directly contribute to the development of a nationwide, advanced telecommunications infrastructure, which is increasingly important to the performance of the U.S. economy and to the well-being of all Americans."

[33]Elton, Martin C.J., Editor Integrated Broadband Networks: The Public Issues

[34]Donzal, Teresa J.Kernan, Jerome B. Television's New Technology: Hardware Plus Software Equal Segmentation Research, Journal of Consumer Marketing v2n3, Summer 1985

[35]Integrated Services Digital Network, ISDN provides a user network interface specification for Basic Rate Interfaces, BRI, which are configured as 2 B + 1 D channels and for Primary Rate Interface, PRI, which are configured as 23 B + 1 D channels. Broadband application usages such as video dial tone would require PRI capable bandwidth which provide end-to-end services at certain multiples of 64 kbps up to 1.544 Mbps. A customer may have multiple interfaces. The full information bearing capacity of an interface need not be provisioned. The facility is organized into 24 time slots of 64 kbps each. A customer or video dialtone subscriber can use only 13 time slots for calls plus the necessary time slot for out-of-band signaling or could share the 1.544 Mbps facility with inband-signaled private line channels.

[36]Fost, Dan Newspapers Enter the Age of Information; American Demographics v12n9, Sep 1990

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TELECOMMUNICATIONS
AND
COMPUTER INDUSTRIES
COLLABORATION

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Abstract:

The relationship between the telecommunications and computer industries has changed dramatically over the past ten years. The needs of the two industries are converging with increasing dependencies on one another. In recognition of the importance of the two industries working the most effectively together, we propose a model for their collaboration.

Introduction

The telecommunications industry has changed dramatically, especially in the last ten years. In addition to regulatory changes, the technology has also changed rapidly forcing more collaboration with vendors and competitors. The computer industry is one of the telecommunications vendors where the relationship is changing daily.

In parallel, the computer industry finds itself in a very different relationship with its customers. Those that were customers are now competitors, partners, or vendors. Especially with telecommunications, the boundaries between the two industries are blurred and are in constant motion, requiring redefinitions.

This paper briefly describes the history of the relationship of the two industries, the current needs of the telecommunications industry, and what collaborations are occurring. Noting how the two industries are changing to achieve technology and services convergence to meet market demands, it then recommends a model for the most effective collaboration between the two industries, recognizing that collaboration will probably be different with telecommunications service providers and telecommunications equipment manufacturers.

Much of the data presented here is from the Customer Collaboration Program that Digital's Telecommunications Business Group sponsors. This program focuses on Digital understanding its telecommunications customers better to lead to more effective collaborative efforts with them. It is conducted with Digital's sales organizations. Executives in the telecommunications companies are interviewed and the data is evaluated within Digital and with the customer. To date, the program has been implemented in Japan, Australia, Canada, United States, Sweden, and France.

This paper also reflects the experience of Sheppard Moscow Consultants in organizational development in their work on collaborative multinationals around the world.

1. Brief history of the two industries' relationship

Both the telecommunications and computer industries have undergone significant changes in the last ten years due to competition and rapid technological changes. For the telecommunications carriers, many of the countries have or are moving from state owned or monopolies operated under strict government control to an unregulated environment. Privatization has pushed the acceleration of change to a necessity.

With deregulation for the telecommunications service providers and the break up of the market monopolies of the telecommunications equipment manufacturers, the competition is now a significant factor. Start-up service providers entering the market are challenging the inflated cost structures of the mega-telecommunications corporations. New wireline operators are going after the most profitable segments of the market. Both wireline and wireless operators are "cream skimming" the Fortune 100 and high usage residential customer, leaving the high cost business to semiregulated entities.

Start-up entities are able to leap frog the antiquated networks and organizations developed by government owned telecommunications companies with cutting edge computer technology.

In Europe, two service providers, Televerket (Sweden) and the Dutch PTT, have formed a new company, Unisource, to protect their installed base and to protect their global multinational customers, like Philips.

For the telecommunications equipment manufacturers, new entrants into the market are providing more dedicated cost effective solutions, for example, Network Systems.

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With AT&T's World Direct Service from country to country, the local PTT's in Europe are bypassed and are losing a significant part of their international calls.

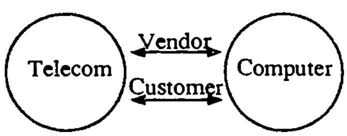
Wireless services are growing by leaps and bounds and are being developed and formed in all parts of the world. Even with a small population like Sweden's of eight and a half million, there are three wireless operators: Televerket Radio, Comvik, and Nordic Tele.

In the computer industry, the rapid changes in technology and consumer needs have driven the large companies like IBM, HP and Digital to drastically change their focus from products to services and business solutions for specific customers. The smaller computer companies with more flexibility to respond to customers have grown to be formidable forces in certain markets such as telecommunications.

Computer companies have had years of extremely rapid growth and controlling the market in certain areas. Now their products are more and more a commodity and what they offer their customers is changing dramatically.

Competition looks very different than ten years ago.

To illustrate, each industry was an entity selling its services and products with very little needs overlapping between the two.

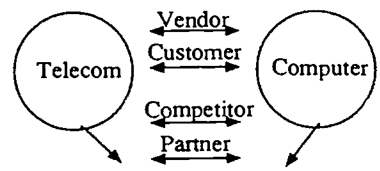


As the technologies change and each industry's customers demand both lower cost services and products and better solutions to their business problems, the two industries are viewing each other differently. They are finding the customer/vendor relationship is limited and no longer meets their business requirements.

Digital as a customer of telecommunications has developed the capability internally to rival telecommunications' services. The company no longer needs telecommunications as a service provider in the same ways.

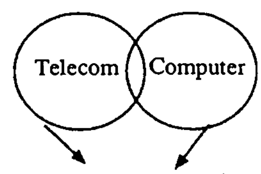
Telecommunications as a customer of Digital once bought its hardware products for specific uses. Telecommunications now requires more complex solutions in the area of both hardware and software and finds that Digital may be a competitor with some its customers.

The relationship now takes on much more complexity.



Selling to same customer

The technology, common needs, and common customers are driving more convergence between the two. Telecommunications finds that it needs the computer industry to develop, produce, and distribute its services and products to a broader market. The computer industry is learning that the convergence of its technology with telecommunications brings a similar value added in opening up new markets.



Whose Customer?
Both Industries

Collaboration is not only a strategy endorsed by each, but a necessity because they are both so dependent on one another.

The telecommunications industry exists by delivering customer service and maintaining customer information data base files. The computer industry, in turn, provides the capabilities to deliver the services, maintain the network and sort and apply the customer-data base files. Without computer intelligence, the telecommunications industry cannot maintain a competitive edge, and quickly bring to market value added services.

The delivery mechanism deployed by MCI for "Friends and Family Service" has been a critical strategy to increase market share. Deployment of this service was realized from inception to deliverance in three months. Without intelligent network computerization this would not have been possible.

The telecommunications industry is redefining its needs and finding that competitors, vendors, partners, alliances, and joint ventures are all necessary to compete in today's market.

2. Telecommunications industry needs and current collaborations

Telecommunications companies are saying they need a wide range of support in their growth opportunities. In addition, they have specific expectations from their computer vendors or partners. The data below is a summary of telecommunications needs and expectations from interviews with customers of Digital Equipment Corporation in Japan, Korea, Australia, Canada, United States, Sweden, and France. This data was collected as part of Digital's Customer Collaboration Program.

Telecommunications companies are focusing on the following business priorities:

1. New revenue development - hope to gain from global expansion and new markets
2. Improvement of infrastructure of networks
3. Improvement of employee morale, capability and motivation
4. Sizable cost reduction
5. Financial performance
6. Customer needs

These companies are also focusing on what will make them more successful.

1. Market and customer focus vs. product orientation:
   . Presently people are technically oriented which requires major "reskilling" of the workforce
   . "We should go to 'paradigm college' with all our suppliers and customers."
   . Reorganizing and re-engineering whole corporate capabilities and internal systems
   . Maturing industry moving towards a commodity market

2. Need to shift internal systems:
The message is "help us align ourselves to be global and customer responsive. This is the biggest barrier to reaching our strategic goals, and is as important as our products and services to our customers." This focus is supported by large current and future budget commitments.

3. The focus has expanded to succeeding globally:
   . help us sell to global markets
   . help us in countries you know and we don't
   . need 'open systems' products
   . new markets are key to strategic success

4. Slimming of supplier base from hundreds to 3-5:
There is a shift in purchasing from all over the company to centralized "strategic" purchasing. The change is in business partner vs. vendor role. These business partners must:
   . understand our needs and deliver to them.
   . focus on our performance, not just what you can sell us.
   . vendor to business partner - The way you deal with us is as important as what you sell.
   . bring us business thinkers, not sales people.
   . partnerships/alliances forming around service capabilities and enhancements. Bring us ideas for new services, not products.
   . promote and maintain honest, open and dedicated relationships
   . you must know telecommunications and share your expertise with us
   . bring economic value to our customers
   . must be "open systems"
   . support broad range of products and services on worldwide scale.

5. Financial stability of potential partners and solutions providers is critical.

The above statements clearly suggest that telecommunications' expectations and needs of computer companies have vastly changed. To shift from vendor to business partner requires a very different way for the computer companies to relate and work with telecommunications. The shift is to move from selling "boxes" to bringing value to the telecommunications business in technology, services, and markets.

For examples of current collaborative endeavors in telecommunications, some of the 1992 literature was surveyed. These endeavors are with vendors, customers, and former and present competitors from the computer industry and other industries. The sheer number is impressive. In one search, over seventy articles were found about specific collaborative ventures. The overriding purpose for the telecommunications companies in each venture is combining technologies to offer wider services in a broader market to be more competitive.

These are some examples:

Network integration: US West Inc. of Englewood, CO, is finally getting serious about being a network integrator.... US West's Advanced Communications Services group has signed contracts to sell hardware from Cisco Systems Inc., Advanced Computer Communications Inc. and plans to sign a contract with Teleglobe Communications. US West will sell itself as a one-stop shop for integrating local area networks (LANs). (Computer Reseller News, Aug. 10, 1992 486)

Competitive edge: "More and more, businesses are using technology to give them a competitive edge," said Curtis Weeks, PBX markets vice president for AT&T's Business Communications Systems group. "Applications that link telephone systems and computers help companies improve customer service, increase agents' productivity and hold down operating costs."

"HP and AT&T are working closely together to give companies the ability to provide the high-quality customer-service that is crucial to the success of their business," said William P. Roelandts, vice president and general manager of HP's Networked Systems Group. "Companies want their phone conversations with their customers to be pleasant, productive, and efficient -- HP and AT&T are offering an integrated solution to allow them to do this."

AT&T also has agreements with other major computer vendors, including IBM, Digital Equipment Corp., Stratus Computer, and Tandem Computers. These companies market systems that support AT&T's ASAI standard to link their computers with AT&T's telephone systems. (EDGE on & about AT&T, July 6, 1992 v7 n206 p22)

Collaboration agreement: Northern Telecom de Espana S.A. and Telefonica de Espana S.A. last week signed a collaborative agreement to establish a business relationship in data networking.

...Telefonica, Spain's national telecommunications carrier, will distribute Northern Telecom's advanced data networking technology, including its DPN-100 product family. The agreement underscores Northern Telecom's commitment to the growing market for advanced data network systems in Spain. (EDGE on & about AT&T, June 8,1992 v7 n202 p4)

Strategic alliance: Dow Jones & Co. Inc. and BellSouth Corp. have jointly developed a new interactive advertising service. The Reader Service Line is the second service announced by Dow Jones and BellSouth as part of their recently formed strategic alliance to jointly explore and develop new business opportunitiesin the information services market. (EDGE on & about AT&T, May 18, 1992 v7 n199 p3)

Agreements: DEC is expected to disclose agreements with RAM Mobile Data and BellSouth Enterprises Inc. to offer users wireless electronic-mail services as well as plans to develop E-mail software for portable computers that will let users exchange messages over a wireless, radio-based packet network. (Network World, May 18, 1992 v9 n20 p8)

Merger: The 1991 merger between AT&T and NCR requires that executives from each company make an effort to understand the corporate cultures involved and to cooperate amidst differing philosophies and policies. AT&T and NCR have combined computer revenues of an estimated $9 billion, and now represent the fifth-largest computer manufacturer in the US. (Business Week, Jan. 20, 1992 n3248 p63)

Successful collaborations philosophy: Corning Inc. has evolved into a creative, flexible organization that knows how to make sure it gets its creations to market -- and quickly. Roger Ackermann, president and chief operating officer, was interviewed in Enterprise (1992 October, pp 10-14)

Telecommunications is one of Corning's four major markets.

Ackermann says that joint ventures for him denote some form of joint-equity ownership, not just in a legal sense. "What's unique about us is that we believe that in a 50-50 venture one party can't control or dominate the other. Rather, we expect it to be between equal parties."

Thirty percent of Corning's equity ventures fail. "It's usually because of mismatched goals."The technology must be commercially viable. "If the technology isn't very good, the business fails whether it's a joint venture or not."

In these alliances, "you just need to stick to the fundamentals -- you bring something to the party that is valuable to the other person, who brings something that is valuable to you. But you have to do your homework and pick your partners carefully."

"For a joint venture to work, both partners must have a differential advantage that they are bringing to the table. You take it and leverage it all of the way to the marketplace as quickly as possible, before somebody else gets there with the same thing. You have to get to the market faster and faster, the way the world is going now, so in a sense, it's a race."

In summary, telecommunications companies are actively seeking collaboration as a critical means of adding value to their customers. In the current exploding marketplace, the real competitive advantage is time; getting technology and new products to the market place first. Organizations in the industry know they cannot consistently do this alone.

Yet the success rate of joint ventures and other forms of collaboration is low. Precious time and huge sums of money have been lost in ventures that have produced nothing.

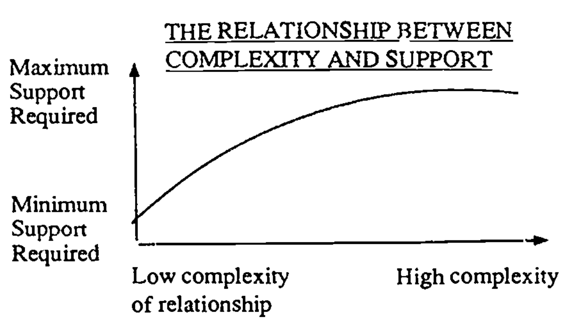
Our findings suggest a framework from which the telecommunications and computer industries can view collaborative efforts, and apply criteria and support factors that make the difference between success and failure.

3. Conclusions from the study

In reviewing Digital's experience, and the experience of its telecommunications customers as they search for collaborative relationships, a number of key points emerge.

To be productive, collaborative formations need to be appropriate to the outcome desired. For example, if joint product creation is what two organizations want to form together, it is a mistake to dump two sets of design engineers in a room and close the door. The teams requite "stage setting", and upfront support to work well. In general, we find that expectations of partners entering negotiations is high, but support (senior management buy-in, time, resources) is relatively less experienced. Management sees collaboration efforts happening with great frequency and makes the assumptions that it is quite easy. In fact, the success rates for collaborative efforts is quite low; 1:4 or less.

The graph below demonstrates the relationship between the two most critical elements to be considered when assessing how to approach joint partnering: the complexity of the relationship, and the level of support required. We will then discuss each element in terms of a continuum, offering examples of differing approaches that produce successful outcomes.



4. Barriers to collaboration -- understanding what they are, and breaking them down.

Our findings suggest that organizations have researched the many different types of collaborative arrangements available to them, and through their own experience understand the value and problems inherent in "jointness." What they consistently underestimate is the type and amount of support required for successful outcomes. There are several reasons for this, all of which are firmly embedded in the fiber of most organizations.

1. Organizations each develop a way of working internally that requires adaptation if any form of partnering is to be effective.

2. Alliances require the ability to tap into multifaceted corporate resources which are typically organized vertically in a "stove pipe" fashion. Establishing horizontal capabilities for decision making and input is difficult at best.

3. Remote geographies are often barriers rather than conduits to communication, common goals and metrics. Yet, opportunities for alliances often appear first in geographies.

4. Organizational metrics often do not a support system-wide focus that would allow alliances to form.

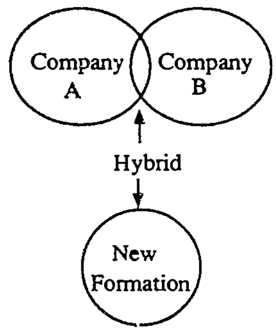
5. Strategic plans are understood and valued by only those who created them, making them difficult to both articulate and to act upon.

6. Organizations struggle to deliver one clear, consistent message from multilevels of the company, causing confusion and mistrust in those inside and outside the organization.

The formation of joint working relationships between companies requires an organization to tackle its own weaknesses internally. Those who are the greatest champions for alliance development are often corporate entrepreneurs who may not have the necessary clout to drive internal changes. Joint efforts can thus easily be killed off at the very start.

Our findings among Digital's telecommunications customers, as well as the extensive activity in alliance development among Sheppard Moscow's clients, suggest two umbrella strategies for successful partnership formations that help to overcome the inherent dilemmas listed above.

1. New ventures need to create a "hybrid culture" at the point of convergence that sets them apart from the day to day operations of both parent companies.



This creates a seedbed environment releasing the new formation from the encumbrances of the parents' organizational problems, and helps to remove barriers that will disable the effort. It also creates flexibility and mobility impossible in the old structures.

2. The new formation needs to be placed above operating or functional division control, into the arena where the "highest common benefit" for the corporation can be realized. Corning Inc., a company with high success in developing joint ventures, has created a Corporate Alliance Program Office, directly attached to the president. This arrangement helps ensure cross-organizational commitment and follow through, alignment of joint ventures with the organization's business strategy, and quick decision making. It also avoids wasted or duplicated efforts and resources.

With the above capabilities in place, we can now take a closer look at the elements of complexity and support in evaluating how to approach various forms of collaboration.

5. A Collaborative Approach Model

Complexity of Relationships: The Alliance Continuum. Organizations engaged in partnership activity recognize the hierarchics or continuum nature of these relationships. Some companies offer guidelines to vendors as to what is expected of them at different points along the continuum. Though each company approaches this a bit differently, the graph below shows the basic collaborative formations, moving from simple to complex.

The Alliance Continuum

Levels of Complexity

High Complexity -- (High gain, high risk)

Convergence Organizations	Temporary or permanent multi-organizational formations
Partner/Joint Venture	Equity participation Joint Development
Contractual Alliances	OEM Supplier Joint Selling Licensing
Associations and Consortia	Standard Setting SOE
Memoranda of Understanding	Marketing Alliances
Information Alliance	Selling agreements Channel Development
Preferred Vendor	Selected small group of highly trusted vendors

Low Complexity -- (Low risk, small gain)

Scanning the continuum, several things are evident: The majority of joint work is in the low complexity , low risk category. The further corporations travel up the continuum, the more demand there is to step out of conventional thinking and practice. The top of the continuum is unachievable without some form of creative technological and relationship leap.

The continuum represents different types of collaboration formations that telecommunications and computers companies currently engage in.

1. They begin with simple but meaningful relationships of preferred vendor status. This represents the industry shift mentioned by telecommunications customers earlier regarding their intent to reduce key vendors to 3-5. The relationship developed at this level sets the stage for more complex collaboration and companies often turn to key vendors (and vice versa) as potential partners. This collaboration represents small risk on every-

one's part, and roles and expectations are usually explicit.

2. Informal alliances are often developed as a means of testing more formal relationships. They involve agreements to serve markets jointly, "shadow" or consult during bidding processes, share information on distribution channels, etc.

3. Memoranda of under-standing are used to solidify informal agreements, but also begin to imply commitment to a specific relationship and outcome.

4. Consortia and Associations have increased in importance as a means of "leveling the field" for standards, operating platforms, and other components of the Standard Operating Environment. Corporations interact and integrate with others in an increasingly sophisticated manner, and work hard to influence SOE's in their favor. These associations are also used to build relationships between organizations that can turn into more formal collaborations.

5. Contract alliances, long familiar to companies in the form of OEM's and licensing arrangements, now are becoming springboards for even more complex relationships. Alliances are high in risk and gain for everyone. They require a lot of attention and forethought, and those that work well and worth their weight in gold.

6. Partnerships and Joint Ventures involving equity participation and joint developments are where some of the greatest gains in collaboration are taking place. Companies work hard to select partners, usually from the pool of relationships already in place on this continuum. Risk and potential gain are very high, and for the ventures pursuing creative technological outcomes, a significant "leap" must occur that allows the partners to think, act, and deliver as one unit.

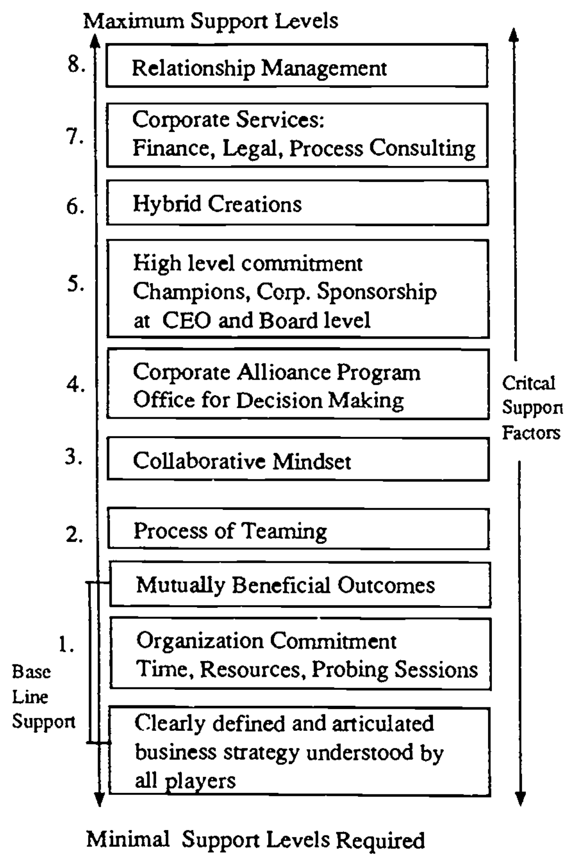
7. Convergent Organizations, defined as temporary or permanent multi-organizational formations, are being created to a) serve market needs unmet by any one company or b) create new products and technologies requiring convergence of one or more industries. These relationships because of multiplicity cross-cultural nature, wide geographical global span, and technological convergence present a challenge unknown to virtually all organizations. Yet, the pay-off for the industry and society at large has fantastic potential. These organizations require a massive leap of technological and relationship faith; as it is impossible to say at the start what might emerge. They are created for both specific outcomes and unknown advancements in technology that solve heretofore unsolved problems.

We found that while all organizations in this study understood the necessity and critical nature of providing support for partnerships, few were successful in pulling together and maintaining support structure long enough to achieve desired outcomes.

Unlike the continuum of complexity, where organizations can enter agreement along the continuum with no previous relationship, support must be perceived as additive.

As complexity of relationships increase, ever increasing and expanding support is required. If at any time support is diminished or perceived to be withdrawn, the joint effort will be at risk. So for example, while dedicated and consistent staff are required to form contractual alliances, they become critical for joint development.

In viewing the Support Required Graph that follows, it is important to keep in mind that the higher the level of support required, the higher the number and frequency of critical support factors needed to ensure a successful outcome.



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Support Levels: The Basics Clearly defined business strategies, organizational commitment and mutual outcomes are three factors which are critical to all collaborative formations. Without these at appropriate levels, all attempts at collaboration seem to flounder, search for meaning, and ultimately fizzle

1. Each player must have a clear understanding of how their activities adds value to their own organizations business goals, and what the other player (s) goals and needs are. This requires time, interest, and a lot of shared understanding of what each other needs to make collaboration worthwhile. In addition, parties must have some level of commitment from their organizations to evidence interest such as time, resources and meetings that permit 'probing' of needs, expectations and desired outcomes. The third 'basic' is for parties to have an idea or concrete expectation of mutual benefit. If one party benefits and the other does not, no further collaboration is likely to happen.

2. As parties join to probe and investigate areas for collaboration, they need to ensure that sufficient time is provided, the right players are present, and the most important matters are discussed. This process needs to reflect a climate of genuine interest and openness, mindful of the fact that both parties come from different environments, and are usually regarded for different things. The amount of process focus ranges from minimal to highly structured, depending on the complexity involved.

3. As opposed to negotiation or "deal-making" collaboration requires a mindset that genuinely values and believes in what the other parties offer. A "not invented" culture can dampen and fizzle efforts and players are not likely to try again.

4. Corporate Alliance Program Offices which are run from CEO or board level provide an excellent screening and commitment mechanism to block unwanted or duplicated efforts and to ensure the nurturing and internal cross-functional commitments necessary for success.

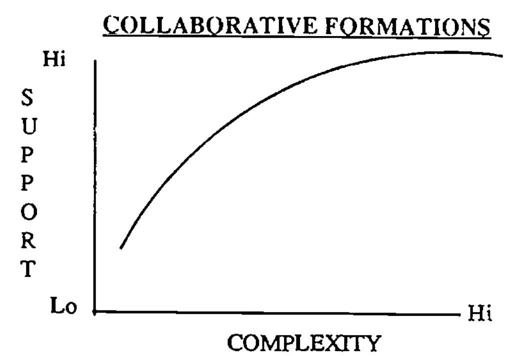
5. High-level commitments are required for any joint effort to reach an investment or equity stage, and champions who personally believe in the efficacy of a venture will greatly increase the success rate. Dedicated teams become increasingly important as complexity increases.

6. We discussed earlier the necessity and value of creating a "hybrid" formation to separate the new ventures from the encumbrances of the old. These can take many shapes - separate offices mutual co-locations, joint metrics, public goals and measurements, etc. The "hybrid" can be simple or complex, matching the need of the collaboration.

7. Corning Inc. provides only three services to their new ventures; finance, legal and process consulting. these services should be provided out of a high level Alliance Program Office, and be sufficient to launch and maintain new ventures.

8. Relationship Management is what replaces structure, hierarchy, rules and regulations in collaborative complex relationships. It ensures a stable and mutually beneficial relationship that can respond flexibly to changing goals, market requirements and technology. It is what remains after one venture has succeeded in its goals, allowing many more to follow. It is also what enables the creative techno-leaps to take place, necessary to convergent organizations and creative joint ventures.

Final Summary



Support is adapted modified and increased as relationships become more or less complex. It is offered consistently over time, not once and then withdrawn. It is negotiated among players, management and stakeholders on an ongoing basis and must be seen as an essential cost of investment, not a remedial resource.

Corning and numerous other companies have raised collaborative success rates dramatically by keeping the afore mentioned support structures in place. In the convergence of multiple industries trying to add value to worldwide telecommunications networks and services, the payoff of success is enormous for us all.

Converging Telecommunications Technologies: Challenges Facing Government and Regulators in Australia and New Zealand

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1. ABSTRACT

Converging technologies in telecommunications, computing and broadcasting are creating challenges as well as opportunities for governments and regulatory agencies. This paper reviews different meanings of the term 'convergence' and considers the relevance of these meanings to policy and regulatory issues. From this perspective, policy developments as they relate to 'convergence' in Australia and New Zealand are discussed. Comment is made on various issues arising from the different regulatory approaches adopted in the two countries.

2. CONVERGENCE AND POLITICS IN THE INFORMATION INDUSTRY

2.1 Convergence

Technological change, historically, has been attributed to play an enabling role in the shaping of new political, economic and social relationships. This enabling role is most evident today in '[the] broadly defined information industry whose primary sectors - telecommunications, computing, broadcasting and publishing - are becoming more integrated at the level of technology but more competitive at the market level'(1).

The information industry is at the leading-edge of international competition with revenues in world telecommunications services alone estimated to be as high as US $1200 billion by 2005 (2). Information and communication technologies are now well established as being central to economic competitiveness and industrial restructuring (3).

The magnitude and importance of the transformation in the global information industry has meant that the interpretation of these changes becomes very difficult. One concept which has been around for many years is that of 'convergence', which is often interpreted to reflect the central, if not deterministic, role played by technology in industrial restructuring. However, no one definition of 'convergence' exists despite many attempts to label the concept in particular ways or give it particular attributes. It would seem as though the term has a function not too dissimilar from 'high technology', a popular term in political debate throughout the 1980s. Macdonald's observation that 'high technology would lose most of its political importance if it ever were neatly labelled and ...rly differentiated from other economic activity' applies also to 'convergence'(4). This point becomes clear if some examples of definitions of 'convergence' are considered.

A recent Organisation for Economic Cooperation and Development (OECD) discussion paper notes that 'convergence, as a general concept, may be defined as the technical process whereby technologies or production functions that are a priori separate begin to merge...Whereas the marriage between telecommunications and computer technology now seems to have been consummated, the convergence between telecommunications and broadcasting is still in the planning stage'(5). It is argued that evidence of this transition is the emergence of hybrid services (which may be supplied either through broadcasting or telecommunications networks), services which use a mixture of broadcasting and telecommunications (e.g. mobile phone communications) and progress in infrastructure development (e.g. interactive services and data transmission on telecommunications networks). The technologies of digitisation, fibre optics and mobile communications are seen as enabling these changes to come about. The focus in this case is on new technology bringing about the historical evolution of the information industry culminating in a convergence between broadcasting and telecommunications.

In contrast to the above, another OECD discussion paper has identified three levels at which convergence of different sectors of the information industry can be understood: networks, service provision and corporate organisation (6). At the network level, convergence is seen to imply the sharing of resources such as switches, the competition for finite resources such as frequency spectrum and geo-stationary orbits, and the integration of networks as well as network providers. At the service provision level, convergence is used to describe hybrid services such as datacasting or video-conferencing as well as the use of existing services in new ways (e.g. junk fax and audiotex). Finally, corporate organisation can refer to the cross-ownership of services and facilities in broadcasting and telecommunications by the one company or the dual manufacture of equipment for both the communications and the consumer electronic industries. This interpretation of 'convergence' is somewhat broader as it emphasises the economic, political and organisational aspects of change.

The definitional uncertainty in 'convergence' is highlighted by other commentators. Free, for example, notes that while convergence is a significant phenomenon, 'less attention has been given to other substantive trends which might be reasonably described as divergence' (7). He points to the increasing multiplicity of options for the delivery of television programs through technologies such as video tapes, direct broadcast satellite (DBS), and multipoint distribution services (MDS) as examples of 'divergence'. Leonard takes a different perspective by emphasising applications and use of technology. He argues that 'although this [the blurring of divisions between telecommunications, broadcasting and radiocommunications] is usually referred to as technological convergence, the process is better described as applications convergence, since it is the use of technologies which is now overlapping...'(8).

No one definition of 'convergence' exists and the term has numerous meanings. While the phenomenon of rapid technological and economic change in the information industry cannot be denied, the potential exists for the term 'convergence' to obscure many of the fundamental issues at stake here. 'High technology' and 'convergence', as political terms, have that potential (9). What then are some of the fundamental political issues associated with 'convergence'?

2.2 Policy and Regulatory Issues Relating to Convergence

The state has a fundamental role in maintaining national security, ensuring that the appropriate conditions are set for capital accumulation, and also maintaining a degree of social order by legitimating its actions. The technological and economic restructuring currently underway in the information industry is forging new relationships between the state and industry. Old institutions, which had evolved to accommodate a particular set of conditions for capital accumulation are now being reformed. New communication and information technologies are providing increasingly more opportunities for the exploitation of information as a commodity and for the successful monitoring and measuring of existing economic activities (10). New technology is also enabling business to reorganise and globalise its activities. A number of significant changes in the information industry can be linked to 'convergence'.

First, the traditional control of a state monopoly Post, Telegraph and Telecommunications (PTT) provider has come under threat since the 1960s as business sought greater economic flexibility in the provision of new services and cost-cutting. The response of the state in many countries has been to liberalise regulations in telecommunications and to privatise the network. Reorganisation was seen as necessary for 'converging' technological opportunities to be exploited and economic growth assured. Since competition was considered to be the best way of encouraging technological innovation, there is now considerable debate on the way that competition is organised and who benefits from it. The entry of broadcasting into the picture represents an extension of areas where economic exploitation of information can be achieved and this is often explained by 'convergence'. The scale and scope of these economic opportunities are often so large that no one firm or government is able to fully exploit them. Globalisation and international alliances are becoming important factors for the state to deal with as it aims to maintain a degree of autonomy. As a result, questions of program diversity and ownership (as well as investment) take on even greater significance. The issue of indigenous industry development is another area of importance to the state. For example, multinational companies without any national loyalties in program production and delivery can undermine the cultural basis for political cohesiveness. The 'convergence' of company ownership in broadcasting and telecommunications can threaten the viability of national systems of innovation.

Second, the growth of information as a central resource in the economy also creates various social and wealth distribution problems. For example, the ownership of intellectual property takes on a special significance as information is turned into a commodity. The state has to legislate in the area of intellectual property to an ever asing extent to protect the rights of investors. The distribution and control of information is another area where state regulation is required, specifically in privacy. In an environment where competition is seen as the best way of organising markets, the prospect of information rich and information poor consumers becomes a reality. Debates about the value of a publicly-owned broadcasting service are now becoming more pronounced in many countries (11). The social costs of massive change to telecommunications networks are also acknowledged by governments through regulation aimed at social and economic conditions (e.g. the provision of universal telephone service).

One of the fundamental issues facing the state in the current environment of change is the organisation and legitimation of who benefits from technological change. In the information industry, this translates into policies and regulations which determine who can do what by means of what infrastructure. Regulation has to deal with legitimation as well as the allocation of scarce resources and how competition for these resources are organised (12).

From the above perspective on definitions and politics, 'convergence' is therefore closely connected with debates on the way markets, competition and regulations are organised in the information industry (13). This paper aims to explore some of the regulatory and political issues facing governments and regulators in Australia and New Zealand as they try to deal with 'convergence'. The focus will be on the telecommunications (including radiocommunications) and broadcasting sectors where most attention is currently focussed. However, it should be emphasised that change is also now actively underway in publishing, which also involves advertising. The 'convergence' between computing and telecommunications has been taking place for some time now.

3. AUSTRALIA

3.1 Recent Policy Changes in Australia

Changes made to Australian Government policies in telecommunications, broadcasting and radiocommunications have reflected a trend towards liberalisation and competition. The approach in all three areas has been 'to look to regulatory instruments that are, as far as possible: technologically neutral; which allow and indeed facilitate commercially viable innovation; and which do not require an intrusive role by government' (14). The major acts of parliament affecting communications policy are the *Telecommunications Act* 1991 which regulates telecommunications networks operated by the carriers and services supplied over those networks; the *Broadcasting Services Act* 1992 which regulates the supply of radio or television programs and the *Radiocommunications Act* 1983 which regulates the use of the radio frequency spectrum. New radiocommunications legislation was introduced into the Australian parliament as recently as November 1992 (15). The Government has recently signalled its intention to set up a Spectrum Management Agency (SMA) to manage the sale of parts of the radiocommunications spectrum (16).

In telecommunications limited competition was introduced into certain parts of the market in 1988 and an industry regulator, the Australian Telecommunications Authority (AUSTEL) was established. Under the *Telecommunications Act* 1991, further changes were made to industry structure and network competition in the form of a duopoly. The publicly-owned Australian and Overseas Telecommunications Corporation (AOTC), the monopoly provider of basic services until 1991, now competes with Optus Communications (partly owned by BellSouth and Cable and Wireless). Optus purchased the debt-laden AUSSAT satellite from the Government in 1991.

In broadcasting, the *Broadcasting Services Act* 1992 came into force in October 1992. The focus here is on a 'technologically neutral' definition of broadcasting service where a range of specified services can be delivered by a variety of means. The degree of regulation for the six broadcasting services in the Act depends on the 'degree of influence' the services have in the community. The six broadcasting services listed in the Act are: national broadcasting services; commercial broadcasting services; community broadcasting services; subscription broadcasting services; subscription narrowcasting services; and open narrowcasting services. The newly-created Australian Broadcasting Authority (ABA) monitors the licence conditions of broadcasting service suppliers, a content related matter (17). As part of broadcasting reform, the Government legislated for the introduction of Pay TV in October 1992. Specific provision has been made for three Optus satellite-based licences for Pay TV using digital compression technology.

In radiocommunications, new legislation has only recently been introduced into parliament. The Government's aim is to introduce a market-based system of spectrum management into selected areas of the spectrum and establish a specialist spectrum management agency. The *Radiocommunications Act* and the *Telecommunications Act* are concerned with regulating the carriage of broadcasting services.

All the major Acts affecting communications are administered by the Department of Transport and Communications (DOTAC) with relevant powers vested in the Minister for Transport and Communications. The Department of Industry, Technology and Commerce (DITAC) has responsibility for monitoring industry development aspects of telecommunications.

3.2 Issues Facing Government in Australia

The rapid introduction of change to Australia's communication policies has inevitably meant that implementation has taken precedence over long-term issues. There have been numerous government reports on communications but 'there are no official statements suggesting that fostering the convergence of telecommunications and broadcasting is an explicit goal of government communications policy' (18). What reports have been undertaken could not really be described as comprehensive technology assessment studies. From recent debate in Australia, a number of long-term issues can be identified.

First, the implementation of communications policy appears to be taking place without sufficient attention to the changing role of information in the Australian economy or to information policy development. A recent parliamentary report noted that long-term information issues and policy, which includes telecommunications and media, are not on the Government's or bureaucracy's national agenda. The Australian situation is characterised by a lack of coordination, fragmentation and comprehension of issues relating to information policy (19). The report points out that 'policies seem to be developed on the run, in response to a crisis. No broad communications or information philosophy has been worked out' (20). Progress towards a national information policy or strategy may be slow but if Australia is to follow the lead of other countries, this area could well take a higher profile on the political agenda in the future (21).

Second, the emphasis given to competition and the market-based approach in government policy could well come under closer scrutiny in the future. The assumption that increased competition in the communications sector will lead to improved economic performance is by no means certain (22). Some major issues still need to be resolved. For example, Australia may not be able to compete in all international markets with the same services as those offered by other developed countries. In addition, the simple restructuring of domestic communications markets may not be enough to contribute to innovation and industry development. National systems of innovation have to be considered and the linkages between particular sectors are important (23). Australian policy does not always recognise this complexity. Australia is moving away from an active role for the state in telecommunications but the likelihood of a single, unified national broadband network could raise planning issues in the future (24). In the same way, redefinitions of the concept of universal service could hinder the diffusion of new technologies to the home and hence retard the demand for information.

3.3 Issues Facing Regulatory Bodies in Australia

Apart form the broad issues raised above, there are many of a more specific nature facing the major regulatory agencies, in particular AUSTEL and the ABA.

First, despite the recent legislative reforms, there is increasing pressure for radical change to the whole system. For example, Free argues that an 'all-embracing Communications Act is the only way to readily provide sensible regulation for existing and future services as they evolve' (25). The Evatt Foundation has called for the establishment of an Australian Broadcasting and Telecommunications Authority which would have the power to deal with the overlap between telecommunications and broadcasting (26). There has also been discussion of a US-style Federal Communications Commission (FCC) as a possible regulatory framework for Australia (27). However, the Minister for Transport and Communications and DOTAC essentially have his role now (28). There seems every likelihood that the present regulatory structures are far from settled and still in a process of active change.

Second, numerous regulatory gaps between the *Telecommunications Act* and the *Broadcasting Services Act* will require ongoing attention and will certainly provide considerable opportunities for the legal profession. Apart from the obvious problem of defining a service under the *Broadcasting Services Act*, the consequences of a service falling outside the Act will mean that the content remains essentially unregulated. The Telecommunications Act does not regulate content. As higher-level telecommunications services will increasingly involve greater levels of information and entertainment services, the issue of content regulation of telecommunications services could become a problem (29). There has already been considerable community concern about offensive material on the '0055' service in Australia which is a non-broadcasting telecommunications service (30). Another issue which cuts across telecommunications and broadcasting is the prospect of telecommunications carriers becoming integrated into the supply of video services (31). Access to a carrier's network could well become an area of anti-competitive activity and this would require legislation. AOTC is already involved in supplying video and news services to hotels in Sydney through its *LaserCast* service (32).

The introduction of Pay TV into Australia will also bring regulatory problems. Despite a 'technologically-neutral' approach in the *Broadcasting Services Act*, an international standard for the mandated digital compression technology may only be resolved by 1995 (33). While Australian content regulations apply to the satellite licences, MDS (multipoint distribution service) licence holders could be in a position to supply pay TV well before 1995. As the MDS service has no content or other forms of program regulation (as opposed to the satellite licences), the traditional distinction between carriage and content is under threat. Pay TV also raises the issue of the involvement of the Australian Broadcasting Corporation as a provider. Involvement in Pay TV is likely to put further stress on the Australian Broadcasting Corporation's financial constraints in carrying out its public broadcast role (34). The above points only touch the surface of the many regulatory gap issues that are likely to arise.

Finally, intellectual property is already seen as a very significant area as technologies converge. Leonard has pointed out that there is a need for more flexible copyright laws to take into account the fact that new technology has multiplied and extended the possible way a creator's copyright may be utilised or exploited (35). For example, Lindsay notes that there is currently no copyright provision for cable television under the *Copyright Act* 1968 (36). The issue of how far copyright protection should be extended and whether it should cover narrowcasting and non-broadcasting telecommunications services will need to be resolved (37).

4. NEW ZEALAND

4.1 Recent Policy Changes in New Zealand

Since 1987, New Zealand has radically changed the way it regulates its communications sector. There has been a consistent emphasis on the market, competition and a withdrawal of government involvement in regulation. Ideological commitment to the free-market has been a major guiding force for change in New Zealand together with increasing national debt as a result of a deteriorating economy. New Zealand 'has shifted the locus of regulation from specific agencies to the Ministry of Commerce, where broadcasting, telecommunications and radiocommunications are not distinguished in policy terms, nor generally from other areas of commercial activity' (38). For example, there are no lines of business restriction within telecommunications or between telecommunications and related activities such as cable television. The *Commerce Act* 1986 is the key legislation and this deals with general competition law in New Zealand. The *Commerce Act* is enforced by an independent statutory authority, the Commerce Commission. Within the Ministry of Commerce, the Communications Division is responsible for policy advice to the Government.

The telecommunications sector has undergone progressive stages of corporatisation, deregulation and privatisation since 1987. In 1987 the Telecom Corporation of New Zealand (Telecom NZ) was established as a State-Owned Enterprise (SOE) following the abolition of the New Zealand Post Office. From December 1987, progressive deregulation of the sector occurred, culminating in the abolition of Telecom NZ's monopoly of the provision of network services in April 1989. In September 1990 Telecom NZ was privatised for NZ $4.25 billion, being sold to a consortium led by Ameritech, Bell Atlantic and the New Zealand companies, Fay Richwhite Holdings Ltd and Freightways Holdings Ltd. In 1991, competition in the provision of network services commenced with the entry of Clear Communications, a consortium comprising Bell Canada International, MCI International, Television New Zealand Ltd, Todd Corporation and New Zealand Rail Ltd. Telecom NZ is rapidly diversifying its information activities with a plan to trial cable television in the Auckland area (39).

The *Broadcasting Act* 1989 introduced substantial deregulation to a previously heavily regulated sector. Competition was introduced into television and a market-based system for the allocation of the radio frequency spectrum was established (40). The old regime of the Broadcasting Tribunal and the Broadcasting Corporation of New Zealand was converted into Radio New Zealand and Television New Zealand (TVNZ). TVNZ is now a State-Owned Enterprise. The emphasis in broadcasting reform has been on self-regulation although some regulatory responsibilities in the standards area reside with the Broadcasting Standards Authority. Foreign-ownership restrictions were removed in broadcasting during 1990.

Reforms to spectrum management have led to competition in the mobile telephone market with Telecom NZ and BellSouth obtaining licences. Also resulting from deregulation was the entry into the market of Sky TV, a pay TV service that came out of the auctioning of UHF frequencies in early 1990 (41). Sky TV's shareholders include Ameritech and Bell Atlantic (major owners of Telecom NZ), TVNZ and Todd Corporation. TVNZ also has a wholly-owned subsidiary Broadcast Communications Ltd (BCL) which has a business role of providing a major interface between broadcasting and the telecommunications industry (42). TVNZ is rapidly positioning and diversifying its activities so that it can become a 'commercially successful electronic telecommunications business' (43).

Since no ownership restrictions exist, there is now considerable cross-ownership in the New Zealand information industry. TVNZ which is still state-owned has a share in Sky TV (a possible alternative telecommunications network), Clear Communications (Telecom NZ's competitor) as well as BCL. Telecom NZ has a share in Sky TV and Sky TV is linked to Clear Communications through TVNZ.

4.2 Issues Facing Government and Regulators in New Zealand

New Zealand is facing a number of issues as a result of its extensive liberalisation program.

First, the retreat of the state from regulatory involvement has inevitably focussed attention on the implementation of competition and away from long-term issues such as information, industry and communications policy. Maharey, Opposition Spokesperson on Communication, has claimed that long-term issues are not being dealt with by the New Zealand Government and there is a need to 'ask how the market can be better organised so as to ensure competition and a rapid movement toward an information society...'(44). As in Australia, this issue is likely to grow in importance.

Second, the social costs of rapid change in New Zealand still has to be counted. For example, Telecom NZ's staff numbers fell from 25,000 in 1987 to 14,500 in 1991 and with tariff rebalancing, residential telephone rentals have increased by 56 per cent since 1987 (45). It is likely that the legitimation of competition in New Zealand will be an ongoing matter for legal and political debate. This may require active intervention by the state in the future.

Third, the complex nature of cross-ownership that has evolved together with continuing national debt problems are likely to put the Government under pressure to privatise TVNZ. A contradiction exists in that through TVNZ, the Government has a share in Sky TV and Clear Communications. The fact that the Government has a share in Clear Communications when it is trying to promote competition in the telecommunications market with Telecom NZ would suggest some inconsistency. However, in selling TVNZ, the Government would not only be selling the national broadcaster but also disposing of an alternative telecommunications network.

Fourth, the deregulated environment places considerable pressure on the Government to provide adequate opportunities for the exploitation of new technologies by the private sector. However, this 'technology push' raises the question of the potential demand for information and information services. A recent consultancy report completed for the Department of the Prime Minister and Cabinet which highlighted the opportunities of 'converging' technologies recommended that funding mechanisms of education in all sectors should be reviewed to ensure that distance and open learning providers are able to gain access to appropriate technology (46). In order to pay for the use of these converging technologies in education the report notes that the 'fee in tertiary education should also be reviewed at the institutional level to ensure that it does not impede the use of cost effective delivery mechanisms' (47). The shifting of the burden of cost onto the consumer (i.e. students) in an already strained economic environment for educational institutions indicates the extent to which technology is being placed well ahead of legitimate social or educational concerns. The Government's decision in June 1992 to establish a World Telecommunications Laboratory with funding of NZ $80,000 to promote commercial initiatives for a broadband public communications network also indicates that demand considerations may be secondary (48). These trends tend to confirm the suggestion that ' big US buyers have stated that the size of our [New Zealand's] market makes us an ideal testing ground for new technologies' (49). While overseas control of the New Zealand economy has a long history, 'converging' technologies provide an increasingly intrusive form of control. This is an issue which is only slowly manifesting itself in New Zealand.

Finally, the lack of an industry specific regulator in New Zealand does not mean that regulatory problems do not exist. In the deregulated environment, Telecom NZ has exercised its market power to take legal action to protect its position. As a result, drawn out legal battles have retarded the introduction of competition in a number of areas, including mobile communications (50). Concern over Telecom NZ's role in competition has resulted in an ongoing dispute between the Commerce Commission and Telecom NZ (51).

5. COMMENTS ON AUSTRALIAN AND NEW ZEALAND EXPERIENCE

Both countries can learn much from their attempts to deal with 'converging' technologies.

A preoccupation with organising for competition in the information industry can focus attention on the implementation of mechanisms to create competition rather that on longer-term planning. In this regard, both countries could benefit from a better understanding of the role of information in their economies and a more serious attitude towards appropriate information policies. 'Convergence' can play a useful role by focussing attention on technology assessment issues but could divert attention if used as a simple justification for liberalisation. A closer scrutiny of the concepts of 'competition' and 'diversity' in communications policy-making is therefore needed.

New Zealand's strategy of liberalisation and privatisation may not be easily transferable to countries with more complex governmental and industry structures. For example, the sale of the radio frequency spectrum in New Zealand has shown that this can be done but the social costs have yet to be determined (52). As a result, the approach adopted by Australia to establish a Spectrum Management Agency to manage sale of parts of the spectrum could represent a workable compromise for some countries.

The pace of change in New Zealand has been more rapid than in Australia and it could be argued that New Zealand is now well placed to take advantage of 'converging' technologies. This may be partly true but the complex cross-ownership arrangements which exist in New Zealand and the size of the market can create its own set of problems, especially for maintaining competition. Demand for services based on 'converging' technologies may be easier to establish in a more regulated environment. The market has yet to determine the level of demand for these services (e.g. interactive education) in New Zealand but the social costs of expensive business failures may well fall on the consumer. Direct social costs are already being borne through the rebalancing of telecommunications tariffs and unemployment. The point is that 'convergence' offers opportunities but that does not always translate into economic growth or an equitable distribution of wealth.

The traditional distinction between carriage and content is becoming increasingly difficult to maintain. The range of business activities in which New Zealand's major players are involved is evidence of this. Attempts by Australian legislators to maintain this distinction will come under increasing pressure from industry in the future. A similar comment can be made about 'technologically-neutral' legislation such as the *Broadcasting Services Act* in Australia. It is fine in principle but the reality of the market provides for unpredictable outcomes for policy (e.g. the possible delivery of Pay TV in Australia by MDS).

Finally, the reform process in New Zealand is likely to give added impetus to the reform agenda in Australia. Ownership patterns which have already evolved in New Zealand favour the prospect of international companies using New Zealand as a launching pad into the Australian market (53). The New Zealand and Australia Free Trade Agreement (NAFTA) is another vehicle for fostering change in Australia. Cross-ownership patterns between Australia and New Zealand could well intensify with the further liberalisation of the Australian market and the need for greater market reach to meet the costs of new techi o ogy.

6. CONCLUSION

This paper has looked at the political meaning of 'convergence' and applied that to current policy changes in Australia and New Zealand. Both countries have differences in their regulatory approaches to 'convergence'. The New Zealand experience confirms that a reliance on deregulation and competition does not necessarily solve regulatory and policy problems. The issue of linking technology to economic growth still needs to be resolved.

New Zealand's experience does provide Australia with an insight into emerging patterns within the information industry encouraged by a largely unregulated environment. With a better understanding of these patterns, more informed policy-making may be possible.

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Harnessing Convergence for Development: Industrial Policy and IT Development in Australia

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Abstract

The convergence of computing and communications towards digital technology and the deregulation of telecommunications are affecting a convergence of industry orientation and structures. Australia is set to exploit the current complex and multi-faceted convergence of computing and communications in the pursuit of IT industry development. This paper explores the conditions underlying this process, examines the mechanics and details of its unfolding to date, and assess the likelihood of its success as an industrial development policy.

Introduction

For the purposes of examining the way in which Australia is attempting, more or less consciously, to harness the forces of convergence to further IT industry development this paper will focus on just two aspects of the multi-faceted concept of convergence. Namely, the technological and structural convergence of the computing and communications industries.

For many years telecommunications was dependent on a relatively stable electro-mechanical technology, but recently this has been replaced by a semiconductor technology base that has brought the industry close to the cutting-edge of scientific and technological development. Among the most important aspects of this technological convergence of communications and computing are the commoditisation of hardware and an increasing dependence on software for product and service differentiation and competitive advantage.

The deregulation of telecommunications markets is also bringing profound changes. Not only are carriers facing competition from other carriers and value-added network services suppliers, but the enterprises in the carriers' supplier chain are also facing new competitive forces. There is an opening global market for communications equipment and the software that supports emerging network services. These changes are precipitating a fundamental reformation of industry structure.

While communications carriers were organised as national monopoly PTTs, their suppliers tended to be domestically operating and oriented enterprises. The forces of change are now pushing carriers and their suppliers towards a global restructuring. Communications is evolving towards the transnational type of globalise industry structure that has been characteristic of the computer industry for many years.

To further the development of the information industries it will be essential to keep these aspects of convergence in mind, and to seek to exploit the emerging synergies that result from the technological and structural convergence of computing and communications.

This paper will briefly examine the information industries in Australia in order to identify areas of potential synergy and to set the scene for a review of the IT industrial policy context in which convergence might be exploited.

Australian IT Industry Capability and Performance

The history of the computer hardware industry in Australia could be said to be one of lost opportunity. From an early post World War II technical lead in computing (1) Australia quickly drifted to a dependence on imported hardware. The relative strength that Australia enjoys in computer software and services evolved, in part, out of a demand to customise solutions for the imported hardware base. It is only recently that computer hardware manufacturing, largely Personal Computer (PC) assembly, has (re)emerged in Australia.

The computer software and services industry, in contrast, has developed a relatively high level of expertise and a significant export competitive presence (2). Areas of market strength exist in mining related software, insurance and other services related software and in a wide range of computer services activities. It is the historical strength in customisation that still underpins the industry. Hence the larger indigenous software and services companies in Australia tend to be services suppliers, rather than specialist packaged software suppliers.

In telecommunications the focus of Australian carriers has historically been domestic, although over recent years they have increasingly become involved in export activities. The communications equipment industry in Australia, through the impact of implicit and explicit procurement policies and the exacting demands of Telecom Australia, has developed a significant capability and presence.

The IT industries in Australia are dominated by the major transnationals operating world-wide. Of the Top 20 IT companies (ranked by sales revenue) in Australia in 1991 only 6 were indigenous enterprises. Of these, Telecom (rank 5) is the largest and only communications sector company represented. Exicom (rank 22) is the largest of the indigenous communications equipment companies. Computer Power (rank 7), Paxus (rank 10) and Ferntree (rank equal 12) reflect the relative strength of indigenous software and services enterprises, and Tech Pacific (rank 15), which was formerly Imagineering, and the recently collapsed Hi Soft (rank 19) are the indigenous players in the distribution sector (3).

Table 1.
Australasian IT Top 20 by Sales, 1991 ($Am)

Company	*Sales*
IBM	1460.0
Alcatel	597.0
Digital	482.2
Ericsson	450.0*
Telecom	435.0*
Unisys	331.8
Computer Power	312.0
Siemens	250.6
Fujitsu	250.0
Paxus Corp.	240.4
NCR (Aust)	240.0
Ferntree	220.0*
Hewlett-Packard	220.0*
Apple	208.0*
Tech Pacific	200.0*
Xerox (Aust)	200.0*
Wang	195.0*
Bull HN	190.0*
Hi Soft	180.0
ICL	158.6

* Estimated.

Source: *Today's Computers*, 1992.

The recent economic recession has had a significant impact on the IT industries in Australia. During 1991-92 they experienced a declining market for the first time. The combined sales of the Top 50 IT companies in Australia and New Zealand for 1991 was some 10% down on 1990. Sixty per cent of the fall is attributable to the poor performance of IBM alone (4). The other multinational majors account for the bulk of the remaining decline.

While the multinationals continue to dominate, Australian companies are playing an increasing role. The 13 indigenous companies in the 1991 IT Top 50 increased their share of Top 50 sales revenues by 29%, from $A 1.4 billion to $A 1.8 billion, over the previous year (5).

In software and services leading indigenous players Computer Power and Paxus both managed a modest increase in revenue during 1991, mainly by concentrating on export sales and big ticket contracts (6). Other strong performances were recorded by indigenous companies just outside the IT Top 20, such as BHP-IT, Andersen Consulting and Computer Sciences of Australia (CSA).

BHP-IT is among the industry's fastest growing companies with a sales revenue increase between 1990 and 1991 of 163% from $A 41 million to $A 108 million. Andersen Consulting, an Australian management buy out of the IT consulting part of the Arthur Andersen business in Australia, has increased its sales revenue 20% from $A 100 million to approximately $A 120 million over the same period (7).

Telecommunication equipment sales are also dominated by the major multinationals operating in the industry globally. These include: Alcatel, Ericsson, Siemens, Fujitsu, NEC, Philips and Northern Telecom (NorTel). Most have some manufacturing presence in Australia (8).

Alcatel has recently performed well, rasing Australian sales revenue by 24% from $A 448 million to $A 554 million between 1990 and 1991. Alcatel has recently completed construction of new factory facilities for the production of digital exchanges, it has been heavily involved in supply for the construction of the Tasman 2 submarine fibre link between Australia and New Zealand, and is now gearing up production for the PacRim East fibre cable's southern link (9). Ericsson also remains strong, although suffering a decline in revenues during 1991.

The recession has had greater effect on manufacturers targeting the customer premises equipment (CPE) end of the market, with reversals for GPT (GEC Plessey Telecommunications), NEC and Fujitsu. All have suffered declining sales revenues since 1990.

GPT has been shedding staff from manufacturing and R&D activities. The PABX and Small Business Systems subsidiary arm of NEC is also suffering cuts, while the Fujitsu-Telecom joint venture, Information Switching Technologies, has abandoned its R&D activities, which were aimed at the development of peripheral equipment for PABX installations (10).

The indigenous companies have also felt the effects of the recession, with sales revenue falls during 1991. CPE manufacturer Exicom has recently declared losses equivalent to more than 10% of sales revenue. Scitec Communications has seen its export revenue halved, and Datacraft reports a weak Asian market, but is still managing to expand slowly.

Trade Performance

One key indicator of the competitiveness of an industry, the success of export promotion policies and locational incentives in the globalising economy, is trade performance.

Over the decade from 1980-81 to 1990-91 the computer hardware import/export ratio began to decline in the mid-1980s. Exports/imports per cent has increased from 7.5 in 1980-81 to 19 in 1990-91. Nevertheless, the hardware trade deficit continued to increase in dollar terms until the current recession. The annual hardware trade deficit is now approximately $A 2.4 billion.

Table 2.
Computing Equipment Imports and Exports, 1980-81 to 1990-91 ($Am)

Year	*Exports*	*Imports*
1980-81	35.47	474.8
1981-82	55.02	517.4
1982-83	65.24	618.0
1983-84	87.28	871.0
1984-85	130.8	1332
1985-86	184.6	1781
1986-87	351.3	2169
1987-88	381.8	2232
1988-89	365.7	2860
1989-90	499.0	3092
1990-91	574.6	2980

Source: The Australian Bureau of Statistics.

There are enormous difficulties of categorisation and definition involved in developing computer software and services trade figures. So much so that the exercise is of limited value. In so far as one can make anything of the statistics it seems that software and services exports have grown strongly since the mid-1980s. Federal government figures suggest an increase in exports from around $A 20 million to more than $A 400 million in 1991-92.

Table 3.
Computer Software Imports and Exports, 1980-81 to 1991-92 ($Am)

Year	*Exports*	*Imports+*
1980-81	-	5.5
1981-82	-	8.3
1982-83	-	11.8
1983-84	10.6*	17.4
1984-85	23.2*	57.2
1985-86	47.6*	92.1
1986-87	101.3*	128.2
1987-88	180#	133.9
1988-89	225#	170.2
1989-90	266#	239.7
1990-91	340#	256.4
1991-92	450#	309.8

* Department of Industry Technology and Commerce.
# The Australian Trade Commission.
+ The Australian Bureau of Statistics.

Telecommunications equipment exports rose from $A 31 million in 1980-81 to $A 216 million in 1990-91; an increase of some 700% over the decade (11). While the increase in exports has been impressive, imports have also grown rapidly. Imports rose from $A 111 million in 1980-81 to just over $A 600 million in 1991-92. Even though there has been a very considerable deficit in telecommunications equipment trade over the last decade, some comfort can be taken from the trend import/export ratio. Exports/imports per cent has increased from 18 in 1981-82 to 44 in 1990-91.

Table 4.
Telecommunication Equipment Imports & Exports, 1980-81 to 1991-92 ($Am)

Year	*Exports*	*Imports*
1980-81	31.39	111.0
1981-82	31.37	175.9
1982-83	62.92	194.3
1983-84	39.44	211.0
1984-85	46.34	324.0
1985-86	53.95	426.6
1986-87	56.95	496.1
1987-88	66.86	484.7
1988-89	89.63	528.5
1989-90	153.5	602.2
1990-91	216.3	489.8
1991-92	198.4	604.3

Source: The Australian Bureau of Statistics.

The recent trade performance of Australian Information Industries Association (AIIA) members is indicative of the health of the IT industries in Australia. Both exports as a percentage of revenue and exports as a percentage of imports have increased steadily since the mid-1980s (12).

Table 5.
AIIA Member Company Performance Indicators

Year	*Exports as a % of Revenue*	*Exports/imports per cent*
1986	1.1	7.6
1990	2.9	18.9
1991	4.5	29.3
1992	6.2	52.8

Source: The Australian Information Industries Association, 1992.

In 1987-88 Australia had an IT current account deficit of more than $A 4 billion when the market was worth around $A 8.5 billion. In the last year, with the national market now worth around $A 11.5 billion, Australia's current account deficit has fallen to $A 3.5 billion (13). One can hardly be complacent about such a level of import penetration, and one must also consider the effects of the recession on these figures, but overall the Australian IT industry shows some encouraging signs of competitiveness.

The Industrial Policy Context

Industrial policy in the OECD countries over recent years has been shaped as a response to a common set of economic challenges and pressures (14). The fundamental policy shift since the late 1970s has been away from defending mature industries, towards promoting newer, more promising industries. Notwithstanding a much more free market approach in English speaking than in non-English speaking countries, most OECD countries are now focusing on removing impediments to competitiveness, shifting from a defended to a competitive environment, regulatory reform and micro-economic reform aimed at reducing enterprise costs (15).

Much greater attention is being paid to innovation as a determining influence on competitive advantage. Indeed R&D is a target of incentives in most OECD countries. Virtually all OECD countries have identified IT, biotechnology and new materials as key enabling technologies worthy of special support in the pre-competitive research and commercialisation stages (16). Greater focus is also being placed on investment in human capital; on education, training and life long skills formation.

The switch to "competitiveness" policies has been provoked, in part, by an observed change in the correlates of investment and employment. Enterprise size and industry sector are no longer indicators of a firm's ability to invest, and thereby create employment and growth. In the context of the evolving capital market the critical factor governing the rate on investment is now the performance and profitability of enterprises in their own markets, irrespective of size(17).

In Australia the Information Industries Strategy (IIS) is the major policy program that covers computer and communications hardware, software and services production. It aims to promote international links and opportunities through the reduction of protection and regulation; to develop integrated export strategies, and international alliances in R&D and marketing; to promote product development through incentives, innovation and international agreements; and to create competitive advantage through investment in resources and generic technologies (18).

A central element of this strategy has been the Partnerships for Development Program (PfD). Under the program transnational corporations (TNCs) enter into agreements with the government regarding their levels of R&D and exports in exchange for a commitment from governments to continue the development of industry infrastructure, especially skills, and exemption from obligations under the civil offsets program. The aim is to encourage the transnationals to expand their long term operations in Australia (19).

All companies with government IT sales exceeding $A 40 million annually are required to participate. Suppliers with government sales between $A 10 million and $A 40 million per annum are required to enter Fixed Term Agreements, which involve spending 15% of their projected government sales revenue on industry development activities - such as those recognised in the partnerships scheme.

The early members of the partnerships scheme were predominantly computer hardware manufacturers, but the focus has recently widened to include communications and software. Members now include: LM Ericsson, NorTel (Northern Telecom), NEC, Fujitsu, Siemens-Nixdorf, GPT and Microsoft.

Table 6.
Company Annual Commitments under the Partnerships Scheme, as at June 1992 ($Am)

Company	*Exports*	*R&D*	*By*
Bull HN	34	8	1994
HP	89	17	1995
Apple	84	13	1994
Digital	100	25	1992
Wang	11	-	1995
Cincom	2	1	1992
IBM	340	75	1993
Sun	68	10	1995
Unisys	45	14	1994
Siemens	9	4	1995
ICL	28	10	1995
Pyramid	12	1	1995
GPT	12	4	1996
NEC	185	40	1996
Microsoft	20	5	1996
NorTel	27	5	1996
Ericsson	156	30	1996
Tandem	36	9	1996
Amdahl	37	7	1996
Oracle	13	4	1997
Fujitsu	126	26	1997

Source: Department of Industry Technology & Commerce.

Similar aims underlie the Industry Development Arrangements (IDAs) for the CPE manufacturing sector (20). The IDAs have experienced only a very mixed success in promoting manufacturing activity and export, but it is important to see the IDAs as a transitional scheme that seeks to provide the environment for a more orderly restructuring of the CPE industry (21). In a sense the partnerships scheme is also transitional. It aims to create the environment for the location of globally strategic production in Australia by the leading tansnationals.

It seems likely that long-term partnership style agreements will be the basis of Australia's Information Industries Strategy for some time to come.

Is the Australian Information Industries Strategy the Right One?

To be successful industrial policy must affect corporate decision-making. So it is essential to know where, and under what strategic orientation decisions are made.

Until recently telecommunications had been characterised by nationally based monopoly carriers that were required to, or simply chose to favour local equipment suppliers. This resulted in the development of an industry structure that was characteristically multidomestic.

The deregulation of telecommunication services has begun to break down the conditions under which the purchasing arrangements of national carriers are subject to imposed or *de facto* government control. This is opening up the communication equipment market. The emergence of a global market is propelling the communications industry along the path of conversion from a characteristically multidomestic structure towards the characteristically transnational structure that the computer industry exhibits.

In a multidomestically structured industry companies operate within national boundaries, with a national focus and with a relatively high level of national autonomy. In a transnationally structured industry a company is a global system in which subsidiaries are inter-dependent, co-ordination is centralised, and actions globally strategic.

The emerging transnational structure allows the development of centres of excellence anywhere throughout the global corporate network. This means that rather than being the site of a number of nationally oriented multidomestic production or distribution establishments, Australia must become the regionally or globally strategic siting of one or more of the core activities of transnationals.

OECD analysts have summarized the situation as follows. The relative decline of the traditional multinational company (MNC) form is generating a new environment for governments in which their relations with, and means of action vis-a-vis both their own major industrial enterprises and the foreign ones they host may change in nature, and may in some respects converge (in new forms of partnerships). Particularly effected will be national and international policies aimed at encouraging R&D (22).

The corporate partnership approach, declining protection and internationalisation, and a general focus on innovation, education and strategic investment in Australia, are appropriate in the context of a globalising economy at the conceptual level. So the basic elements of industrial policy are in place; but does it work?

Does it Work?

In 1987 the companies now party to the partnerships scheme exported $A 190 million worth of goods and services and undertook $A 63 million worth of R&D in Australia. During 1991-92 partners' exports reached $A 513 million and R&D expenditure $A 200 million. This year's results exceed targets for exports by 14% and R&D expenditure by 12% (23).

Table 7.
Performance of Partnership Companies, 1990 ($Am)

Sector	*Exports*	*R&D*
Hardware	334.2	71.7
Software	146.2	123.2
Services	31.6	5.5
Tech Support	18.0	3.3
Total	512	200

Source: Department of Industry Technology & Commerce.

As well as promoting export and R&D activity in Australia the partnership scheme seeks to integrate the indigenous industry into global market structures. At the end of the financial year 1990-91 there were 131 local companies supplying partnership companies. Of these, 6 were supplying PCBs, 57 components, 8 cables, 17 services, and 43 were supplying other requirements. There were 4 joint-ventures. In addition there were 116 local companies undertaking R&D for partnership companies - 7 in relation to hardware and 109 in relation to software - and 91 local companies had had exports facilitated by partner companies. Nine local companies were receiving venture capital (24).

Of the 21 partner companies during 1990-91, 6 contracted out R&D in relation to hardware, 15 in relation to software and 6 contracted manufacturing out. Sixteen of the partner companies were involved in export facilitation for local companies (25).

These figures suggest that there is a growing level of interaction, integration and inter-dependence between transnational and indigenous companies in the Australian IT industries. There is *prima facia* evidence that indigenous Australian companies are being integrated into the global operations of the transnationals and thus into global markets, and that the transnationals are extending both their activity in Australia and their involvement with Australian IT industry players.

Notwithstanding the dominance of IBM in the Australian industry, export figures do not suggest the development of undue dependence. Five indigenous companies appear among Australia's Top 10 IT exporters during 1991, compared to 3 in the Top 10 by sales revenue. They are: Paxus (rank 2), Computer Power (rank 4), Andersen Consulting (rank 5), Datacraft (rank 8) and Telecom Australia (rank 10) (26).

Table 8.
Australia's Top 10 IT Exporters, 1991

Company	*Exports ($Am)*
IBM	317.0
Paxus Corp.	133.7
Alcatel	60.0
Computer Power	50.0
Andersen Consulting	48.0
Ericsson	40.0
Fujitsu	32.0
Datacraft	31.3
Unisys	30.7
Telecom	26.5

Source: *Today's Computers*, 1992.

There are two aspects to the 1991 results that are particularly encouraging. First, only 2 indigenous companies ranked in the 1990 Top 10 IT exporters compared to 5 in 1991 (27). Second, the Top 10 IT exporters earned a total of more than $A 700 million in 1991 compared to only $A 450 million in 1990 (28).

What is also encouraging is the way in which recent ventures are playing to the relative strengths of Australia's IT industries. Namely, software and communications equipment.

Paxus Corp, with software and services export sales of almost $A 134 million in 1991, now claim to be the world's largest supplier of applications software to the insurance industry outside the USA. In communications Datacraft continue to develop export markets, especially in Asia. Exports accounted for some 38% of Datacraft's sales revenue in 1991 (29).

Most encouraging of all is that there are signs that ventures are emerging in Australia which seek to exploit the synergies that the technological convergence of computing and communications offers.

In 1991 Fujitsu Australia, which doubled its exports between 1990 and 1991, released the AIM/Bridge software product developed at its Australian Software Centre. The Fujitsu centre in Australia was set up for the specific purpose of developing communications and connectivity software for sale world-wide (30).
Bull HN also focuses on communications related software development in Australia, including the joint development of "Transerve" with Telecom Australia (31).

Digital has a Network and Communications R&D centre on the campus of Bond University where it is undertaking joint development. As the prime contractor for the new carrier Optus Communications Digital will be undertaking the development of Optus's Operational Support Systems (OSS) in conjunction with Computer Sciences of Australia, Computer Power, IBM and Whitesmiths in a project expected to be worth a billion dollars over the next ten years. Digital will be establishing a global OSS Support and Development Centre in Australia, and has committed its marketing resources to selling the systems produced world-wide (32).

Similarly, the Australian Centre for Unisys Software (ACUS) has become the international home for Unisys's R&D work for data communications products conforming to Open Systems Interconnection (OSI) standards (33).

These and other ventures reveal a focus on the exploitation of possible synergies arising from the convergence of computing and communications, and a determination to build on Australia's relative strengths in communication equipment manufacturing and software and services.

Summary and Conclusions

There is support at the analytical level for the partnership approach to industrial policy which the Australian government is pursuing in the Information Industry Strategy. Bringing communications and computing into a single partnerships scheme, a single industrial policy program for the information industries, is an essential aspect of managing the convergence of computing and communications, and of attempting to maximise the potential synergies between the sectors of the IT industries in which Australia has some competitive strengths.

There is also *prima facia* evidence that the approach is beginning to work. Australia is relatively well placed to exploit the focus of the technological convergence of computing and communications in communications equipment and software, and there is some evidence that enterprises, both transnational and indigenous, are beginning to do so. There are, nevertheless, some points of fragility in the present situation in Australia.

One immediate problem is to manage the transition that the communications sector of the industry is experiencing, and to maintain a relatively strong communications equipment manufacturing base in Australia during the industry's transformation.

It is not yet clear that the industry development plans that the duopoly carriers have undertaken as a condition of their licence can be effectively implemented. It may have been better, and may yet prove necessary to bring the carriers into a corporate partnership scheme rather than relying on a regulatory approach that is somewhat anomalous in the context of deregulation. Clearly some other arrangement will have to be in place before the end of the carrier duopoly period in 1997.

Another concern is the extent of Australia's dependence engendered by such an industrial policy approach. IBM's exports account for around half Australia's total computer hardware exports, and some 60% of the partnerships scheme's export achievements. IBM's Australasian IT sales in 1991 were almost two-and-a-half times those of its nearest rival, Alcatel. IBM's partnership commitments end in 1993, and they clearly have a strong bargaining position from which to negotiate their next agreement with the Australian government. It is also noticeable that representatives of IBM and Alcatel have recently emerged as leaders in setting the IT policy agenda in Australia. Such indicators of dependence, be they statistical or participatory, must be a cause for some concern.

Finally, one must always be concerned with the evolutionary adjustment of industrial policy strategies. Where have we come from? What are we doing now? Where are we going? These are perennial questions.

There are some important issues to consider relating to industrial policy focus and enterprise size. Analysts suggest that profitability is becoming the main indicator of investment performance. No longer are enterprise size or industry sector major correlates of investment. This suggests two things.

First, sectoral industrial policies should be phased out, or, perhaps, harmonised and merged into an overall "competitiveness" strategy. A sectoral strategic focus on IT, biotechnology, or whatever else may not be appropriate over the coming decade. Second, industrial policies that focus on enterprise consolidation and/or working with the major transnational corporations, as IT policies in Australia over the last decade have tended to do, should give way to a "competitiveness" strategy that works with competitive players, irrespective of their size.

In relation to the broader evolutionary trajectory of industrial policy the current trend is relatively clear. The telecommunications era in which the regulated monopoly structure focused on universal access based on technology as the facilitator of universalisation is at an end. The micro-economic cost of communications is now driving consumer demands for competition. Carriers and their suppliers are now undergoing the painful transformation from a technology paradigm to a market paradigm (34). This is the context in which an overall "competitiveness" strategy in industrial policy is apposite.

Where to next? The obvious response to this question is that we are entering an information age. The likely overriding customer demand in such a context will be access to information. What are the implications of this for industrial policy?

In an interesting series of articles recently published in *Telephony* (35) it was suggested that the true value of regulated competition has not been its ability to increase technology, or even in adding efficiency to industry, but rather its role in forcing the telecommunications industry to make the transition to a market paradigm. The authors observed that hardware, software and content are becoming so interwoven that the artificial separation of those industries will delay a country's entry into the information age, and its ability to compete globally. Continuing to separate information (content) from the infrastructural technology only prolongs the old technology paradigm (36). It would follow that some broader convergence of industrial policy and competition and content regulation in communications must come.

Put into this wider perspective it is clear that the specific aspects of convergence that have been the focus of this paper are only a small part of the overall phenomenon of convergence. At this stage one can see only the broad outlines of the requisite regulatory, institutional and policy structures for the development of successful industrial policy into the next century, but it is clear that harnessing convergence will be a key factor.

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HIGH DEFINITION TELEVISION: THE KEY TO MULTIMEDIA AND BROADBAND NETWORKS

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1. ABSTRACT

HDTV is not just about television! Current developments and definition in high definition television (HDTV) and its relationship to alternative applications and its relationship to the various delivery media will change forever the way we communicate in the U.S. and throughout the world. This will not be "home television entertainment" as we know it but a much broader, image-based communication medium. In fact, HDTV will play a key enabling role in the development of multimedia beyond the rudimentary level of today and in providing the economic backbone for the development of a world-wide broadband network.

2. INTRODUCTION

Why do we say that high definition television (HDTV) is not just about television? And why is it the key to multimedia and broadband networks?

We all know that HDTV will give us much improved, motion picture quality television pictures when it is widely available at the end of the decade. But the process through which HDTV is now being defined in the U.S. includes a substantial opening up to allow inclusion of a far more robust digital, image-oriented transmission and processing. No longer will the personal computer necessarily be a separate entity. No longer will we really have separate telecommunication facilities for telephone, television and computers. In fact, in part through the development process of HDTV, these three entities are merging.

The entertainment, business, health, education and other sectors focused upon HDTV will provide the large application base by which multimedia and broadband networks can be based. Without a large, growing application base, these networks cannot be economically justified in other than limited situations.

The purpose of this talk is not to wildly toss around "blue sky" ideas. What I am talking about is something that will be real and widely used by the end of this decade, only a few years away.

3. DEVELOPMENTS

Jules Bellisio, executive director of the Video Systems and Signal Processing Research Department at Bellcore has emphasized that the so-called television receivers of digital HDTV will possess capabilities for several applications beyond broadcast television. "What we have is the basis for a multimedia system."[1]

Martin Hoffman of Digital Equipment Corp. has stated that the U.S. FCC will soon back "technical standards that would speed a merger of computer and TV technology, making possible an array of new services...." He said he expected "a number of common technologies linking computers and the proposed advanced digital-broadcast TV signals, including high-speed packet-switching of data, special identifiers for data streams to allow computers to store and manipulate images and sound ...."[2]

Fundamentally, what is occurring now is the development stage of a new, image-based communications medium which some people call HDTV, some people call multimedia, some people call video telephone and other people are not sure what to call it. Conceptually, the motion image and audio associated with today's television (and for that matter motion pictures) is merging with today's personal computer and computer networking technologies which are merging with today's telecommunications technologies to form a whole new way of communicating not only for entertainment but for all forms of communication.

Actions principally in the United States, but also a through a number of entities in several other countries such as Japan, Taiwan, South Korea, Singapore, Canada and the Netherlands, are pushing this environment. The U.S. is leading the way with Japan and the other Asian countries likely to quickly follow and the European Community more slowly recognizing these developments.

The Driving Forces

What is the driving force behind this? It's really two things. One is the current strain and stress of having television, computers and telecommunications in separate "baskets". Today, we work and play with these tools as separate things. The human being naturally likes things to be more integrated and natural so that there is little "work" associated with receiving and sending information. Before now, we had technological and economic as well as artificial barriers to making it "easy".

The other driving force is the tremendous development of digital technology in the world but especially the U.S. Microprocessors get smaller and cheaper and more powerful by tremendous amounts every year! The human interface through image displays, now fairly bulky and expensive, will soon become far better with the developments of large and small solid state displays and other interface mechanisms. These development allow for the integration of all these communications forms through affordable, digital technology.

Open, Interoperable Systems

Another element of the current developments is the push for open systems and common standards to allow the hardware to interoperate together, no matter what the application. The current difficulty of operating personal computers with an entertainment television, for example, will be no more.

A necessary component of this openness and interoperability is the incorporation of headers and descriptors into the digital data streams for HDTV and other image and non-image based applications. Headers and descriptors provide a periodic and structured labeling of the digital image data which allows for identification of the types and components of data in the digital data stream by a receiver/processor no matter what type of network is employed. This will allow processors at any point along the way to identify the type or types of applications represented in a given data stream and the type of coding and other information embedded in the data for each application.

The idea is that an entertainment program could be transmitted through the same telecom/computer network that a game or video conference or any number of new applications. The receiver/processor at the receiver end(s) would quickly determine the type of application and process it accordingly to decode and display the signal.

Standards

There is a great deal of work in the television area focusing on international standards for this new medium.

In the U.S., the FCC's Advisory Committee on Advanced Television Service (ACATS) is close to its final recommendations to the FCC regarding over-the-air transmission of HDTV. A significant element of this recommendation will be the emphasis on interoperability (with alternative delivery means and with alternative applications), scope of services and features, and extensibility (based on future developments). These three parameters are three out of ten evaluation factors employed by ACATS.

The Motion Picture Experts Group (MPEG) of the International Organization for Standardization (ISO) is in the final processes of developing a set of international standards called MPEG-2 which will encompass digital motion pictures/television from today's quality levels to tomorrow's HDTV. There is some likelihood that this standard will be employed in computer processing and the U.S., Japanese and European HDTV standards.

The Society of Motion Picture and Television Engineers (SMPTE) is intensely investigating standards for headers and descriptors as well as architectural approaches to digital imaging.

Networks

There is a tremendous activity today regarding telecommunications/computer networks of the future. Substantial world-wide activity is under way today leading to standards and technology for broadband, packetized networks such as Broadband Integrated Services Digital Network (B-ISDN) using cell-based information transfer. Substantial, politically-backed efforts are being made for broadband, packetized networks such as the U.S. National Research And Education Network (NREN) and fiber-based networks in Japan. There is growing activity in the U.S. regarding the development of a whole, new information infrastructure, especially with the new political administration entering office with a new infrastructure program. This will coalesce by the end of the 90's to a new, fungible broad band networking commodity available to all at a reasonable economic price.

Image Compression

In order to transmit, process and store high quality images in an image-based communications environment, a substantial amount of compression must be performed for both still and motion images. A significant number of companies world-wide are working on this area and the first major efforts are being solidified through the MPEG-2 and FCC Advanced Television efforts. The compression approaches which will initially be employed will generally employ discrete cosine transform (DCT) type compression schemes. Other different compression approaches may be expected in the future.

The result of this, for example, will be to allow a digital high definition television image of movie quality to be transmitted over the same transmission channel that the moderate resolution entertainment television signal of today. Or conversely, allowing multiple television signals be transmitted within a single channel of today's television.

Do We Want This?

Do we want this? It's beginning to appear that people are starved for this. But they want something that is not a hassle and easily performs many functions. As hardware and software begin arriving into people's offices, homes and other locations, that which is economical and most "usable" will become what people select and use.

4. THE PROBABLE/POSSIBLE

What will the world look like in the years 2000 to 2005 (only 7 years from now)? First, most of our communications will be over broadband digital packetized networks. Much of our business communication and a growing amount of our personal communication will be image based - both moving and still images. Television sets will probably be component systems (like our stereos today) containing a small but powerful digital processor. The sets will incorporate our video, audio, computer and telephone systems. These functions will be tied together through the broad band network. Much of our business and entertainment activity will be interactive.

In the entertainment area, we will see the advent of movies/television on demand at movie quality, exotic new interactive games (watch Nintendo, Microsoft and others) and perhaps interactive movies. We will see the ability for the viewer to control the individual viewing angle in a network televised sports event. We will see personalized television combining a broadcast program with personalized viewer information to create a personalized program such as is being worked on by the Personalized Mass Media Corporation.

In the interpersonal communications area, both business and consumer, we will have high quality video telephones (that many people are working on) and video snapshots and database albums (like Kodak Photo CD but more).

In the business area, we will see video databases which include text, image audio and maybe other information which can be accessed without cumbersome keyboards and displayed on wall-sized displays. Companies in Japan and the U.S. lead the way here. We will see new architectures to control the movement of image-based data within a corporation.

In the education area, dynamic image-based multimedia learning systems which might employ large, networked multimedia data bases will come into being.

In the health area, doctors will be able to diagnose remotely and compare image and other data with reference data from around the world in making a diagnoses.

In fact, these examples are only a small fraction of what we will see by the year 2000. As the components of this image-based communications approach begin to jell in the next several years, more intensive thought will be put to applications. The result will be applications in place in, say, ten years that are broadly based but that no one today has thought of.

5. CONCLUSIONS

As we have seen, HDTV is not just about television but about a whole new communications paradigm. Two-way image communications for a broad number of applications will be inserting itself into the fabric of our lives. Countries of the Pacific Basin are likely to the first to experience this because of the leading edge technologies being developed in North America and Asia. The Europe will follow soon thereafter.

This is particularly important to the people of the Pacific Telecommunications Conference because this new paradigm will impact this conference before the end of this decade in a way of great significance because of the extraordinary shift in the human capability to communicate.

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[1] " HDTV Experts Offer Outlooks During A Videoconference On The Technology", HDTV REPORT, v2 no23, November 11, 1992
[2] "FCC Expected To Back Steps To Make TV, Computers Compatible", Wall Street Journal, November 30, 1992

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The Current Status and Future Prospects of KDD's International ISDN Service with the Focus on Typical Application Examples

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ABSTRACT

KDD in cooperation with AT&T and BT launched the first international ISDN service in the world on June 1, 1989.

The network growth since the inauguration of international ISDN service includes the interconnection with NTT's domestic INS-Net and the overseas expansion to fourteen countries: USA, UK, Singapore, Australia, France, Italy, Germany, Hong Kong, Belgium, Spain, the Netherlands, Sweden, Switzerland and Denmark as of December 1992.

Regarding international ISDN applications, the use of videoconferencing and Group 4 facsimile has been steadily increasing in every business category while still picture transmission and wide bandwidth audio transmission have been also put into use mainly by the press and broadcasting businesses.

This paper introduces the current status and future prospects of international ISDN applications focusing on such 1992 world events as the Albertville Winter Olympic Games, the Munich Summit and the Barcelona Summer Olympic Games.

The information in the paper is based on facts and studies as of December 1992.

1. International ISDN Service in Japan

1.1 Direct Access and Switched Access

KDD's international ISDN service is the first international service to offer 64Kbps clear digital channel transmission to selected countries in the dial-up mode.

The international ISDN service was developed to meet the needs of customers for cost-effective, high quality digital services.

There are two types of contract for the international ISDN Service.

①Direct access contract with which KDD installs a direct subscriber tie-line to customer's location.

②Switched access contract with which the domestic INS network is used for international access.

KDD's international ISDN offers various services as follows:

①64Kbps circuit switched service
②International telephone service
③HI-BITLINK(International leased circuit service) ※
④VENUS-P(International packet-switched service)
⑤VENUS-LP(International high speed data transfer service) ※
⑥F-Port(International store-and-forward facsimile service)
⑦Messavia(International electronic mailbox service)

※Only direct access customers are accessible.

1.2 Network structure

1.2.1 Development Stages

ISDN services are perceived by the customer as one set of services offered over a common access of basic or primary rate interface. However, the traffic of each service may actually be carried on existing separate international networks.

(1)Stage 1 (TUP J)
The stage 1 network provides end-to-end switched 64Kbit/s unrestricted connectivity, and uses the CCITT No.7 Telephone User Part with J-bit on (TUP J) as the signalling protocol for interconnection of international ISDN. The TUP J between KDD and its partner network providers has been adopted most as its network interconnection protocol. This type of interconnections may remain existed until such network providers' shift to using ISUP.

(2)Stage 2 (Q767 ISUP)
In order to provide the international ISDN supplementary services, the CCITT No.7 Q.767 ISUP signalling protocol is used as the international signalling protocol.

The protocol has been applied to the international link with AT & T since March 1992.

1.2.2 Services

The international ISDN supplementary services are made possible only by the implementation of CCITT No.7 Q.767 ISUP on the international connections. KDD supports the following services.

(1)Bearer service:
①64kbit/s unrestricted digital
②3.1kHz audio
③speech

(2)Supplementary service:
①CLIP/CLIR
②Subaddressing
③User to User Signalling Service 1

(3)In addition, the following user information can also be supported:
①Low layer compatibility
②High layer compatibility

The terminal compatibility information above if received from the user will be transported end-to-end by the network.

1.3 Routing

For the circuit switched digital bearer service, both dedicated TUP J circuit and ISUP circuit are used in the international section. Circuit switched speech (and 3.1 Khz audio) calls originated or terminated at ISDN users are carried by PSTN.

1.4 International Link

The table 1 shows the current status of international links for ISDN. Signalling with U.K. is scheduled to be changed to ISUP in 1993.

1.5 User-Network Interface

1.5.1 Local Network Structure

Fig. 1 shows KDD's local network structure for international ISDN in Japan.

Both Basic Rate Interface (BRI) and 1.5Mbps Primary Rate Interface(PRI) are supported by KDD's ISDN. The ISDN user-network interface specifications conform to the TTC* standards, which are completely in line with the CCITT Recommendations.

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Table 1 International link

Country	Signalling	Speed	Country	Signalling	Speed
Australia	TUP J	64Kbps	Netherlands	TUP J	64Kbps
Belgium	TUP J	64Kbps	Singapore	TUP J	64Kbps
France	TUP J	64Kbps	Spain	TUP J	64Kbps
Hong Kong	TUP J	64Kbps	BT	TUP J	64Kbps
Italy	TUP J	64Kbps	AT&T	ISUP	64Kbps
Sweden	TUP J	64Kbps	MCI	TUP J	64Kbps
Germany	via France	64Kbps	Switzerland	TUP J	64Kbps
Denmark	TUP J	64Kbps	New Zealand	TUP J	64Kbps

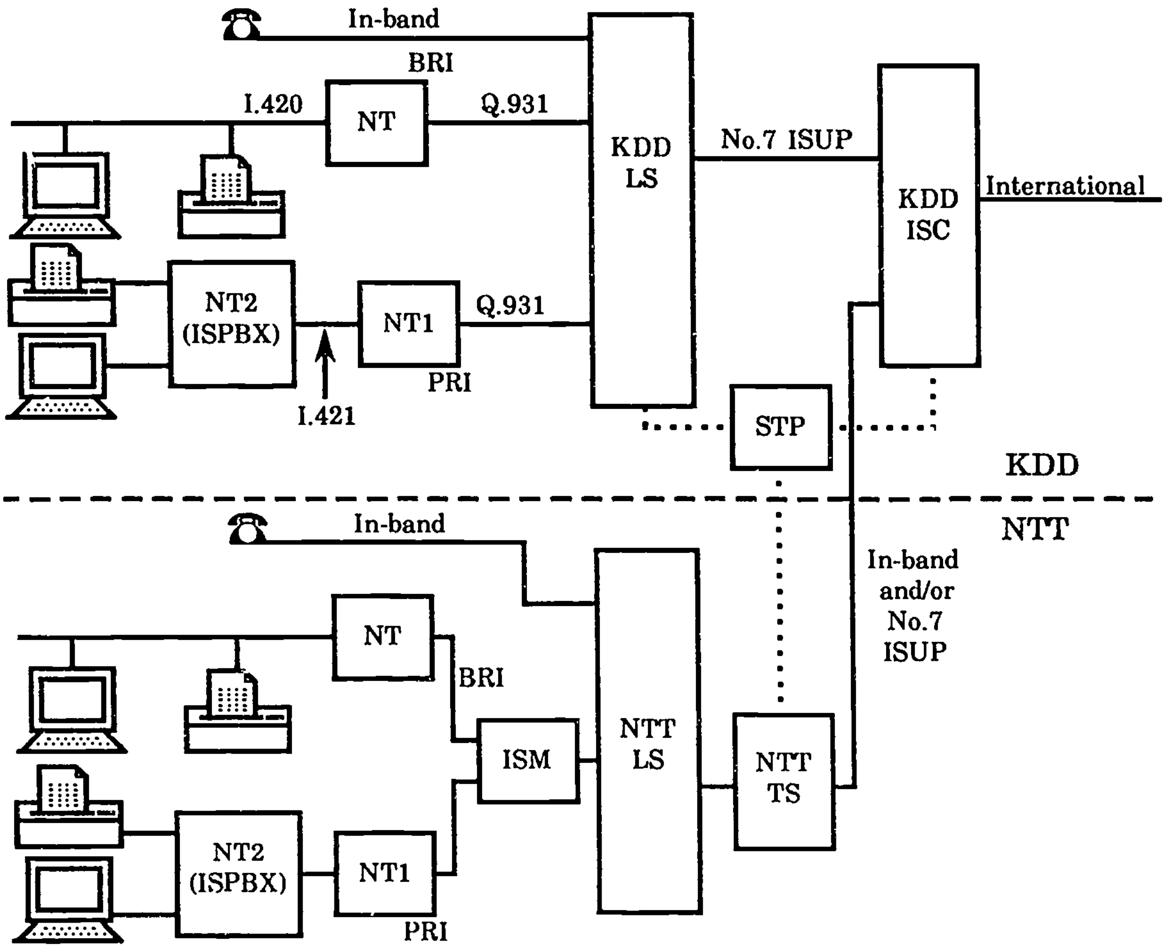


Fig. 1 Local Network Structure for International ISDN

ISDN switched access via INS-Net (NTT's domestic ISDN) is made available by the interconnection between KDD's international ISDN and NTT's national ISDN with TTC-standard ISUP circuits.

TTC : Telecommunication Technical Committee is a Japanese entity for standardization of telecommunication.

1.5.2 Numbering Structure

E.163/164 number starting with "81" as the country code of Japan is assigned to Japanese ISDN customer, though the maximum length of number is still twelve digits (not fixed numbering).

Therefore, the numbering structure of KDD's ISDN customers in Japan is as follows.

$$+81\ X_1\ X_2\ X_3\ X_4\ X_5\ X_6\ X_7\ X_8\ X_9\ X_{10}$$

Area codes "3117" and "6117" in national significant number are used to designate KDD's direct access customers as well as for KDD's international telephone direct customers, Route KDD customers. "3117" is for KDD's direct customers in the eastern area of Japan and "6117" is for customers in the western area of Japan.

Therefore, the numbering structure for KDD's direct customers is as follows.

+81 3117×××××× (Eastern area)

+81 6117×××××× (Western area)

1.5.3 Dialing Number

Owing to the adoption of standard Q.931 protocol at user-network interface, the dialing number for international switched digital call is the same as for international telephone calls, i.e.

001 (prefix for IDD) - CC (country code) - NN (national number)

1.6. International and Local Coverage

1.6.1 International Coverage

Table 2 shows the international coverage of 64Kbps circuit switched service as of November 1992.

Table 2 International ISDN Coverage

Country	Commencement
USA (AT&T)	1 June, 1989
UK (BT)	1 June, 1989
Singapore	28 Dec, 1989
Australia (AOTC)	15 Jan, 1990
France	26 Apr, 1990
Italy (ItalCable)	20 Dec, 1990
Germany	1 Apr, 1991
Hong Kong	1 Apr, 1991
Belgium	23 Apr, 1991
Spain	14 May, 1992
Netherlands	15 June, 1992
Sweden	3 August, 1992
USA(MCI)	1 Sept, 1992
Switzerland	6 Nov, 1992
Denmark	1 Dec, 1992
New Zealand	8 Dec, 1992

The network expansion is being made to those countries where 64Kbps circuit switched service is provided in the form of pre-ISDN or ISDN. It is foreseen to be expanded to Canada, Finland and Norway in 1993, and Korea and other Asian countires in 1994 or later.

1.6.2 Local Coverage

①Direct access

The service coverage of direct access is currently limited to Tokyo 23 wards. It is scheduled to extend other major cities in Japan.

②Switched access via NTT's INS network

The service area has already covered every major cities throughout Japan. This means that international ISDN lines have already become ubiquitous and can be accessed in almost all over the country.

2. International Applications

This section describes major applications and equipment available on the market in Japan for international use as opposed to domestic use.

Because type-approval regulations on terminal equipment, marketing coverage of terminal equipment and user-network interface vary from one country to another, international usage of ISDN terminal equipment has its own characteristics in many ways.

In addition, the variety of users' demands causes a difference in popular applications in each country. One example is the popularity of Group 4 facsimile ISDN usage in Japan whereas in other countries PC-to-PC communication is the most common use of ISDN.

Each subsection below details characteristics of terminal equipment and KDD's contribution in each application domain.

2.1 Still Picture Transmission

(1)Characteristics of the equipment

The transmission of full color still pictures has become very convenient with the use of a still picture transmission system on ISDN. Picture signal is normally compressed by a factor of 1/10 compared to the original signal without degradation. The high quality compression technique makes it possible to dramatically save on transmission time and the necessary storage capacity of filing systems. The equipment usually transmits various picture signals input from such as digital cameras, digital color copier and PCs.

(2)KDD's contribution

KDD Technology, a subsidiary of KDD, have developed "cpMuncell" digital full color visual data processing and communications equipment.

cpMuncell has capabilities of a visual data communication, a visual data input/output processing, a data compression and decompression using LSI chips with adaptive vector quantization techniques. Using high performance compression and decompression techniques without degradation of visual image quality, it enables the reduction of communication time to 1/10 and provides 10 times larger filing capacity for the same memory storage.

Using cpMuncell as a central unit, CS-3000 as shown in Fig.2 works as a integrated graphic station for editing, storing, and transmitting color imaging. CS-3000 is composed of Macintoch as a system control, Pixel Dio a digital color copier as a data input/output device, magneto-optical disc drive as a data filing device and terminal adaptor for the ISDN communications.

2.2 Wide Bandwidth Audio Transmission

(1)Characteristics of the equipment

The terminal equipment carries 50 to 7,000 Herz frequency audio as opposed to the conventional telephone system with 300 to 3,400 herz. The equipment meets the demands from radio broadcasting companies because of the high quality sound equal to AM radios. Even though all the 7Khz audio codecs available in the market conforms to G.722 CCITT standard, they are not assured interoperability among different manufacturers.

Some recent models of audio codec transmit even up to 22Khz audio using several 64Kbps circuits in conjunction with an inverse-multiplexor for integrating several 64Kbps circuits into Nx64Kbps transmission stream.

(2)KDD's contribution

KDD developed a newly designed 7Khz stereo audio codec for international ISDN service.
The codec allows to enjoy high quality stereo transmission via two B-channels of international ISDN at the rates of 64Kbps or 56Kbps with a ISDN terminal adaptor. The codec can transmit the stereo sound ranging from 50hz to 7Khz which is more than twice wider than the conventional telephone's bandwidth. For the benefit of live program transmission system in he broadcasting community, the codec offers an extremely economical way of high quality stereo program transmission on a dial-up, time-sensitive basis.

The codec features H.221 framing recommended by CCITT to combine two independent lines as one integrated line. The codec can compensate up to 0.64 second of differential delay between the two independent channels, and allows the transmission with no differential delay between them even if one of the paths is routed via satellite and other via submarine cable.

Also, this codec has a unique feature which allows it to intercommunicate with monaural 7Khz audio codecs from different manufactures if they use CCITT G.722 coding.

2.3 Group 4 Facsimile

(1)Characteristics of the equipment

The demands for facsimile communications services have lately grown very rapidly in Japan due to the transmission capability for graphics, Kanji and other Japanese characters and non-alphabetic writing. Of all international subscriber dialling traffics, the volume of facsimile calls reaches up to as much as 70%.

The number of G4 facsimiles installed at offices in Japan is increasing as its high transmission speed and image quality started to be perceived by facsimile users.

(2)KDD's contribution

Because of the G4 facsimile with T.70 protocol available in other countries, G4 facsimile installed in Japan must have T.70 protocol in addition to T.90 protocol for ISDN use. 56 Kbps transmission speed is absolutely necessary when communicating with Accunet Switched 56 service or the 56 Kbps switched network in Hong Kong.

In line with the possible incompatibilities that should be solved in international environments, KDD developed in cooperation with manufacturers G4 facsimile prototype machines with V.110 rate adoption capability and T.70NL/T.90 protocols.

Among G4 facsimile terminals Japanese facsimile manufacturers have been marketing, KDD recommends users to purchase only those which are equipped with two functions: T.70/T.90 protocols and 56 Kbps/64 Kbps transmission speeds.

2.4 Videoconferencing

(1)Characteristics of the equipment

Videoconferencing, an example of multimedia communications, offers the exchange of not only audio but also visual information of participants in the videoconferencing.

The videoconferencing on ISDN has been getting more and more popular and prevalent as the ISDN network expands and the interoperability is obtained among different manufacturers. In the domain of the international ISDN service, PictureTel and CLI codecs are currently most available, however, the codecs in accordance with H.261 are expected to become available and popular very soon. Videoconferencing is among others most expected to increase the international ISDN traffic.

(2)KDD's contribution

KDD R&D laboratories have developed a videoconferencing system with the following configurations. In this video codec, audio, video and data signals are multiplexed into 128 Kbps link. In addition, Forward Error Correction (FEC) coding is performed for the coded video signals. The videocodec is connected through ISDN lines with two B channels of the basic rate interface. Two B channels are synchronized to each other by the codec so as to use them as a single 128Kbps link. Two B channels are framed into 80 octets conforming to CCITT Recommendation H.221 and are synchronized using the channel numbering and multi-frame numbering scheme provided by FAS(Frame Alignment Signal) of H.221 frames. In H.221 frame, one B channel is divided into 8 subchannls of 8 Kbps: 1.6Kbps of 8th subchannels is assigned to the framing signal and residual 6.4 Kbps is available.

The internal channel structure, i.e. the allocation of each subchannel is indicated by BAS(Bit rate Allocation Signal). In the simplest case, 56 Kbps in the first B channel is assigned to audio signal and all of the rest except FAS and BAS are assigned to video signal.

For intercommunications between videoconferencing systems with different configurations and capabilities, and end-to-end protocol is defined as follows. At the start of communications, information on capabilities of both remote and local terminals are exchanged using BAS codes and then the terminal commences the transmission of video, audio and data in the mode which is decodable to the other party. This communication mode can be changed at any time during the call by sending appropriate BAS codes.

(3)Use of international videoconferencing

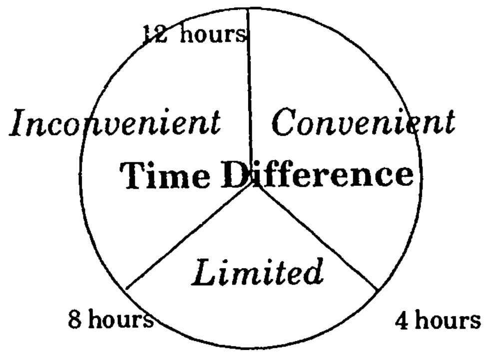
The videoconferencing allows the reduction of time and cost spent for business trips and it is expected to supplement face-to-face communications. As for international videoconferencing with different time zones, the time difference among involved locations affects its convenience for participants. It may be concluded that the time difference is the last obstacle to be solved in the expansion of videoconferencing use because equipment price gets more economical, and picture and voice get better in quality every year .

The convenience in relation with the time difference may be classified into the following three grades.

1) If the time difference is less than 4 hours, videoconferencing is considered *convenient* because about half of the normal working hours a day could be allocated for meeting hours for videoconferencing.

2) If the time difference is less than 8 hours, videoconferencing is considered *limited* because about quarter of the normal working hours a day could be allocated for meeting hours for videoconferencing.

3) If the time difference is more than 8 hours, videoconferencing is considered *inconvenient* because the normal working hours a day could not be allocated at all for meeting hours for videoconferencing. In this case, either party should always be at their office late at night or very early in the morning to meet its counterpart of the videoconferencing.



2.5 PC to PC

(1)Characteristics of the equipment

Businesses have been introducing rapidly PC-to-PC communications on ISDN. The types of the communications may be classified based on models of personal computers: IBM PC, Macintosh, NEC PC98 and others.

PC board together with those PCs and software offers the abilities of file transfers, file exchanges, batch transmission and file manipulation of the distant site's hard disk at the transmission rate of 64Kbps.

(2)KDD's contribution

1) μ-OSI/ISDN board

OSI, open systems interconnection, which defines a framework or discipline for interworking of heterogeneous computers in a distributed processing environment is another key technology for advanced data communications.

KDD R&D has developed a number of OSI communications software including File Transfer, Access and Manipulation(FTAM), Message Handling Systems(MHS), Directory System(DS) and Transaction Processing(TP).
The significantly increased processing power of Personal Computers and WorkStations which are the majority in number of computers has made it possible to implement OSI applications on PCs and WSs.

μ-OSI/ISDN board, a communications board as shown in Fig. 3 developed by KDD R&D, plugged into PCs and WSs, enables OSI protocol communications up to the session layer and propriety protocols for presentation and application layers.

PCs with the μ-OSI/ISDN board establishes three types of OSI-based data communications on ISDN as shown in Fig. 4.

①X.31 case A: The μ-OSI/ISDN system can access the other PSPDNs via access unit using ISDN circuit switched mode service.

②X.31 case B: The μ-OSI/ISDN system can use ISDN packet-mode services on B channels and D channel.

③DTE-DTE packet mode communications: The μ-OSI/ISDN system can directly communicate with another μ-OSI/ISDN system using ISDN circuit switched mode service.

2)Quick-CUICK ISDN

Quick-CUICK ISDN system which KDD R&D has developed has the capabilities of transmitting color still pictures, voice and telewriting data on ISDN. The system is applicable to image database retrieval, audio graphic conference and remote monitoring systems. The system is composed of a personal computer, the μ-OSI/ISDN board and a video processing unit which implements an international standard encoding system. In sending visual data, the system first transmits a rough outline which is gradually filled in to create a high-quality image. The progressive buildup feature is considered effective for image search systems since it is possible at a glance to tell whether the image is needed or not. The system is expected to be used as a consultation system in the printing, publishing and fashion industries.

2.6 LAN Interconnect

(1)Characteristics of the equipment

Local area networks are being introduced into business environments. With LAN routers, these LANs are interconnected only when it is necessary on ISDN and data for host computer access, interactive editing, file transfer and imaging can be transferred at low cost. LAN interconnect on ISDN does not require a costly high speed leased circuit.

(2)KDD's contribution

In comparison with LAN interconnect on high speed leased circuits, that on ISDN generally does not include any deterioration in the quality of data throughput.

The data throughput is, however, affected by a selected international route, either satellite link or submarine link on a call by call basis. We have conducted experiments on the transmission time with varied parameters of transmission delay time and file size.

Tables 3 and 4 show the results of the experiments. Conclusions may be drawn as follows.

①The transmission time with 300 mseconds delay becomes 6 to 7 times longer than the case with no delay.

②The above condition is the same for the transmission rates of 64Kbps and 1.5Mbps.

③The increased transmission rate from 64Kbps to 1.5Mbps decreases the transmission time with the case of no delay on the link as opposed to the case of 300 mseconds delay indicating little reduction of time from 36 seconds to 32 seconds.

The little reduction of time from 36 to 32 seconds is because the window size is small and the receiving buffer size is 1,024 bytes, therefore it causes too frequent response acknowledgements. When the window size and the buffer size of the receiving end are appropriately larger than that, the transmission time would be shorter than 32 seconds.

The transmission delay affects those applications requesting frequent response acknowledgements and those with a small window size and buffer at the receiving end. It may be advisable that a buffer size and window size should be adjustable depending on the transmission delay of a selected international link on a call by call basis.

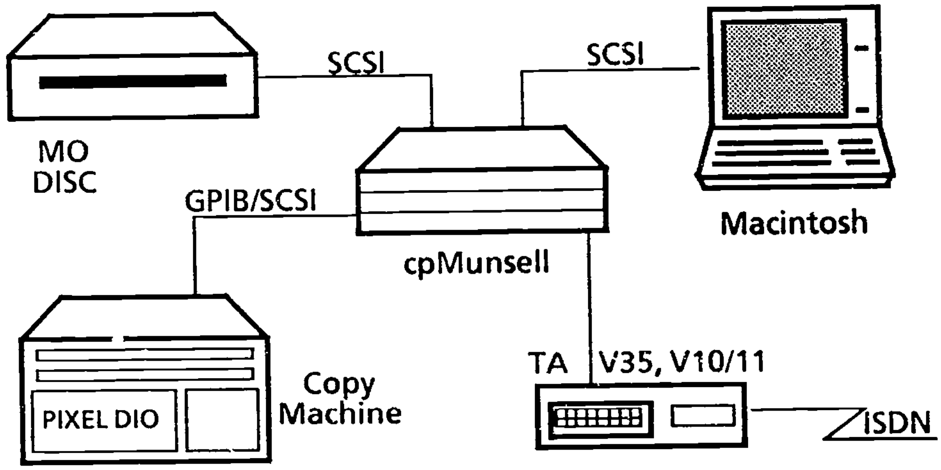


Fig.2 Color graphic station CS-300 standard configuration

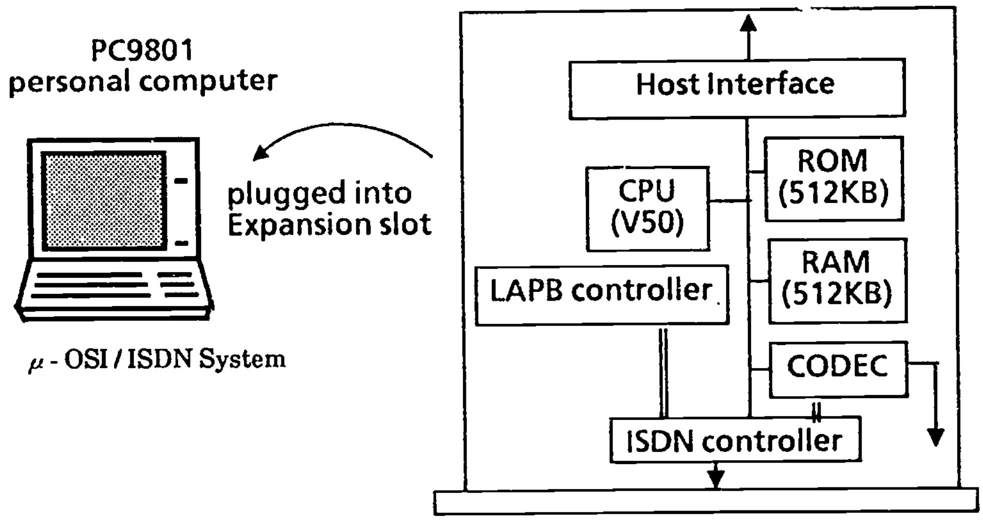
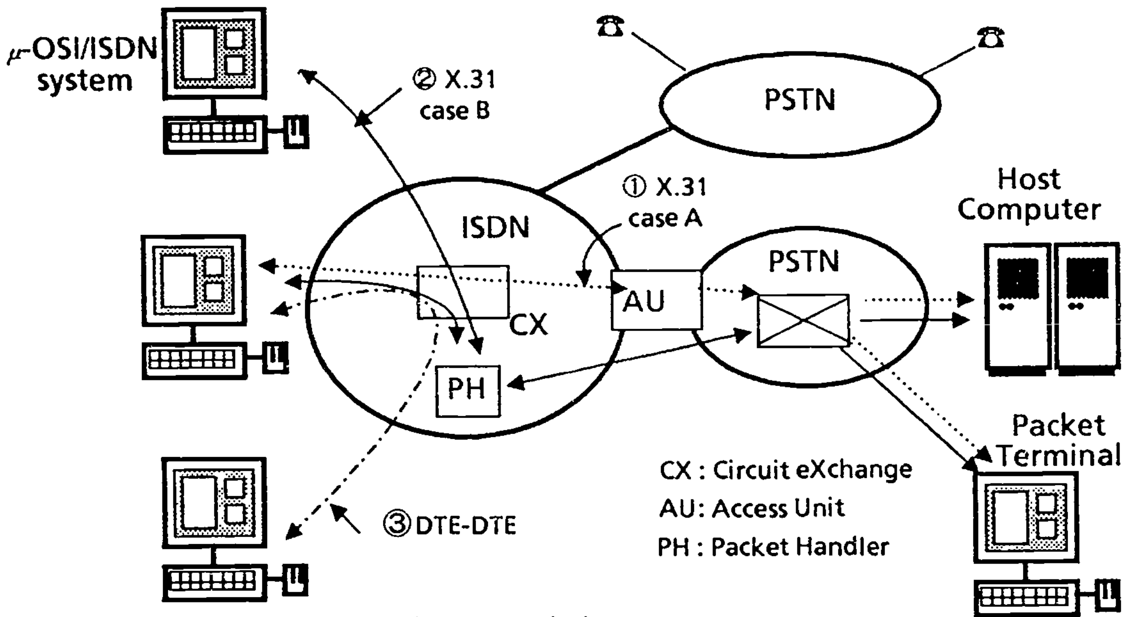


Fig.3 μ - OSI / ISDN Board



- - - - - - X.31 Case A(Circuit-mode ISDN service)

———— X.31 Case B(Packet-mode ISDN service)

- - — - - DTE-DTE communications(Circuit-mode ISDN service)

Fig. 4 OSI-based data communications with μ - OSI / ISDN systems

Table 3 File transmission time for file size of 2671 bytes

Transmission speed	Transmission delay (0 msec)	Transmission delay (300 msec)
64Kbps	1.1 seconds	6.4 seconds
1.5Mbps	0.8 seconds	5.9 seconds

1) 300 mseconds is assumed a delay on satellite link.

2) File size is 2671 bytes.

Table 4 File transmission time for file size of 25345 bytes

Transmission speed	Transmission delay (0 msec)	Transmission delay (300 msec)
64Kbps	5.0 seconds	36 seconds
1.5Mbps	1.5 seconds	32 seconds

1) 300 mseconds is assumed a delay on satellite link.

2) File size is 2671 bytes.

3. World Events

This section spotlights some world events in which ISDN played an important role in providing the press and broadcasters with high-speed digital transmission at economical costs.

The advent of ISDN with the property of a public switched network starts alleviating the burden born by the press and broadcasters in ordering the installation of temporary international digital leased circuits for world events.

The introduction of ISDN in these world events shows that ISDN is penetrating more and more into the marketing domain of digital leased circuits as it is proved that ISDN rivals leased circuits in quality.

Each subsection below details applications, performances and users' analysis of ISDN usage.

3.1 Albertville Winter Olympic Games in France from 8 to 23 Febr‹·ary, 1992

(1)Application for newspaper printing

It is quite important for newspaper cameramen to send most up-to-minute pictures to meet the the deadline requirement of each paper printing. At the Albertville Games, eight-hour time difference between France and Japan made it difficult to send pictures of the opening ceremony held in the evening in France for the purpose of printing morning papers in Japan because a conventional telephone line takes too long time to transmit. cpMuncell with the associated equipment on ISDN solved the problem and brought a success for Japanese newspapers in carrying vivid and clear pictures taken at the opening ceremony.

cpMuncell transmitted a numerous digital pictures not only at the opening ceremony but at many games for newspapers to Japan from France. It enabled 20 minutes faster printing process per one picture than the case on a conventional telephone line. All the process from picture-taking with camera to international transmission to the editing and printing at newspapers are digitalized and it has provided pictures with such a higher resolution as that each one of the audience can be clearly recognized.

Such big games like Olympics, games and competitions are held in many places. The situation makes the use of leased circuits costly and ISDN with the properties of a public circuit switched network provides more economical, simple and convenient use of high speed digital network.

(2)Application for radio broadcasting

A radio station in Japan transmitted live programs of the Games by connecting studios at in France and in Tokyo. The equipment for the transmission is 15Khz monaural audio codecs, inverse multiplexors to produce 128Kbps bandwidth from 2 channels of 64Kbps switched circuit.

It provided such a high quality sound to listeners that those who were accustomed to the sound with 4Khz bandwidth complained that the sound from France was too clear as overseas sound.

One episode shows the property of ISDN as convenience: the Japanese bronze medalist of figure skating, Miss Midori Ito had left her music tape for an exhibition skating. She realized the fact on the night before the exhibition game and asked the radio station to transmit the music from Japan to Albertville. The audio equipment on ISDN explained above saved her trouble and she played her exhibition skating in her best conditions.

3.2 Munich Summit in Germany from 6 to 9 July, 1992

A news agency in Japan introduced ISDN for the first time for their transmission system at such a big event.

In addition to conventional communications equipment, a full color still picture transmission system and G4 facsimile on ISDN contributed to their news releasing.

The full color still picture transmission system reduced the necessary time to transmit pictures by 25% so that news correspondents were able to send more pictures within a limited time by their deadline and it reduced the communications charges by 25% as well.

The G4 facsimile installed in Munich which handles B5 paper size, the standard size of the news agency, came handy operations, and it reduced the transmission time to 10%. The capabilities provided faster and more economical means of transmission of their manuscripts in an normal way of operation.

The news agency found the use of ISDN as a success and they intends to continue to use ISDN in conjunction with leased circuits. They have concluded that an appropriate combination of those two transmission means would provide most effective supports to correspondents.

3.3 Barcelona Summer Olympic Games in Spain from 26 July to 10 August, 1992

The ISDN international link which was inaugurated in May, 1992 between Spain and Japan made possible the convenient transmission of audio and video information during the Games.

A TV station in Japan introduced a videoconferencing for monitoring the programs actually aired on TV. Those programs actually aired on TV were selected and edited at the TV station in Tokyo from many video programs which correspondents gathered and transmited on the circuits for TV transmissions. Videoconferencing on ISDN has provided an economical means of monitoring actually aired TV programs for TV correspondents overseas. Though the images of ISDN videoconferencing do not have equal quality to images on TV, the TV station was satisfied with the images on ISDN because of the purpose.

4. The Network Expansion of 64Kbps Circuit Switched Network

KDD has been expanding ISDN network interconnections aggressively to the world. As a result, the ISDN interconnections from Japan reach as many countries as the coverage of international digital leased circuits. In 1994, ISDN expansion to Asian countries is expected to gain more momentum.

The shifting of international signaling system from TUP J to ISUP facilitates the use of cooperative supplementary services between countries and meets the demands of highly sophisticated applications.

5. Close Cooperation with International Carriers and Terminal Vendors to better meet Users' Demands

In order to meet users' demands and to encourage users to further introduce ISDN into their global communications networks, international carriers are required to provide users with more application-oriented consultation consisting of information not only on network but also on terminal equipment in both domestic and foreign countries. To this end, KDD has been making constant efforts in having closer cooperation with international carriers and terminal vendors.

TELCO VISION: DELIVERING DISTANCE EDUCATION

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ABSTRACT

This paper discusses what the power of telecommunications in the 21st century can mean for education and the regulatory changes needed to unleash this power. GTE's perspective of emerging telecommunications — what we call "Telco Vision" — is that we are experiencing a convergence of technologies. Future telecommunications will combine characteristics of the telephone, television and computer — in essence, a "telecomputer." Connecting these telecomputers would be a nationwide public switched broadband network. This paper discusses how regulatory roadblocks have slowed deployment of a switched broadband network across America and delayed delivery of a wide variety of innovative video services, including educational applications.

1. INTRODUCTION

What role in education will telecommunications play in the 21st century? If emerging trends continue, telecommunications could well become an indispensable tool in the classroom of the future.

In this paper, we will describe:

- GTE's vision of the future broadband network;
- Regulatory considerations that affect deployment of a broadband network by telephone companies; and
- Innovative broadband services for education.

2. GTE'S "TELCO VISION"

Now, what is "Telco Vision"? It is our view of what telecommunications will be like in the 21st century. Our perspective of emerging telecommunications is that we are experiencing a convergence of technologies. Future telecommunications will combine these characteristics:

- The switching capability of the telephone;
- The picture tube of the television; and
- The data-crunching power of the computer.

You would have what futurist George Gilder calls a "telecomputer" or John Scully of Apple Computer calls a "smart TV." In the 21st century, you would find a telecomputer sitting in virtually every classroom, office and living room across America.

But what would connect these telecomputers? At GTE, we envision a nationwide public switched broadband network to make the connections. From our perspective, the critical issue is not *whether* telephone companies will deploy a broadband network, but *when*. Deployment of a broadband network is a virtual inevitability. It already makes sense for telephone companies to use fiber optics in their networks just to carry voice and data traffic.

In fact, the industry has been installing fiber optics since 1977 and is increasing its use each year. According to Corning Industries, telephone companies had installed 1.4 million miles by the start of 1991, about 73% of the fiber in America. And the industry is investing about $20 billion annually in capital equipment.

But it will take another 40-50 years to fully deploy a fiber-based broadband network founded on voice and data use alone. That means America would not have a switched broadband network until, perhaps, the year 2035.

We could cut this time in half if telephone companies were allowed to provide video services. By the turn of the century, the market for cable TV, video rentals and pay-per-view entertainment is projected to exceed $50 billion in annual revenues. Such video revenues could help to underwrite the costs of deploying a broadband network. Under current law, however, telephone companies are precluded from providing such video programming.

Accelerated deployment could mean a target date of 2015 — the same year targeted by some Japanese policymakers for a broadband network in Japan. The difference of some 20 years between these deployment dates represents lost opportunity for U.S. students, educators, consumers and businesses, when they could be enjoying innovative broadband services and a decisive edge in global competition.

Telco Vision is more than telephone companies becoming just another species of cable TV operators. Using the analogy of an electronic mall, Telco Vision would lead to a full-service shopping center. This center could have several anchor tenants, such as a telephone company programming entity, an independent programmer, or even an existing cable TV operator.

The key to success of such a shopping mall is the existence of an anchor tenant. A telephone company programming entity would guarantee the existence of such an anchor tenant. With such an anchor tenant, the financial prospects of the mall would be enhanced. Revenue from transporting the video programming of the programming entity would help to pay for the telephone company's broadband network.

Because the telephone company's broadband network would be an open network, other specialty or niche programmers could be a part of the mall. And, a variety of government and social agencies could also participate. Imagine these activities over a broadband network: taking foreign language classes, diagnosing patients with 3-D medical images, accessing movies on demand, renewing a driver's license or applying for a building permit.

The Telco Vision electronic mall can be the platform to offer an exciting array of diverse services that are not widely available today. But — as we will discuss in the next section — federal law currently prohibits telephone companies from entering the video programming business, thus delaying the electronic-malling of America.

3. REGULATORY CONSIDERATIONS FOR THE BROADBAND HIGHWAY

What are the rules that govern telephone companies in the United States in the video business and the implications of federal policy on educational applications in telecommunications?

The Cable Act of 1984 generally prevents telephone companies from offering video programming services in the same areas where they provide telephone service. We believe this restriction has slowed the deployment of a switched broadband network across America. And this has delayed delivery of a wide variety of innovative video services, including educational applications.

Ever since they came into existence, the Regional Bell Operating Companies (RBOCs) have had two hurdles to overcome to enter video programming — the Modified Final Judgment (MFJ) and the Cable Act of 1984.

The MFJ prohibited the RBOCs from engaging in information services, which includes video programming. However, in July 1991, U.S. District Court Judge Harold Greene lifted that prohibition and allowed the RBOCs to enter information services. While that decision is under appeal, the RBOCs are free to offer information services, but not video programming services.

In contrast with the RBOCs, independent telephone companies, such as GTE, have had just a single hurdle to overcome — the Cable Act.

For the past several years, GTE has been working with the United States Congress and the Federal Communications Commission (FCC) in seeking relief from this restriction.

Legislation amending the Cable Act was introduced in the 1991-92 congressional session to encourage competition in the cable TV industry by allowing telephone company entry into video programming. Congress held public hearings on the bill, but decided to hold the legislation. Lawmakers chose instead to enact a measure on October 5, 1992, that would permit local governments to re-regulate the cable TV industry where meaningful competition does not exist.

This complemented the FCC's July 16, 1992, action, when it came out in favor of "video dialtone" for telephone companies to encourage a competitive video marketplace. In its order, the FCC clarified the rules by which telephone companies could transport video programming of third-parties. The FCC also allowed telephone companies to engage in related activities with programmers that were previously prohibited.

4. THE "VIDEO DIALTONE" CONCEPT

What is "video dialtone"? Simply put, video dialtone is the transport and switching of video signals; *it is not video programming.*

As the FCC views it, video dialtone is a common-carrier service provided by telephone companies. The FCC recognizes that telephone companies already are transporting voice and data signals on their networks, as well as video signals by way of channel service for specific customers.

Moreover, new technology is blurring the lines between voice, data and video transmissions. With fiber optics, each of these signals is in the form of light pulses. Some pulse streams are digitally encoded voices, while others are encoded still- or motion-pictures. The FCC decided that as long as the telephone company is carrying these signals on a common-carrier basis, the rules applied should be essentially the same

The *common-carrier* aspect of video dialtone means that any programmer can gain access to the telephone company network at *non-discriminatory, tariffed rates*. And, the telephone company cannot exercise any control over programming carried on its network.

With a common-carrier approach, video dialtone offers programmers a direct pipeline to consumers. Programmers no longer need to convince cable TV operators to carry their material; instead, they can reach their audience through video dialtone.

As part of its video dialtone ruling, the FCC also decided that telephone companies could provide ancillary services and engage in cooperative ventures with cable operators and other video programmers, including securing up to a five percent interest in such entities. This will open up new opportunities for telephone companies to make their networks more useful and accommodating to video programmers.

But, the FCC's video dialtone order does not place telephone companies into the video programming business. The Cable Act defines "programming" to include not only *creation* of content, but also *scheduling* and *packaging* program content created by others.

Time will tell whether video dialtone alone will be sufficient to deliver on the promises of Telco Vision.

5. THE FUTURE IS NOW AT CERRITOS

GTE is not just talking about the future of America's telecommunications networks; we are working on delivering the future at a variety of sites across the country.

Perhaps GTE's most visible success is our testbed in Cerritos, California. This project began in 1988 and is scheduled to run through mid-1994, under a waiver granted by the FCC of its rules prohibiting any relationship between a telephone company and a programmer beyond a "carrier-customer." Earlier, the city of Cerritos had solicited proposals for an advanced cable TV system. GTE and Apollo Cable Vision developed a proposal acceptable to the city.

In August 1991, GTE wired two schools in Cerritos — the Joe A. Gonsalves Elementary School and the Benito Juarez Elementary School — with fiber optics and connected them to a broadband switch developed by GTE Labs. Six teachers and 190 students have been using several special features:

- **Full-motion videoconferencing** — All of the six classrooms have the ability to hold videoconferences with each other. This allows a teacher who is a specialist in one subject to teach several classes simultaneously. Children in different classes also can interact with each other.
- **Video-on-demand** — Each teacher has access to a video-on-demand library of more than 200 titles from the Greater Los Angeles School District catalog. Normally, teachers would have to order a videotape and then wait days or even weeks before getting delivery. Today, they can simply punch-up the desired video when they need it and control it with VCR-like features of pause, fast-forward and rewind.
- **Video microscope** — This allows a teacher to position a specimen on a microscope and display it on the television monitor. The teacher then can discuss what is on the screen with the class, rather than taking the time for each student to look at the specimen on a standard microscope.
- **Electronic tablet** — Teachers can highlight material on the television monitor by writing comments or drawing diagrams over video images. This technology is similar to that used by sports announcers giving "chalk talks" on television replays.

All of these features can be accessed through a user-friendly remote control developed by GTE Labs. Teachers do not have to be computer wizards or technology buffs. They do not have to manipulate a keyboard or even a mouse. All they have to do is point the remote control and punch a button.

To the teachers, this "point-and-punch" technology is virtually invisible. But, the technology empowers teachers to accomplish more with their classes. They have embraced the technology, weaving it through their lessons. With the video-on-demand feature, for example, teachers accessed more than 300 titles in the first two months of the current school year.

Video-on-demand gives teachers control over programming. They can select just the segment they want and show it to their classes when it makes the most sense in their lesson plans. In contrast, traditional network or cable TV educational programs are broadcast at specific times. Teachers have to either arrange their lessons around the broadcast or tape the program and show it when it is more convenient.

One of the teachers, Ron Bridgette, confirmed the benefits of this service: *"Video-on-demand has proven its worth in my classroom. It doesn't replace me as a teacher, but it does make me more effective."*

With the video technology, students are discovering that they are not confined by the walls of their classrooms. Much to their delight, they have access to a wide range of outside resources. They can see

John F. Kennedy deliver his inaugural address, witness the launch of a space shuttle or follow the movements of a cursive handwriting expert. With the help of a broadband network, the television monitor literally has become a video "window to the world" for the classes.

Another Cerritos teacher, Betty Hyatt, observed, *"This test brings everything that's available in the world right into the classroom, and we can't afford to lose that."*

To analyze the effects of the video technology on students, the Annenberg School for Communications at the University of Southern California is conducting a study at Cerritos. This study will reflect the consequences of learning via video-on-demand, interactive lessons and distance learning. Results are expected in July 1993.

6. OTHER EDUCATIONAL VENTURES

GTE is not relying solely on Cerritos to determine effective ways of delivering educational services. While the Cerritos testbed is our most publicized project, GTE is taking a variety of approaches in developing telecommunications solutions for educational applications. Here is a sampling:

❑ **Westfield, Indiana** — On October 14, 1992, U.S. Secretary of Education Lamar Alexander presented his *"A+ for Breaking the Mold"* award to the Westfield-Washington School Corporation in Indiana for bringing high technology to the classroom. Working with GTE, Northern Telecom, Southwestern Communications, Dynacom, Steele & Associates, and Ball State University, the school corporation installed computer and communications technology to link three schools in the district with a total of 2,000 students through a fiber-optic network, provide computer voice mail and set-up satellite down links.

Now, each teacher has an individual voice mailbox. Teachers can send notes or homework by voice mail to students in the building or district, while parents can leave detailed messages for teachers.

For video resources, each teacher can call up videotapes, laser discs, CD discs and even satellite material on a television monitor that is connected to the district technology center. The district also has installed large-screen systems in cafeterias, gyms and large classrooms.

For data needs, each classroom is plugged into the district network, allowing access to a central file server containing educational, productivity and school administration software.

❑ **Athens, Ohio** — In 1992, GTE worked with Ohio Bell and the College of Education at Ohio University to build a fiber-optic network connecting the university with three elementary schools in southeast Ohio. This effort has been named the Appalachian Distance Learning Project.

One elementary school, Athens East, is just a few miles from the university. The others, Ironton Whitwell and Dawson-Bryant, are 120 miles away on the Kentucky border. GTE installed the video master switch for the network at its Athens central office.

The Appalachian Distance Learning Project creates a classroom with aspects of a television studio. Elementary students work in small groups and interact with other children and teachers in distant classrooms via two-way, broadcast-quality video. College students who hope to become teachers assist on-site, while their professors observe from a studio at the university.

A typical classroom is partitioned into learning centers in which groups of five or six students work on science, math, social studies or language arts projects. Learning centers are equipped with cameras, monitors, microphones and personal computers.

Jennifer Hoffman, an Athens East teacher involved in the project, said, *"Children discover things themselves and learn from their peers, not just from a teacher lecturing to them and then giving them a test. The teachers are there as facilitators, but the students can take control of learning."*

❑ **Lexington, Kentucky** — In 1991, the University of Kentucky began an ambitious project to install a compressed video digital network, linking the main campus with 14 community colleges dispersed throughout the state. To date, four community colleges have been connected — Paducah and Owensboro in the west and Ashland and Hazard in the east. Helping to make it happen are GTE and South Central Bell.

The goal of the project is to bring doctoral programs, medical training and other graduate-level courses to students in remote areas of the state. Andy Spears, associate director of media design and production for the university, noted, *"The Council on Higher Education, our governing body, mandated that the University of Kentucky would create graduate centers in the state. For the most part, we've done so via compressed video."*

Each site has one classroom equipped for distance learning and is linked to other sites through dedicated digital video service. Each classroom has two voice-activated cameras, one to focus on the instructor or students and the other for visual aids. Also in each classroom are several 35-inch television monitors.

Steve Patton, director of information systems at the

University of Kentucky, said, *"Interactivity is a critical element of the learning process. At the graduate level, exchange of ideas is as much a part of learning as the standard lecture. Two-way video raises the students' comfort level and allows the instructor to read the faces of students at the distant location. At the same time, it gives students the freedom to speak to the instructor as if they were in the classroom."*

The university also uses the network to offer non-credit classes in agriculture and continuing education courses in law and pharmacy. University administrators routinely use it to meet via video.

❑ Glen Rose, Texas — In 1989, GTE installed fiber optic cables, along with academic and data management software, in the Glen Rose Independent School District, connecting more than 400 personal computers and 100 printers.

The 1,400 students in elementary through high school complete math, science, language and art lessons on computers located in labs and classrooms. When students graduate, they will take with them, not just a diploma, but also a portfolio on disk containing course work and school records.

Teachers and administrative staff can keep records current on these networked computers as needed, rather than waiting to have information input by the school district. Martin Yarborough, technology director for the school district, said, *"We were hiring temporaries to enter all the information by hand. We had to get all our eggs in one basket, to bring that information to the computer at one time."*

Instead of lunch money, students carry bar-coded identification cards to their cafeterias. The food service director gathers food orders electronically from cafeteria managers at each school.

The football coach tracks weight-training schedules and player statistics, teachers exchange electronic mail and students produce newsletters and the high school yearbook on computers.

The bottom line is that these projects are helping to realize the promise of the broadband network. And, through these projects, GTE is working to meet distance learning objectives identified by educators throughout the United States.

7. WHAT DO EDUCATORS WANT FROM TELECOMMUNICATIONS?

In April 1992, the Roper Organization released the results of a poll of leading policymakers and administrators in education that was commissioned by GTE. Harry O'Neill, vice chairman of the Roper Organization, said, *"The survey shows widespread endorsement by the academic community of an advanced public telecommunications system and of public policy changes that would make this system available to all Americans."*

The survey showed that 79% believe that a nationwide, public, advanced fiber-optic communications system should be made available for educational applications. The survey also showed that 79% favor legislation to create such a system. Regarding competition, 84% believe telephone companies should be allowed to provide advanced video services in competition with cable TV companies.

Educators also were asked to rate the importance of various applications to the educational community, using a scale of zero to ten. "Zero" meant "not at all important," while "ten" meant "very important." All of the applications were rated high in importance:

- ❑ National interactive educational systems, where students in rural areas could take classes from urban colleges and all students could sample the unique offerings of various institutions. [Score: 8.3]
- ❑ Campus-wide interactive data networks linking students' computers, classroom computers, the security desk, the library, and other systems with each other and with the school's central mainframe computer. [Score: 8.1]
- ❑ Interactive "distance learning" systems, where lectures are broadcast from campus to campus or to the homes of non-traditional students, such as senior citizens, working professionals and the disabled. [Score: 8.0]
- ❑ Immediate access to up-to-the-minute research findings, rare documents and hard-to-locate journals. [Score: 7.9]
- ❑ Classroom teleconferencing available for the use of community public education systems, where teachers, parents and administrators could conduct video meetings. [Score: 7.1]

The findings of the Roper survey echo the policy recommendations adopted at a national forum by the United States Distance Learning Association (USDLA) in July 1991. Among these recommendations are:

- ❑ In order to accelerate and fulfill the tremendous potential of distance learning and educational technology, federal, state and local government should develop a vision for a national infrastructure, recognizing the critical importance and interdependence of systemic educational reform and advanced telecommunications services.

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- Recognizing that all forms of advanced telecommunications services are critical to supporting distance learning and educational reform, federal, state and local government should facilitate the development of a broadband educational network utilizing the public network with an open system architecture and guarantee equal access and governance responsibilities for all educational constituencies.

8. LESSONS TO BE LEARNED

The educational projects across the country involving GTE are demonstrating the value that telecommunications can add to the classroom. But, the limitation of these projects is that they are essentially private networks. Only those sites that are specifically tied into the system have access.

Under a Telco Vision scenario, the entire country would be served by a public switched broadband network. As noted above, the USDLA and others in the education community are strong proponents of such a public network. Just about anyone could get onto the system to interact with anyone else. How the network is used — whether for education, health care, entertainment, business — would be up to the individual.

But, as we have previously discussed, the current regulatory environment is slowing deployment of an advanced broadband network. Clearly, changes to the Cable Act are needed to remove roadblocks to Telco Vision. In turn, Telco Vision would help to accelerate delivery of innovative video services in education.

The challenge for policymakers in Washington is to take the necessary action to accelerate deployment of a broadband network, which can help in the dissemination of knowledge through the nation. As Daniel J. Boorstin, Librarian of Congress, once said, *"Knowledge is not simply another commodity. On the contrary. Knowledge is never used up. It increases by diffusion and grows by dispersion."*

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HIGH-RELIABILITY LAN WITH NEW RAS FUNCTIONS

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Many Japanese factories, universities, and laboratories are installing backbones for their key local area networks (LAN). Fujitsu makes MHLINK, a multimedia highway line network with a transmission capacity of 400 Mbps, and FSLINK; both conform to the international standards of FDDI (ISO 9314). These LAN backbones were well received by users.
As LAN capacit; increases and multimedia applications become more common LAN reliability will become more important.

This paper introduces a highly reliable LAN system concept, and discusses future large-capacity multimedia LANs.

1. LAN RELIABILITY REQUIREMENTS

In Japan, optical-loop LANs of the time-division multiplex type became popular in the first half of 1980s. They are used as internal networks in factories and laboratories where here are strong electromagnetic fields. Fujitsu has installed more than 300 of its F2880 optical data highway systems, ich are 8- and 33-Mbps optical loop LANs.
In the late 1980s, very-high-speed optical LANs appeared, faster than 100 Mbps. Fujitsu has MHLINK, a 400-Mbps mult-media LAN backbone, which now has many users.

Optical-loop LANs are used as general office systems, as production and application development systems in large factries, and as part of railway and expressway systems where communication lines run outside. LANs for office systemsshould be low cost and compact. For production systems in factories and railway and expressway systems, priority is given to reliability.

Below, we discuss LAN reliability requirements in various environments.

(1) Large factory (see fig. 1.)

A large factory may contain many different systems, for production control, operation, application development, and in offices. There is a great deal of communication between the host computer and the process computers and terminals at work positions. A LAN is needed to connect the communication acilities, but a LAN failure, would directly affect production and cause a costly holdup.

Large factories often use optical LANs to link private exchanges and remote units, used to connect remote extension trunk lines. Video conference systems are becoming more popular, and there is an increasing demand for image communication.

Large factories would benefit from multimedia communications for data, voice, image, and video. It is uneconomic and unwieldy, however, to have an independent LAN for each information type.

A LAN which integrates many media must meet the following reliability requirements.

① Prevent a fault in one device causing a system failure

A failure in the backbone LAN which integrates factory systems would be very costly. Such a failure must be prevented. A system which has control functions assigned to nodes is better than the centralized control system of a conventional LAN. In a centralized control system, all nodes are controlled by one supervisory node.

② Minimize disruption during automatic recovery

A fault in the telephone system, which is lower priority than the production system, must not affect production.
A new automatic recovery function is needed to avoid momentary disconnection of all lines. Lines are momentarily disconnected in a conventional LAN when the automatic recovery function is activated to fix loopback or other faults.

③ Minimize the affect of system alterations

Like in ②, we cannot allow a change to the telephone system to affect production and we need some mechanism to prevent this happening.

④ Prevent multiple faults causing a system failure

If the power supply to one node is disconnected for routine maintenance, a fault at another node should not cause a system failure. Communication between the working nodes must be maintained even when the LAN connection is broken in two places.

A LAN which satisfies the reliability requirements listed here can be used to integrate an entire system with a backbone, without risking a complete system failure.

(2) Railway (See Figure 2.)

Railways are installing LANs as transmission lines for train

	LAN property	Conventional LAN	Highly reliable LAN	User needs
1	Internal components	Only repeaters (E/O, O/E) duplicated	Fully duplicated	Duplicated node components (Railway①)
2	Supervisory node	Centralized contr ' system with a supervisory node	Receive select system with no supervisory node	Avoiding system failure (Large factory①)
3	Influence of optical loop fault	Momentary disconnection of all lines by optical loop switching	Disruption avoided by receive select system	Minimized influence of automatic recovery (Large factory②)
4	Influence of node fault	Influence of node fault	Momentary disconnection of all lines by loopback	Minimized influence of automatic recovery
5	Momentary disconnection by RAS function	Communication disconnection of several seconds when optical loop is switched or loopback is executed, or of more than 10 seconds when a duplicated supervisory node is switched	Full switching after a momentary disconne econd or less	Minimized line disconnection time (Railway②)
6	Influence of dou''e fault	Renders unusable a node physically disconnected from the supervisory node	Normal functioning of non-faulty nodes	That multiple fault do not cause a system failure (Large factory④)
7	Monitoring	Monitors connection to supervisory node only	Monitors connection to any node	Several monitors (Railway 3)
8	Influence of node addition	Momentary disconnection by loopback	Disruption avoided by receive select system	Minimized influence of system alteration (Large factory③)

service control, power control, and railway telephones. Optical cables are immune to electromagnetic interference, and long-distance transmission is possible without repeaters

Since reliability requirements for large factories are similar to those for railway LANs, only additional requirements are listed here.

① Duplexing node components

Because of the importance of safety, components in each LAN node must be duplexed.

② Minimize the line disconnection time

A railway service control system checks train locations at very short intervals. Even a momentary power failure caused by a LAN fault may paralyze the service control system. If there is a fault, the system must be switched immediately to a spare one.

③ Have several monitors

In a railway system, the parent facilities for train services, remote power, and telephone control may be distributed between several locations. Because these management functions are distributed, LAN supervision may also have to be distributed. It is desirable that more than one LAN monitor can be installed, and can be connected to any node.

-2. HIGHLY RELIABLE LAN SYSTEM

This section compares the reliability, availability, and serviceability (RAS) functions of a conceptual highly reliable LAN with those of a conventional LAN. We show how a LAN can meet the seven requirements above.
(A conventional LAN means Fujitsu's F2880-series and MHLINK)

(1) Receive select system

A conventional optical-loop LAN has a supervisory node for each single, or double in a duplex configuration, system which controls and supervises the entire LAN. This is called centralized control.

Current and spare optical loops are clearly distinguished in a conventional LAN. Usually, all lines use the current optical loop.

As fig. 3 shows, if the supervisory node detects a fault in the current optical loop, it instructs all nodes to switch to the spare optical loop.

This loop switching causes a momentary line disconnection.

We propose the receive select system for our high-reliability LAN.

In fig. 4, terminal node A transmits data to the terminal at node C simultaneously in two directions, through clockwise and counterclockwise optical loops. Sender A adds monitor signals to data at transmission time. Receiver C reads the monitor signals received through the clockwise and counterclockwise loops an uses them to select a working channel.

In fig. 4, the monitor signal received through the clockwise loop is abnormal. Communication can be restored simply by switching to the counterclockwise loop. If the interface switch is already set to the counterclockwise loop, there is no need to change the switch setting. Communication is completely unaffected.

(2) Node fault processing

In fig. 5, node B is faulty. In a conventional LAN, all nodes loop signals back together when instructed to do so by the supervisory node (fig. 4). This momentarily stops communication in all lines.

In our high-reliability LAN, if there is a fault at node B, only the interface switch needs to be operated to restore communication. If the interface switch at terminal C is already set to counterclockwise loop, communication will be unaffected by a fault at node B (fig. 4).

(3) Multiple faults

Multiple faults are assumed in the conventional LAN in fig. 7. The node disconnected from the supervisory node can no longer communicate because only the supervisory node can create communication frames.

The highly reliable LAN, however, can maintain communication within the physically connected range, despite multiple faults (fig. 8). This is because the LAN has no supervisory node and each node can create communication frames independently.

(4) Internal block

Fig. 9 is a block diagram of the highly reliable LAN. The i nternal components are all duplicated.

3. COMPARISON OF RAS FUNCTIONS

The table below compares the RAS functions of the conven tional optical LAN and of the highly reliable LAN. The"User needs" column shows the corresponding reliability requirements of large factories and railways described in the previous sections.

4. FUTURE TOPICS FOR HIGH-RELIABILITY LANS

In future, there will be more kinds of information communication systems and capacity will increase.
The need for multimedia communication is accelerating LAN development and highly reliable LANs are essential to multimedia applications.
Below, we discuss the outlook for highly reliable LANs for multimedia communications.

(1) Multimedia services

In Japan, multimedia communications began as integrating many media, including data, voice, image, and video, on a single transmission line. This idea of multimedia has, however, always been an environment where people can fetch, process, and transmit information of any form.

Multimedia LANs should provide transmission lines, and also link host computers, multimedia personal computers, and display equipment.

As an example, consider image processing services on a multi-media LAN.

Dynamic image services can be divided into those which require realtime processing, and those that do not. Realtime processing is not usually needed for services such as dynamic image mail and retrieving images from a database. Dynamic images are generally compressed by a workstation or personal computer when they are transmitted through a LAN. Video conferencing, videophone, and other communication that uses dynamic images requires realtime processing (fig. 10).

To provide these services, a LAN must have a low-cost codec function which compresses images and support internal image exchange.

An image exchange service will enable efficient use of the transmission area and extend LAN applications. If the LAN can only transmit images on fixed basis, a dedicated path must be provided for all communication and the LAN is always completely occupied. If the LAN has an internal image exchange service, the number of lines simultaneously available may be limited, but, free exchange of images between any two parties will be possible. This will realize the services in fig. 10.

Image exchange in a LAN has the following two technical requirements:
1) Visual equipment handling dynamic images must be able to specify a communication party to the LAN. The equipment must, therefore, be free to change the address of a communication party in the LAN.
2) A backbone LAN handles dynamic images and also data and voice. This means the LAN must be flexible enough to cope wi with large changes in the transmission capacity. Dividing the transmission area in the LAN into each information type is nefficient equipment handling visual information must be able to secure the transmission area in the LAN it needs for image communication.
A standard protocol is required for communication between the LAN and any multimedia equipment that may be connected. It must, therefore, be possible to control equipment from the LAN.

(2) Very-high-speed processing

As multimedia becomes more popular and image communication needs grow, faster LANs will be developed. The Synchronous Digital Hierarchy (SDH) standard recommended for multiplexed transmission will be a key technology.

150 Mbps, 600 Mbps, and 2.4 Gbps LANs can be connected in ahierarchical structure if they support an optical transmission interface which conforms to SDH. It will also be possible to make these LANs compatible with B-ISDN.

Fujitsu is developing the kind of highly reliable LANs described in this paper, staying at the forefront of providing multimedia services.

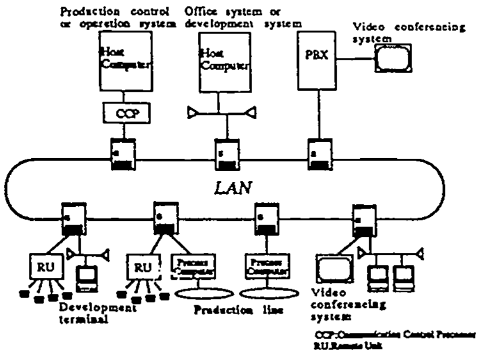

Figure 1 Example large factory system

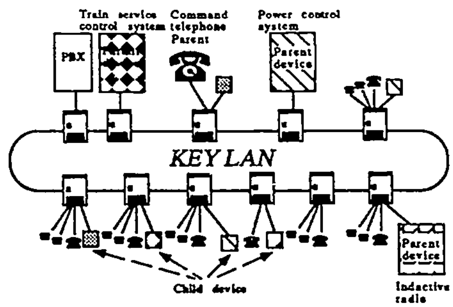

Figure 2 Example of a railway system

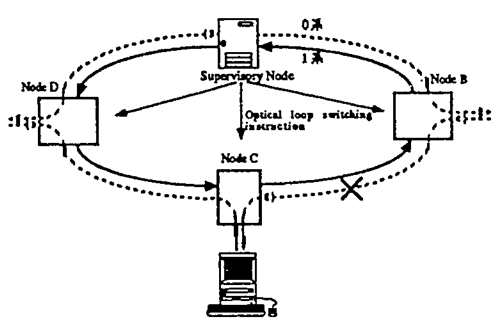

Figure 3 Loop switching in a conventional LAN system

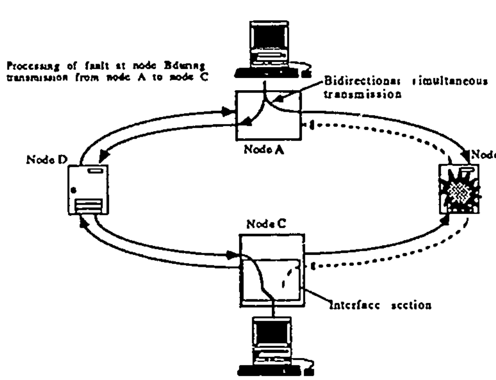

Figure 4 Receive select system(transmission line fault)

Loopback in conventional LAN

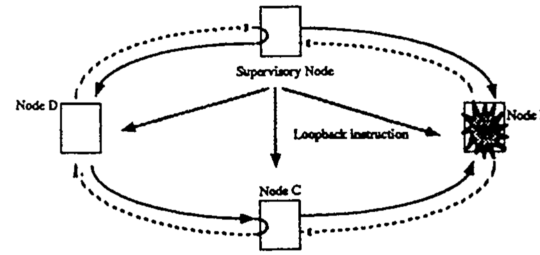

Figure 5 Loopback in conventional LAN

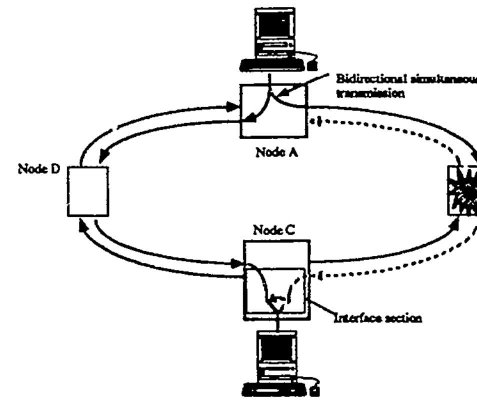

Figure 6 Recieve select system(node fault)

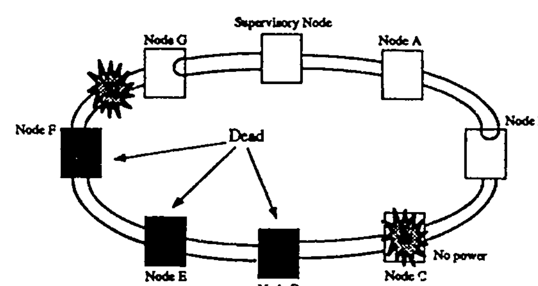

Figure 7 Multiple faults in a conventional LAN

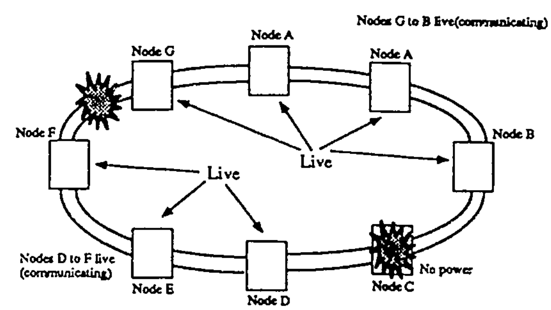

Figure 8 Multiple faults in a highly reliable LAN

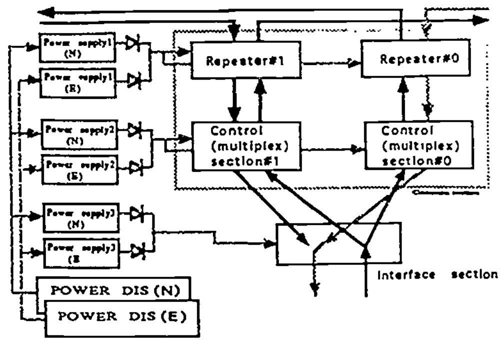

Figure 9 Block diagram of a highly reliable LAN

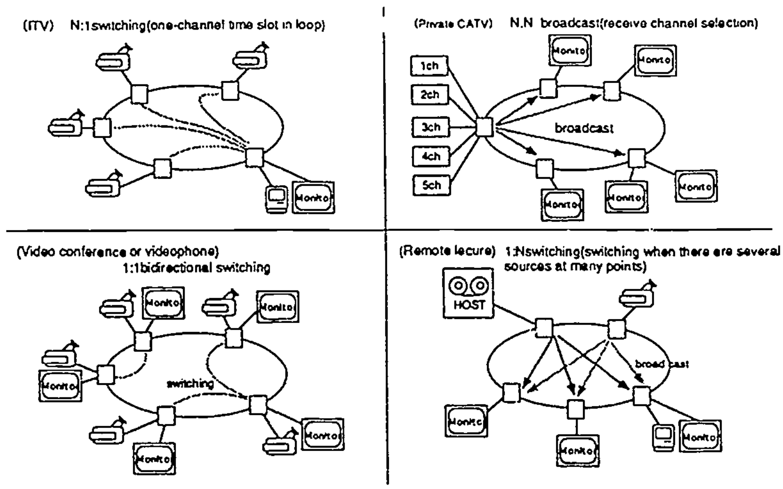

Figure 10 Image exchange services on a multimedia LAN

The Customer in Product Development: A Marketing Perspective

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ABSTRACT

Although the development of telecommunications products is a highly technical activity, technology alone is not enough to satisfy customer demands. The research and development resources of AT&T Submarine Systems, Inc. (SSI) have combined with marketing to create a series of products which satisfy customers' varied requirements. This paper will show the process in which SSI matches a product to the market by focusing on customer demands. It covers the evolution of fiber optic submarine cable technology beginning with SL280 through today's diverse product offerings: SL100, SL560, and SL2000 cable systems.

Introduction

Conventional wisdom provides the long-held view of marketing as a business activity which identifies customers' needs and then sets about to satisfy those needs. The problem with this view is that it is fairly one-sided and simplistic. Although it properly describes marketing as a product development function, it over simplifies the process. It presumes that needs are uniformly consistent and identifiable. It further presumes that the entity performing these marketing functions has the resources required to devise a solution capable of satisfying those identified needs. Finally, it makes the customer a passive agent in the process, with all of the product development activity centered around the vendor.

One can see businesses following this conventional wisdom every day. In periods of economic recession, such as this, fewer businesses are actually following this practice, because its flaws can lead to business failure. Even if needs were so easily identifiable and static, few vendors have the resources to develop a product solution that will truly satisfy those needs. Instead of developing products for their customers, they offer customers the products they happen to have available. One result of this approach to the marketplace is the niche solution. Niche vendors are challenged to find customers with needs that match their solutions. A more common approach is to try to convince the customer that a vendor's available solution will satisfy a need whether it does or not. This approach leaves opportunities for competitors to try to come closer to the mark.

AT&T's experiences depict a marketplace that is far more dynamic, multi-faceted, and sophisticated than traditional wisdom allows. Instead of a one-way movement from the vendor to the customer, we find that product development is a relationship in which the customer becomes intimately involved. True satisfaction of customer needs requires more than a slogan about being committed to customer satisfaction. It recognizes the necessity of a continuing dialogue with customers during development and it requires having a breath of resources and expertise available to offer products that actually meet customer needs.

Effective product development to satisfy customer needs requires the willingness to include the customer as a participant in the product development process. SSI has found that it is the dedication to work with customers during development as much as the technical resources that has given the company a competitive edge in product development. The benefit of customer involvement in the beginning stages of product development is evidenced by a steady evolution of fiber optic submarine cable systems across a spectrum of feature capabilities.

Although the newer developments maybe more technologically advanced, the succeeding products do not necessarily make their predecessors obsolete. Rather, they expand and shift the spectrum in such ways as to give customers more choices. As the product spectrum expands, so does the marketplace. The breadth of AT&T's product line opens the door of opportunity to telecommunications service providers that have never operated submarine cable systems before. These customers will use submarine cable technology in new ways to expand their own ability to provide services in the areas ranging from local phone service to broad band digital capabilities.

SL2000 is the first AT&T SSI product to be developed fully with the customer as a dynamic partner in the process. SL2000 pushes the technology envelope farther out in terms of expanded capabilities with less maintenance and eventually lower operating costs. However, SL2000 does not make its predecessors obsolete. Rather, it responds to specific customer demands. SSI's experiences with customer involvement shares a significant responsibility for expanding our product spectrum.

How Needs Evolve Into Demands

In approaching product development, SSI realized early that a more sophisticated understanding of customer wants, needs, and demands was required. Philip Kotler, world-renowned expert in the area of marketing and customer satisfaction, provides an interesting insight into the dynamics that lead to customer demands:

> *A human need is a state of felt deprivation of some basic satisfaction; wants are desires for specific satisfiers of these deeper needs; demands are wants for specific products that are backed up by the ability and willingness to buy them.*
>
> *Kotler simplifies this observation by saying that "wants become demands when backed up by purchasing power."*

Based on Kotler's explanations, SSI recognized that we could fulfill requirements with real products only when the customer's needs evolved into real demands. To put ourselves in a position to offer a product solution when the customer reached the point of demand required developing a strategy to translate the customer's needs into wants and wants into real demands. Obviously, by directly engaging the customer in the product development process, the customer's realization of a demand also coincides with the availability of the product specifically to satisfy that demand. In other words, purchase decisions are made when customer needs evolve together with product development. The bottom line measurement of success for this philosophy is SSI's current inventory of orders valued in excess of $1.0 billion (US). Moreover, that inventory of orders includes products serving the entire spectrum of customer needs.

Talking With Customers

SSI's success in developing products serving the submarine cable market comes after many years of talking directly with customers and studying their business goals. A critical aspect of this process involved paying continuing attention to the customers' needs rather than to just the products and services we had to offer. SSI appreciated the imperative to understand the customer's view point in order to compete successfully in a global marketplace. Looking at the marketplace critically, we discovered that it is really a diverse collection of many smaller markets, each requiring unique products to satisfy its needs. To become recognized as a global telecommunications provider, it was very important to develop a group of diverse products. One product cannot satisfy the total marketplace.

We looked at each customers' characteristics and various stages of development and sought where communities of interest lie. Segmenting this universe into common communities of interest helped simplify the market development task. In addition to talking directly with our customers, we also took advantage of traditional research techniques to identify common bonds of interest among different customers. The research included analyzing trade journals, news releases, sales force debriefings, and customer interviews. We identified current and potential customers for transoceanic, regional, inter-regional, and national cable systems. As we identified gaps in current product capabilities, we simultaneously identified opportunities to develop new products to fill those gaps. The results include expanding our fiber optic submarine cable products from our original SL280 base to a complete line of systems: SL100, SL560, and SL2000.

Expanding the Marketplace

AT&T's traditional submarine cable systems market comprises those administrations and entities that have always provided submarine cable service, beginning with the early days of coaxial cables. They began to deploy fiber optic submarine cable systems a decade ago. Back then, AT&T's SL280 product was the first and remains a benchmark for quality and service. A key concept that we address is the customers' need for connectivity to the global network. During the last few years, the marketplace for submarine cable systems has expanded rapidly as more national telecommunications providers seek access to the global network through national and regional submarine systems. Market research shows that more money will be spent on improving telecommunications infrastructure in the next ten years than in the last hundred years combined. Researchers suggest this investment will reach $200 billion (US) by the year 2000.

Newcomers to the submarine cable systems marketplace have slightly different priorities than established customers. Although each customer has its own unique set of priorities, the following requirements addressed these issues:

- **Price** — Although every customer is sensitive to the price they pay for equipment and services, the costs of submarine cable systems have reached a level where this market pays more attention to questions of value.
- **Reliability** — For experienced operators of submarine systems, demonstrated reliability is measured in terms of both system availability as well as in maintenance costs.
- **On-Time Delivery** — The revenue-driven aspects of this business elevate the importance of the vendor's ability to meet the date when the system is scheduled for service. Every day's delay means thousands of dollars in lost revenue opportunities.
- **Shorter Delivery Cycle** — This requirement is also revenue driven. Rather than a three-year cycle from contract to installation, customers want to cut this to one and a-one-half years. In April 1992, AT&T was able to

pull together its vast internal engineering, installation, and technical support resources to install TAT 10, a SL560 transatlantic link between the United States and Germany system, in less than 30 days. Not only fast, the installation was also flawless.

- System Performance — Error-free transmissions also impact revenues. Therefore, most system tenders include stringent performance requirements measured in bit-error rates.

World-class Resources

As noted earlier, SSI recognized long ago that one of the key ingredients to being able to continuously meet customers emerging and evolving need for sophisticated fiber optic submarine cable based products was a rich mix of resources and expertise:

- **Partnership Tradition** — Until 1984, AT&T's primary customers for telecommunications equipment and services were within the AT&T family. It was routine to talk with one another about needs and requirements. Therefore, our traditional corporate culture developed as one of cooperation and partnership. It remains one of the pillars of how we do business today. We take this practice to the point of reviewing where our customers may identify gaps in their expectations of SSI, even if a project goes to a different vendor.
- **World-class Experience** — SSI has the advantage of being part of the largest and most experienced *operator* of telecommunication networks. Many of the technologies that evolved into international or industry standards originated in AT&T's operating networks. More than a century of global experience gives us a unique perspective and enables SSI to relate submarine cable systems to the larger network implications. We can easily understand our customer's needs from a operator's point of view.
- **Comprehensive Technology Base** — AT&T develops, manufacturers, installs, maintains, and operates every aspect of telecommunications technology. Although we are at the forefront of open systems and multi-vendor initiatives, we are capable of delivering every piece of a submarine system from the interface with the national network to the transmission equipment, the operations, systems, and the cables. This means that we can help customers develop complete systems tailored precisely to their needs without compromising either the technology or the standards.
- **Turnkey Services** — From idea to operations, AT&T SSI is capable of providing it all. Comprehensive services include engineering, design, delivery, installation, training, operations, and maintenance. For customers new to submarine systems ownership and operations, the availability of turnkey services and planning support is very appealing. For others, AT&T provides the confidence that we can work with their team, supplementing their resources with those of our own.
- **AT&T Bell Laboratories** — When we speak of unique resources, none are more widely recognized and appreciated than AT&T Bell Laboratories. Many vendors have fine research and development capabilities. The element that distinguishes Bell Laboratories is a level of basic research comparable to that sponsored by national governments. This is the only industrial research and development organization to boast seven Nobel laureates.

Many competitors in the information movement and management industry do not have this breadth of resources available. Developing, building, installing, operating, and maintaining submarine cable systems is beyond the scope of many telecommunications vendors. Many vendors can offer pieces of a solution only. Submarine cable systems require a breadth of expertise limited to a handful of companies around the world. Even among the world leaders, few compare with AT&T in available resources. However, sometimes what the others may lack internally can be acquired through joint ventures and creative partnerships. The one resource that others cannot acquire is the technological leadership of Bell Laboratories.

Choices — AT&T's Breadth of Products

AT&T's product development efforts began more than a decade ago when we realized that to meet the market requirements for higher quality, higher capacity and more economical long haul transmission systems, analog coaxial cables had to be replaced with fiber optic undersea facilities. Our SL280 was introduced in the 1980's as the first fiber optic light wave system capable of transmitting up to 20,000 voice circuits per fiber pair. It is from this foundation that we have engaged our customers in further advances in light wave technology. The next major development was the introduction of SL560, an optical fiber based system capable of carrying up to 40,000 voice circuits per fiber pair. SL560 represents a fundamental advance in quality and performance in addition to its expanded capacity. With appropriate multiplexing technology, its capacity can be further extended to 80,000 circuits. This system uses proven design techniques with a robust operations capability that includes automated surveillance control and maintenance systems as well as equipment redundancy. The first SL560 system is TAT 9, which was installed in 1991 and went into service in 1992. This technology will continue to serve as a proven, reliable work-horse in systems around the world for many years to come.

With some newer customers, we have identified an emerging need for non-repeatered systems as the preferred telecommunications medium for shorter haul systems. Non-repeatered systems are ideal for mainland-to-island, festoons of coastal loops, island-to-island, and river, bay, or lake crossings. These applications, which are growing in importance all around the world can provide national connectivity to a regional system. AT&T's SL100 is a non-repeatered system that delivers tremendous flexibility at a very attractive cost. Without the need for repeaters, the terminal equipment becomes the key determinant of bandwidth. Once the undersea plant is installed, the system is capable of operating at a variety bit rates. This is especially ideal for applications that must start small and that can grow as requirements grow.

Building on this experience in customer-based product development, AT&T SSI fully engaged our understanding of customer demands for reliability and performance in the development of the SL2000 product. This system has advanced reliability features that also lead to lower operating and per-circuit costs. The SL2000 system takes advantage of optical amplification technology. This advancement eliminates the need to convert the optical signal to electronic and back to optical again at repeater sites. This results in high quality and reliability, because fewer components are required at each repeater location. AT&T's amplifier technology can span distances of up to 9,000 kilometers. Capable of transmitting at 5.0 gigabits per second, SL2000 will offer up to 300,000 voice circuits per fiber pair using the appropriate multiplexing equipment. This system also supports CCITT-Synchronous Digital Hierarchy (SDH) standard capabilities, including end-to-end surveillance and line monitoring. As part of the customer-driven development of this product, a comprehensive installation process assures on-time delivery of a fully-tested system that performs as required from day one.

The first SL2000 system will go into service in 1994. However, SSI will not wait that long to know how this new product will perform in service. Part of the development process includes constructing an actual 9000 km model consisting of fiber and electronics to demonstrate, not simulate, optical transmission performance at 5 gigabits per second. This test bed system has been operating for several months.

Summary

These products, SL100, SL560 and SL2000 are end to end system solutions that respond directly to customers problems. More than technological solutions, these products represent total response to customers ' demands- turnkey solutions for which SSI assumes full responsibility for manufacturing, assembly, construction, testing, and maintenance. Responding totally to customer demands is fundamental to a corporate wide AT&T commitment to quality. SSI follows this commitment through the use of multiple measurements to tell us how well we respond, from customer interviews to Malcolm Baldridge National Quality Award measurements process. The ultimate measure of our success is that two of AT&T's business units, Transmission Systems and American Transtech, won the Malcolm Baldridge National Quality Award in 1992 — an absolutely unheard of feat that has earned national recognition for our unparalleled devotion to customer satisfaction.

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1993 Pacific Telecommunications Conference
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The Technology-Human Factor Relationship

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ABSTRACT

In the adaptation of telecommunications technology to societal applications, the importance of `technology push' in both the rapid development of telecommunications and related information technology and their diffusion nationally and internationally, receives some acknowledgement. However, the neglect of the demand side is seldom mentioned. Three interrelated aspects are explored in this paper. First, the nature of demand for information as opposed to IT; second, the complementarity between new technology and human and organizational resources; and, third, the need to combine the `technology push' supply side aspects with demand considerations in the context of a theory of economic growth. In this way some progress can be made in clarifying major claims made for telecommunications technology; namely, that it makes a significant contribution to economic growth and that there is an equitable sharing of the benefits of the Information Age. The dominance of technology in analysis has led to policies and resource allocations that inhibit the benefits of investment in IT. All too often problems arising from neglect of the basic complementarity between human and organizational resources and technology are viewed as merely roadblocks on the way to the technological utopia - roadblocks that can be removed at low or even zero cost. Analysis, policy formulation, and their supporting research agenda are in need of substantial revision.

1945 WAS A GOOD VINTAGE

We need historical perspective on the way these processes are conceptualized, on the `pushes' and `pulls' that are involved. For information society buffs and especially IT ones, 1945 was a good vintage, even if few had the vision to take full advantage of the mix of rich perceptions that were on offer. For example:

(i) Arthur Clarke's paper, "Extra-Terrestrial Relays Can Rocket Stations Give World-wide Coverage?", was published in *Wireless World* (1), showing that satellite communication was possible. There were, of course, the inevitable denials by 'experts' but the first satellite of the 1960s was to grow in size, complexity and output. Diffusion of the new technology generated great expectations and probably did more than anything else to foster 'the global' myth;

(ii) Hayek's "The Use of Knowledge in Society" had appeared the previous month (2). I think someone described Hayek as "the most intellectual defender of capitalism" and that essay, a significant milestone on the road to development of information economics, was a defence of the market system, for he attributed to that system the capability of handling the use of knowledge in society.

(iii) Mid-1945 Vannevar Bush sprung the notion of information overload upon us in his paper, "As We May Think":

> There is a growing mountain of research. But there is increased evidence that we are being bogged down today as specialization extends. The investigator is staggered by the findings and conclusions of thousands of other workers - conclusions which he cannot find time to grasp, much less to remember, as they appear. Yet specialization becomes increasingly necessary for progress, and the effort to bridge between disciplines correspondingly superficial. The difficulty seems to be, not so much that we publish unduly in view of the extent and variety of present-day interests, but rather that publication has been extended far beyond our present ability to make real use of the records (3).

Bush's solution was a "memex": "a sort of mechanized private file and library", storing all the individual's "books, records, and communications", which could be consulted "with exceeding speed and flexibility-an enlarged intimate supplement to his memory" (4).

So half a century ago there were:

- Technological foresight coupled with optimism about the development of communication technologies;
- A seeming reconciliation of this kind of technological change with the basic market model on which Western societies were operated; and
- Promise that the new technologies could be harnessed to serve science, through new specializations and the industrialization of information processing and research activity.

I do not need to stress the unresolved nature of the debate about the possible outcomes from this interacting set of forces. I believe it helpful to think in terms of 'technology push' and 'demand pull'(5). No doubt there is an element of each whenever technological innovation takes place. Modern times, however, seem to have witnessed the dominance of 'technology push', to the neglect of the human factor, perhaps especially in the case of communications technology but also in, for example, medicine.

Consider a recent occasion: the Geneva 1991 World Telecommunication Exhibition and Forum, the latest in a 20-year series reflecting the growth of the telecommunications industry. How successful was Telecom 91? The organizers judged success in terms of the number of visitors; the total amount spent on exhibits, travel, entertainment and other expenses (i.e., more than $US 0.5 bn); the presence of the "stars of the industry" (i.e., 1,000 ministers, chairmen and other top officials); and the conduct of business "at a dizzying pace"(6). But even the *Telecom 91 Daily* could see a down side: the conference would be remembered "for its inattention to the needs of developing nations", the absence of a "clear theme", and the "technical pornography"(7).

This major event was directed towards "An interconnected world: improving the quality of life for all"(8). I was reminded of the Du Pont slogan: "Better things for better living...through chemistry". The Du Pont painting for the 1939 World's Fair, now hanging in the company lobby in Wilmington, Delaware, made very clear that the better living was "for all", the poor and downtrodden coming on stage from the left are transformed into a happy, enlarged family with a basket of goodies moving off to the right. Of course, telecommunications is spoken of as a benign technology when compared with Du Pont products, which included black powder, dynamite, management services for the Manhattan Project, tetraethyllead, and CFCs, so creating "a merchant of death image" (9).

Perhaps it is as well to remember that Du Pont and nearly everyone else uses telephones and the associated IT, before being swept up by the Telecom 91 "vision for a Borderless Planet" promoted in Geneva. After all, 15 per cent of the world population has access to 85 per cent of telecommunication services and two thirds of that population have no telephone services available (10).

We find much the same mix of 'technology push' and neglect of equity considerations if we look to the future with the cyberspace experts. The world they contemplate and seek does not yet exist; it is the ultimate human-computer interface - a world behind the computer screen as magical and marvellous as the one Alice discovered behind her looking glass. It gives access to "vast data bases that constitute the culture's deposited wealth, every document is available, every recording is playable, and every picture is viewable"(11). This is 'technology push' in the extreme. There are no economic constraints in a "harsh, nightmarish", "man-made information jungle"(12). There is an added Orwellian threat: "With the thrill of free acess to unlimited corridors of information comes the complementary threat of total organization"(13). Of course, the PVWs (Personal Virtual Workplaces) and CVWs (Corporate Virtual Workplaces), on closer scrutiny, bear quite a resemblance to Bush's memex.

THE DEMAND FOR INFORMATION

Let me turn to the first of the interrelated aspects I wish to introduce - the demand for information. Developments in information economics have focussed attention on the characteristics of information, in sharp contrast to mainstream economics which was somehow able to transform uncertainty into a perfect certainty equivalent. Now we try to unbundle the uncertainty, to look at the various characteristics: receiving the desired information at the time required, in the briefest form and in order of importance, with necessary auxiliary information, all with the reliability and sources indicated. The effort or cost should be minimized. The process should not be cluttered with unwanted material. And finally, no response should, in an ideal information system, mean very definitely that it doesn't exist. This list dates back to the 1950s (14).

There are further complications to the notion of rational use of information. Choice theory favours optimization while satisficing theory recognizes the limits to information and sees optimization as impossible. These approaches have in common the good and effective use of information. We must also allow the possibility that decision-makers fall into error: they may fail to select the correct action even when the messages are appropriate; and they may respond to the wrong information. The influence of their experience, of their attitudes, must be added to such factors as transactions costs, search costs, and asymmetries (15).

HUMAN AND ORGANIZATIONAL RESOURCES

Not only do decision-makers have histories, they also exist in an organizational context, or rather many organizational contexts - family, workplace, community, State, etc. Each brings to a decision the learning and skills of experience; each operates in an organizational context. This can lead to the Kenneth Arrow argument that "the combination of uncertainty, indivisibility, and capital intensity associated with information channels and their use imply (a) that the actual structure and behavior of an organization may depend heavily upon random events, in other words on history, and (b) the very pursuit of efficiency may lead to rigidity and unresponsiveness to further change"(16). In effect, Arrow is providing an economist's version of cognitive dissonance (17).

TECHNOLOGY, THE HUMAN FACTOR AND GROWTH THEORY

I am trying to contrast the technological utopias with an emphasis upon human and organizational resources.

What is needed is recognition that these inputs are complementary; and that recognition can come, I believe, from an understanding of the economic growth context.

It is fashionable to assign telecommunications a leading role in economic growth. The new systems enable rapid and flexible adjustment to changing market conditions; coordination is improved and extended; everyone can operate globally - whatever they take that to mean. While the multiplier effects of telecommunications expenditures are comparatively small, those effects are spread widely through backward and forward linkages; scale, scope, growth and network economies are achieved; greater expectations are generated; competitive edge is conferred - although Schumpeterian imitators might be quickly off the mark to erode the profits.

More generally, so the argument goes, cheap and easy communication helps create wealth. 19th-century towns grew around railway stations; 20th-century ones need good, cheap telephone service. Information flow around the world is itself part of trade, and a means of trading. Even investment is more difficult with poor phone service. Reasoning like this, despite its appeal to many actors in the telecommunications industries and to many of those responsible for policy matters, still needs to be put into the context of a theory of economic growth.

The mystery of economic growth is, according to a recent article in *The Economist* (18) about to be solved. A new orthodoxy stemming from the work of Paul Romer and like-minded thinkers is said to be discernible. To the neoclassical theory's capital and labour has now been added another factor of production: knowledge. This is said to be yielding more plausible conclusions. Knowledge can raise the return on investment, but like the acquisition of other productive assets, there are costs. Because knowledge is productive, success can fund further investment in knowledge creation which in turn can make further investment more productive. This purported breakthrough might come as a surprise to those familiar with the work of the pioneers of information economics, who analyzed the role of information in decision-making and growth. Certainly their efforts have linked information with organization -with Arrow's information channels- and this plays a vital part in growth. The role of knowledge has been recognized for a long, long time but we have neglected the interaction between knowledge and economic activity. Knowledge must be operative; there must be capability of using knowledge for identified ends; technology must be complemented by human and organizational resources (19).

It looks as if we have identified the building blocks: organizational capital, incentive structures, stocks and flows of information. But we have been content to give the design prize for organizational form to the "market", despite the importance of what goes on inside organizations.

CONCLUSIONS

It is time to revise research agenda and decision-making practices to focus on the potentially very rewarding activity of design of organizations, with a view to fitting together ways of organizing, innovation, and new technology. This is a genuinely interdisciplinary task: scientists and technologists, social scientisis, management and policy-makers must all be involved.

These are not abstract, irrelevant theory issues; they translate into decisions about the world we live in and the world we would like to live in.

The basic complementarity between technology and human resources helps clarify the major claims made for telecommunications technology, i.e., that it makes an important contribution to growth and that it facilitates an equitable sharing of the benefits of the Information Age.

The concept of capital is complex. Schumpeter warned us long ago that capital is "neither homogeneous nor an amorphous heap"(20). Questions I asked almost 20 years ago still seem pertinent:

> We should ask how various kinds of information, both the existing stocks and current flows, complement both each other and other resources. Can we say that those complementary relationships are understood as soon as we hear of books, data bases, computers, land lines, and satellites? Do we know which parts must be available before we can operate others? Do we know the various sequences and lags between economic actions imposed by modern information technology? (21)

Investment in technology, or more specifically in IT, does not guarantee growth benefits, any more than an increase in R&D expenditures does so. Analysis and policy must take account of the complex complementarities, the leads and lags, and the ongoing substitution process. This consideration extends to the equity aspects. There will be no equitable sharing unless those complementarities and leads and lags can be so managed that the benefits of the interconnected world reach all parts of society and all countries. Such an outcome seems improbable: the global economy as seen from New York, Tokyo and London is not the economy seen from within Africa and South America (22).

You may prefer to think these are just transition problems, roadblocks to be brushed aside with ease (23) as we learn how to use these marvellous enabling technologies. If so, I ask you to reflect on the 1945 vintage and ask how much progress we have made in this debate - a debate that goes back much further if we look to the history of other technologies.

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The Human Impact of Converging Communication Technologies: Entertainmentisation, Social Change and Saturation.

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1. ABSTRACT

Interviews and planning workshops helped define the meaning of convergence for Australian users in terms of changes in perception, interactivity, feedback and other capacities. Unintended counterproductive human consequences are then considered. These include continued entertainmentisation of basic institutions and dilution of what might be termed, psychological and cultural infrastructure. An adequate response to these human impacts will depend not on technologies themselves but on the ability of stakeholders to access new ways of socially constructing media and communication systems.

2.0 INTRODUCTION

Human beings embarking on the implementation of new technologies typically are seeking to achieve certain outcomes. Often these are motivated by technical, economic or political imperatives. As well, new technology usually engenders unintended consequences, not imagined by the original advocates of the technology. They are unintended because they are not foreseen. Indeed sometimes they are unforeseeable. Often they occur in domains which are distanced from the original intended outcomes in space, time or the knowledge base required to foresee them. Social and psychological impacts are frequently cases in point. Sometimes they are damaging and sometimes they are productive. When they are potentially damaging it would seem even more important to predict them. The focus in this paper is on unintended potentially damaging impacts, not because these will be the only outcomes of a converged communication system, but because they need to be made visible to designers and stakeholders in the convergence process.

Of course, anticipatory studies are inherently speculative. Therefore, anticipating the human impact of the convergence of telecommunications, information technology and broadcasting must be a speculative analysis. Arguably, speculation is more likely to be valid if it is informed by sound theory and reflections of those who potentially will be affected. Consequently, in this paper we develop a scenario of human impact driven by a theoretical analysis of what converged communication technologies will mean for individual human users. This analysis was informed by interviews with stakeholders driving the technology of convergence within Australia, which helped to define the emerging technologies and products and the way stakeholders framed them. We then report on concerns articulated by representatives from the Australian community in a series of workshops where the future telecommunication system was described and debated. Next, we compare the theory driven scenario with that derived inductively and point to compatible themes of concern. Finally, we briefly describe and evaluate possible responses to these concerns.

2.1. DESCRIBING CONVERGENCE

Initially, we sought to describe in non-technological terms, what was emerging technically in Australia and what this would mean for individual consumers. To this end, as well as examining the international technical literature (Free, Stevenson, Mandeville, Hearn and MacKenzie, 1992), we accessed interviews with key stakeholders in the convergence process in industry and government. The stakeholder interviews, which were sponsored by the Australian Coalition of Service Industries, DITAC and AOTC, were part of a broader scoping study seeking to ascertain the extent of activity related to convergence across Australia (Free et al, 1992).1 These interviews focussed on technical and commercial, as well as social issues. Because scoping studies seek to isolate relatively rare information which is spread throughout a large system, the key procedural issue is the identification of respondents for the study.

Initially, we analysed industry sectors suggested as those likely to hold important interests in the convergence of communication technologies. Major organisations within each industry were then targeted and key individuals who were most relevant and accessible were approached. The analysis of industry sectors was based on an investigation of existing users of analogue communication and other media, a review of the International Consultative Committee for Telephone and Telegraph (CCITT) on future possible services for broad-band telecommunications, a review of the literature and consideration of users of relevant technologies. The final list of contributors included representatives from electronic manufacturing companies, computer and communications manufacturers, the airline industry, software companies, service industries, government departments, libraries, and, engineering, architectural and advertising consultancies.

The interviews were conducted in a semi-structured format and focused primarily on convergence-related activities that the respondents were involved in.2 The interviews were not directly concerned to evaluate or explore issues of human impact. However, they nonetheless chronicle the attitudes and ways stakeholders are currently constructing the meaning of the convergence process. They give an insight into the metaphors, models and driving images which are guiding stakeholders in the convergence process.

On the basis of these interviews and literature we developed an understanding of the dimensions of convergence and a first principles analysis of the impact of this convergence on human communication. The term we use to describe the communication systems arising from convergence is digital video communication (DVC). DVC is not just an extrapolation of our current visual media. The term advanced video communication might capture this. But the term digital video communication implies a quantum shift not just an extrapolation. DVC marries the power of current visual media with the power of the computer and injects it into a network which connects vast numbers of humans around the globe. Because developments are happening at such a rapid pace and many alternative scenarios are hypothesised, it is difficult to be precise about just what changes are in train. Ultimately, political, technical and market considerations will shape the exact nature of the products and services made available. This analysis is therefore based on the general notion of a converged communication system consisting of increased bandwidth, increased intelligence via computerisation, increased visual facility, and integration of video, text, voice and data. We make no precise prediction about the exact form of technology and the likely timing of its emergence though numerous studies suggest the general description is accurate (Free et al, 1992).

3.0 INDIVIDUAL IMPACTS

In trying to understand the human impact of convergence in communication technology, one starting point is to ask what would be different for the individual human communicator in the communication environment engendered by convergence. Human beings relate in an intimate way to their immediate informational and communicative environment. They exist in a cocoon of space and time which is defined largely by the information and communication they receive. Existing media have already radically changed the nature of the space-time habitat of individual humans (Hearn, 1991).

However, an analysis of the essential components of digitalisation, visualisation and networking suggests a number of even more fundamental changes to the communication environment of individual users that may result from convergence. These include:-

- hyper-realistic perception
- increased interactivity
- integration of communication channels
- increased storage of communication history
- increased descriptive capacity for complexity and detail
- increased capacity for experimentation
- greater elaboration of communication feedback loops

Let us examine each in turn:

3.1 HYPER REALISTIC PERCEPTION

The digitisation of television pictures and the associated technology of high definition television (HDTV) has been heralded as providing an equivalent increase in viewing quality to the increase in quality compact discs have provided for audio communication. However, the relationship between increased definition and enhanced viewing experience is not necessarily a simple and direct one. (See Lupker, Allen and Hearty, 1988; and Neuman, 1988.) Viewer reactions to the new quality of picture have not been adequately assessed. The main reason for this is that the quality of the viewing experience will ultimately depend not solely upon the picture quality per se, but upon the picture quality in conjunction with new genres of picture content. Put simply, suitable test materials have been lacking. Viewers may experience a high definition picture of an orange as not particularly more dramatic than an ordinary TV picture of an orange. However, a snowstorm sequence in a dramatic film on a large flat screen may in fact be perceived as a quantum leap in viewing experience. The development of such films capitalising on HDTV is under way (Hallett, 1991). Moreover, the enhanced quality of image is expected to have applications in printing, medicine, public display, computing, education and the military (Bedford, 1991). When combined with digital technology, applications and genres are likely to be developed which exploit the higher image quality. In Japan, the Gifu Art Gallery is a good example of such an application. The enhanced picture quality allows visitors to appreciate not only composition, but brushstroke and texture of paintings chosen from a database of masterpieces.

It is fair to say, therefore, that despite some evidence of only moderate reactions from potential consumers, it is clear that DVC will enhance the "quality" of the image and sound packages we receive. That is, the package will be more attractive to eye and ear; smoother and more seamless. The Nippon Telegraph and Telephone corporation (NTT) vision for the 21st century suggests the key word to describe the new technologies is "ultra" (NTT, 1990). Indeed it could be argued that the perceptual quality of DVC will actually surpass the perceptual quality of reality. A digitally constructed video of a walk through a rain forest will feature greener foliage, more detailed textures, clearer twig snaps and so on, than an actual walk: DVC will allow us to achieve an artificially heightened awareness. As such, will digital take us a step closer to realities we are attempting to represent or a step toward a different dimension altogether? Are we changing our perception rather than supplementing it?

3.2 INCREASED INTERACTIVITY

In addition to altering perceptual qualities, DVC also alters the nature of the interaction between the communicator and the medium. Consumers' interaction with television sets is limited to switching it on, changing channels and occasionally talking to it. For the most part the communication is initiated by the producer and received by the consumer, notwithstanding the fact that consumers may process this material in diverse and idiosyncratic ways.9 DVC opens new opportunities for interaction. These include expanding repertoires of choices (e.g. via digital delivery systems), both of content and order of presentation (e.g. interactive video disc), the ability to change content and image (e.g. CAD) and ultimately perhaps total emersion in completely synthesised sensory experience (i.e. virtual reality) (Rheingold, 1991). As well, videoconferencing applications provide for increased interaction, at a distance, in the traditional sense of communication interaction.

Although some of the enhancement of interactivity will be initially trivial e.g. an extra ending on a movie, the range of interactivity available may expand exponentially in time (Rheingold, 1991). This interactivity will change the communication experience of users. But interactivity will not automatically guarantee the human communicator is advantaged. On the one hand, the increased interactivity will lend itself to a dramatically increased ability to engage in problem solving activities e.g. in the case of a designer experimenting with different structures and forms. On the other hand the increased interactivity may lead to hyper-passivity e.g. a surrogate traveller choosing among views from a mountain. In this case, arguably, the involvement is less, only the illusion of involvement is greater. Interactive educational media will assist in routine information acquisition but will not necessarily provide higher level analytical skills. Clearly, industry, entertainment and educational uses need to be evaluated separately.

Perhaps the overriding conclusion is that the increased interactivity which the technology will potentially provide will be used in different ways by the humans involved. The human variables remain unchanged. The new technology will magnify their manifestation.

3.3 INTEGRATION OF COMMUNICATION CHANNELS

Existing communication technologies tend to operate using only one or perhaps two of the communication sensory channels which human communicators have at their disposal. For example, telephones operate by voice, newspapers operate by sight, television operates visually and so on. DVC will provide the opportunity for the integration of video, text and voice in both one-way and two-way communication processes. As such, DVC opens up a new paradigm of communication possibilities: a communication environment where all channels are integrated more closely, parallels our experience of normal perception and unmediated communication. This would possibly make utilisation of the new technologies more transparent. In a real sense they become an extension of our normal selves, our normal means of operating and communicating on a day to day basis. As well, this integration provides for a restoration of a holistic approach to communication. That is, it better provides for a more complete analysis of problems or presentation of ideas from all perspectives not just those able to be communicated visually or those able to be argued for logically. Instead, it invites us to develop a multi-dimensional perspective in our communication. This may enhance our ability to deal with the many complex problems that face industry and society generally. This integration of communication channels could conceivably impact on our timing and arrangement of communication. For example, it may be no longer necessary to fax preliminary printed material as a precursor to a complete pictorial document, to precede a verbal discussion. The new media will allow the compression of the separate types of communication. As such they open up new approaches to decision making and education in organisations.

3.4 INCREASED STORAGE OF COMMUNICATION HISTORY

Digitalisation brings about an increased capacity for storage. This will mean more communication histories are available. All relationships have a history. All communication automatically generates a history. In some contexts the recording of what has been said is of crucial importance, for example in parliamentary and legal contexts. Our current communication technologies are capable of storage to a limited degree. Video tapes may be recorded and kept or transcripts may be entered into computers. DVC will generally enhance the capability of storage of recorded communication. More importantly, it will enhance the ability to retrieve such information. This may be accomplished via sorting and database processes which are an extension of current technologies. It is likely that, given their common digitisable form, current storage capacities for text will be paralleled by storage of visual and data forms. As well, their integration will be possible. Scientific reports may utilise an integrated visual and text-based format as a better guide to replication than the traditional report (Davies, Bathurst and Bathurst, 1990).

Speculatively, it would be a relatively simple matter to record every public utterance of politicians, for example, and to sort, access and process this material in sophisticated ways. Meeting minutes, whether in organisations or parliament, could be superseded by complete storage of all interactions. Replays of previous meetings will be instantly accessible and repayable at the request of any future participant in a meeting procedure. Whereas current methods of retrieval are lengthy and of necessity sequential, digitised visual storage can be accessed more quickly and more randomly. Communication history is important because it provides the context for the perception of meaning of any communication. Access to communication histories enable multiple sampling of that background from different perspectives and under different emotional and social circumstances. Although the exact storage capacity of DVC systems is still technically uncertain, at the very least, DVC will offer an enhancement of current storage capabilities. Even though the exact extent and nature of the use of such storage is difficult to predict, the issues raised here are not unrealistic.

3.5 INCREASED DESCRIPTIVE CAPACITY FOR COMPLEXITY AND DETAIL

As a consequence of increased storage capacity and integration of channels, as well as the increased visual facility of DVC, the capacity of the human communicator to deal with complexity and detail will be enhanced. A picture is worth a thousand words because it is a much more economical and natural way of describing something in detail. HDTV will allow the brushstrokes of a work of art to be discerned. Geographical Information Systems (GIS) databases will allow us to zoom in on a designated district to extract whatever details we require. Advanced medical applications will allow for more fine-grained analysis of symptomatology.

Not only will DVC allow us to focus on detail but it will allow for the rapid juxtaposition of different frames of information. This enables a more complex picture to be built up over time. For example, drought patterns, erosion patterns, stock disease patterns as well as urbanisation trends could be juxtaposed to gain a better understanding of complex social, economic and technical systems. Thus DVC will make possible both convergent and divergent treatment of detail. Convergent by allowing for greater and greater focus and divergent by building more and more layers of information.

3.6 INCREASED CAPACITY FOR EXPERIMENTATION

As a result of all the preceding capacities that DVC provides, DVC brings with it an unparalleled capacity to manipulate the pictorial symbol system. Visual experimentation is already impacting dramatically on the sciences, design processes and entertainment (Freidhof and Benzon, 1990). Two processes facilitate this. Firstly, human experimentation proceeds essentially via extrapolation and guessing. Computer driven visualisation allows humans to see the consequences of their guesses much more quickly. Secondly, and partly as a result, this allows the time saved in picturing the consequences of guessing to be devoted to more guessing, analysis and synthesis of ideas. In a related way, it can be argued that pictorial communication is superior to the word-based and numerical communication for initial stages of problem solving, particularly for those requiring open ended or fuzzy analysis rather than strictly deductive logic (Davies et al, 1990).

Davies et al (1990) provide an example of how DVC aids in the process of experimentation in biochemistry, where traditional ball and stick model building has been replaced by computer graphic simulations of moving molecules which can be observed, analysed and then discarded or built upon. Computer-aided design allows engineers to discern how components will fit and to assess how new designs will cope with compression, tension and twist. Applications of this enhanced ability are already extensive.

In a sense then, the examples described use enhanced experimental capability to lead to a more accurate understanding of reality and more complex interventions on reality. The same technical capabilities that allow us to speculate, see from a different perspective, and "play with" reality will also allow for more elaborate manufacturing of unreality as well. Rich and complex fantasy scenarios could be constructed and experienced (Rheingold, 1990). This capacity presents a number of problems which will be returned to in the final section.

3.7 GREATER ELABORATION OF FEEDBACK

Feedback is an important component of the human communication system. Feedback is essential to our capacity to learn. It enables the communicator to monitor the consequences of their intended communication to make adjustments accordingly. DVC enhances feedback capability in two ways.

Firstly, many of the consequences of communication are invisible. For example, when we communicate with someone else we do not see their emotional reaction in its entirety. We certainly do not see the thoughts that accompany that emotional reaction. Feedback consequences of communication may also be complex, subtle and dissipated e.g. the consequences of an environmental communication campaign may be difficult to encapsulate directly. DVC thus enhances the feedback process by (a) making complex processes visible (for example, data can be collected over a long period of time from diverse sources and translated into graphs or direct pictorial simulations), and (b) speeding up processes that would normally take many months. For example, erosion patterns which occur slowly and imperceptibly can be speeded up and made visible. DVC would enable heart rate, EEG, GSR, and other biofeedback indicators to be displayed for remote medical diagnosis. In distance education DVC may allow for more complete feedback to be provided for students more opportunely.

4.0 SYSTEMIC CHANGES

While this assessment of what DVC may mean for individual users is instructive, it has a major limitation. Namely, it treats both users and changes largely in isolation. Human impacts will need to be understood in a systemic way as well. For example, the impact of interactivity will depend in part on a critical mass of willing interactants. As well, the final shape of communication services will depend on a dynamic combination of political, technological and economic factors. Given DVC is pervasive and infrastructural, unforeseen systemic human impacts also need to be predicted. Given this, we sought to include some form of systemic considerations in our initial analysis as well.

One avenue of analysis of systemic affects is provided by the tradition of analysts who have considered societal effects of new media forms as opposed to contents (McLuhan, 1964; Meyrowitz, 1985; Ong, 1982). Most recently, Mitroff and . nnis (1989) have advanced an argument that existing media are having subtle yet dramatic societal effects. Indeed they argue that existing media have fundamentally changed basic societal institutions. The mechanisms of this dynamic include the enhanced capacity for fantasy; the juxtaposition of radically different contents and some subsequent warping of traditional content boundaries; the engineering of bizarre images; the overloading of information and subsequent radical simplification of ideas; incestuous recycling and dilution of ideas and images; the reversal of natural patterns of causality by image manipulation; the accentuation of the visual and emotional leading to the development of personality and celebrity cultism.

4.1 ENTERTAINMENTISED INSTITUTIONS

What results is a "massive infusion of entertainment into every realm of human affairs, to the point that everything threatens to become nothing but a sub-branch of it" (Mitroff and Bennis, 1989). Politics, education, religion and business have become significantly entertainmentised. Further a society so infused with entertainment has become dependent on it in order to distract it from the complex problems which require solution. Its impact can be argued to be economic as well as social. If it is true that DVC entertainment products will be exponentially more engaging than television (Rheingold, 1991), an increasing rate of slide to unreality is a reasonable prediction. In other words such an analysis based on existing media can be extended into the realm of converged communication technologies given the way we have argued these technologies will affect the individual human communicator.

4.2 PSYCHO-SOCIAL INFRASTRUCTURE

At a more basic level we can ask what will be the effect of this new century communicative environment on much of the basic cultural infrastructure now taken for granted. Every culture depends on basic infrastructure of language cognition and arousal management which are very expensive for a culture to produce and maintain. Partly this infrastructure has to do with literacy. Literacy in numerical and word base communication represents a gigantic cultural infrastructure which is easy to take for granted (Bathurst et al, 1990). Traditional media requires many years of development of the requisite skills for participation in production and consumption. Visual media requires no literacy to begin consumption and different forms of literacy to exploit the media (Postman, 1985). Current media involve consumers, especially children, spending large amounts of time in consumption. Children watch 20 to 25 hours per week television. DVC promises new experiences which will be even more engaging. Will we see a fundamental shift in the literacy infrastructure as a result of the immersion of a generation of consumers in the environment that converged communication systems provide?

Moreover the cultural infrastructure we are speaking of is much more than print literacy. It relates to even more fundamental processes of arousal, motivation and time orientation. These are the very building blocks of culture. It can be argued (Hearn, 1991) for example, that existing media have altered the way people allocate their time between obligatory and discretionary activities. Currently, people spend most of their time either working or engaged in other obligatory activities. The 20th century has seen an increase in what might be called left-over time or discretionary time. Large chunks of this discretionary time are currently absorbed in media consumption. Media consumption has displaced many discretionary activities, for example crafts, reading, and so on. Moreover, media consumption has rendered solitude a thing of the past. The displacement of solitude and discretionary activities in which humans can be reflective and creative is also part of the change in the cultural infrastructure that we are speaking of. DVC will continue to change this cultural infrastructure providing more variety, more engaging and influential media and simply more quantity of material for consumption. This is likely to increase time spent in media consumption and accelerate the dilution of the traditional cultural infrastructures.

This analysis foreshadows some systemic changes that are predictable given the impact of DVC on individual human communicators. With this theoretically derived scenario in mind we conducted some basic research to begin to derive community perceptions of this emerging technology and associated issues. This research was intentionally inductive. By giving a voice to those who will be affected by the new technology we sought to inform our analyses with a different perspective from that of the stakeholders or theorists. It was carried out by a team of researchers who represented different viewpoints to the theoretical analysis so far described.

5.0 PLANNING WORKSHOPS

This phase of research comprised a series of future planning workshops involving a cross section of community, corporate and government representatives. The process was intended to be a participatory and anticipatory consideration of future communication systems. It was designed as an active, learning process in which all participants were encouraged to critically appraise the alternative futures open to them and learn to judge the issues, opportunities and problems associated with such options (Morgan and Ramirez, 1983). These search seminars, as yet not completed, brought together a cross section of the Australian community to discuss and debate future social and policy implications of future telecommunication services. The focus was on broadband intelligent network services, but within the context of convergence more generally.

The design of the discussion sessions began by encouraging participants to sketch a broad picture of desirable futures for society. Generally, this formed a bench mark for the next day and a half of discussion, debate, analysis of issues and formulation of description of social and policy implications of new telecommunication services. To date, two workshops have been held in South East Queensland with a total of fifty-two participants involved in these forums.

6.0 INDUCTIVE SCENARIOS

Many issues were raised by participants. Some issues were extensions of issues from the current telecommunication environment (e.g. cost, subsidisation, equitable access, public participation and accountability, basic communication rights, and ethical services). Others were technical, economic or regulatory in nature (e.g. privacy, ownership and control of information, and impact on jobs).

Three themes, however, recurred which are directly relevant to our focus on human impacts, especially unintended ones. These were the impact of technology on social structures, the need for enhanced customer control of personal information and services and thirdly the impact on leisure time.

6.1 IMPACT OF TECHNOLOGIES ON SOCIAL STRUCTURES

A fundamental concern revolved around the issue of whether new technology would impact on fundamental and valued social structures. Issues of alienation, fragmentation and the dilution of existing community were emphasised. Related themes revolved around the meaning of individuality and the loss of anonymity in the information age. It was seen that individuals fashion their sense of identity in community with others. While it was acknowledged that communicative technologies could in fact contribute to a sense of community, it was felt that this depended on the way technology was implemented and understood in the community. Most technologies, for example, home shopping or other interactive services could be seen to provide potential to either enhance or decrease the sense of community felt by consumers to be already greatly eroded and fragile.

What then will be the impact of increasing technologisation of this process of community and identity formation? The technology of the information age seems to be committed to increasing individuality and fragmentation. How will the new system design for integration and understanding between people - for an increasing sense of "usness". How will new telecommunication systems provide for this process and prevent people from becoming more housebound and even further isolated?

6.2 PERSONAL CONTROL OF INFORMATION AND SERVICES

A fundamental human need is to feel in control. Consumers already feel deluged by an over complex information environment. New services threaten to exacerbate this problem. A fundamental design consideration therefore is the type of control which the new system allows. Further, control may not be achieved by more information or more levels of choice. Rather, it may be achieved by simpler information with more attention paid to educative processes instead of technology. Some ways in which new technology might enhance customer control would be through knowledge of progressive billing, smarter identification of phone calls and more intelligent billing systems.

6.3 IMPACT ON LEISURE

Leisure time is seen to be fundamentally implicated in these technological changes. New leisured services are part of people's imaginings about new telecommunication services. Included are accessing of video and music databases, cinematic quality and virtual reality activities. The location and form of leisure is seen to be changing.

7.0 ANALYSIS AND CONCLUSION

Clearly, in terms of theoretical analysis and respondents' reflections, a central image in the future scenario we are considering is that of individuals as they exist in their immediate sensory/informational/communicative environment. Consumers describing and contemplating the new communication systems intuitively sense a change to this basic unit of existence. This change is engendered by the volume, complexity, and rate of change of the informational environment that they will inhabit. In the face of this change a sense of control over what is happening (or lack of it) is fundamental to a sense of well being. In particular, attributions made regarding whether control resides in us or in the environment are crucial. To the extent that we feel control resides with the technology of the communication system rather than with us, we will feel some disquiet to our sense of well-being. As well, this attribution will eventually trigger more complex beliefs about disenfranchisement from the communication system and alienation from others in the system. At the heart of this dynamic is a fundamental link between human beings' sense of well being in their immediate space and time environment and the way they construct their social milieu (Giddens, 1984).

A fundamental dimension of the social milieu is the distinction between private and public space. Understanding and feeling comfortable with this distinction between private and public space is basic to a sense of well being. Perhaps respondents sense that convergence threatens to change our notions of private and public space (Meyrowitz, 1985). For example, on line database searching would mean we spend less time in public spaces, such as libraries, for example. At the same time other areas of our life once considered private become public space. Video phones for example make our home more public space. Even the inside of our body becomes public space at the hand of sophisticated visual monitoring systems.

The redefinition of the boundary between work and leisure is another example of shift in the notions of private and public space. Not only will the sites where work and leisure are engaged be blurred through telecommuting and telecottages, but shifts in the form of leisure will also blur the boundary between private and public. Interactive fantasy scenarios of previously unparalleled realism will engage people for large amounts of time in experiences in "virtual locations", limited only by imagination. These experiences will shift perceptions, change arousal management habits, change the base line of acceptable stimulation in leisure time and generally distort the boundary between reality and fantasy, private and public.

As we change the basic notion of private and public we also change the way we see ourselves connected and disconnected from our fellow humans. Notions of private and public spheres are about connection and disconnection from others and control over these two processes. New communication media potentially change our connection to our fellow humans. It is even arguable that once this basic relationship is changed our whole social structure is also potentially changed. It is in relationship to others that we derive much of our sense of who we are. Thus when workshop participants articulated concerns that future telecommunication services would impact on their sense of community, and their experience of their own individuality and a sense of meaning in their lives, it may be this mechanism they are intuitively implicating.

In a nutshell, new telecommunication services will provide a dramatically more complex communicative environment for individual consumers. It will arguably impact on our relationship with our immediate sensory/ informational environment, changing boundaries between private and public, and work and leisure. Basic constructions of our social and community milieus will be redefined. Some respondents questioned whether we were already beyond the limit of our ability to cope with complexity. Moreover, in the face of this rapid escalation in the complexity of our communication and information environment what are the coping mechanisms?

The answer to this question must itself be complex. However, there are two broad themes discernible amongst stakeholders and community members which help scope possible future reactions. One response is a continuation of our existing reaction to an already complex media and information environment which Mitroff and Bennis (1989) and Postman(1985) have described. This involves the continued radical simplification of ideas and diversion from complexity by denial and escape into fantasy and idealisation. Technology is constructed as having more sensory richness, as being more seamless, more controlling and encompassing than our current media. Such idealisation is a defence which prevents us from understanding the potential of new media to change human variables in more optimistic, learning oriented ways. An alternative route is to look for new models of dealing with complexity. Central to this response is greater reliance on others to share and learn about the complex information environment, greater selectivity, and better scrutiny of the informational environment via both more rigorous analysis as well as intuition. The bench mark of a learning oriented approach are human connection, curiosity and problem solving. It offers the potential for the development of new forms of community operating in new and more effective ways.

As Mitroff and Bennis (1989) argue, our existing paradigm of dealing with complex communication systems is failing us. If their argument is right, it is essential that the development of new communication systems be decoupled from the existing entertainment driven paradigm of communication. However, this is unlikely in the extreme. Firstly, there is now a well entrenched market for current styles of entertainment. Secondly, much of the platform technology for non-entertainment application of DVC is already being developed in the entertainment industry3. Finally, entertainment media conglomerates are one of only a few corporations with the wherewithal to provide the infrastructure required to bring about the technological convergence which is enormous in financial and technical terms.

Of course, it is likely that the new system will be driven by other players as well and that there will be an inter-marrying of corporate entities (Mulgan, 1991). But the key variable which will shape the new communication system may be the relative contribution of the existing entertainment driven paradigm. The crucial question is how effectively can new corporate players harness new ways of thinking about the possibilities generated by this new communication system.

Any analysis of the human impact of technology has embedded within it the seeds of a technological determinist argument. But, by way of conclusion, it is important to reiterate that it is not technology in and of itself which will bring about such impacts. Rather, new technology merely provides a catalyst for change which is essentially social rather than technological. It offers a window of opportunity in which underlying social and philosophical infrastructures can be challenged. Within that window of opportunity it is the way technology is socially constructed - the images metaphors and meanings it becomes encased in - that will determine the ultimate human impact of a converged communication system.

NOTES

1 The first half of this paper is based on a report by the author to Australian Coalition of Service Industries in conjunction with a study by Free et al, 1992.
2 The author gratefully acknowledges the contributions of Les Free who conducted the interviews and Jan Chalustowski who assisted in analysing the interviews.
3 Animation techniques developed in the entertainment industry made possible the development of applications in medicine and science. (See Davies et al, 1992).

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THE IMPACT OF THE NEW SERVICES OF TELECOMMUNICATIONS IN DEVELOPING COUNTRIES

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ABSTRACT

The developing countries are incorporating new services of telecommunication in the existing networks. In this paper, the social and economical impact of these new services is analized. It is possible to point out that celular and satelital communications plus the introduction of optical fibers cause the main effect on the economy and the society.

SUMMARY

There are clearly two main areas where the impact of new services of telecommunications takes place, the economical and social environment.

In the economical aspect, we have a great improvement in industry, commerce, government, agriculture and scientific activities, due to the velocity in the management of information. On the other hand, it can be proved that, the application of new services in telecommunications are changing the concept of information to the individual and group of people, because of the elaborated and sophisticated information that they receive.

A significant aspect in the application of new services of telecommunications in developing countries, is the effect that these countries can jump certain steps in the development and the new services can be applied at the moment that they emerge, with the condition that telecommunication and economical policies are well defined and tend to the free open market.

Some important cases that characterize the application of telecommunications new services in developing countries are the following.

- In the practice, radio celular communications can complement and satisfy some telephonic demand without installing external networks. We find this situation in cities, where are no available telephonic lines, but the major impact is in rural areas, near of the highways, at the beaches, etc., this leads to an enormous development in agriculture and tourism with well oriented plans.

- The impact of the FAX in the management of different activities is well known, but this form of communication is being uses to personal communications reducing dramatically the cost por unit of information (compare one minute of FAX information with one minute of telephonic information). This is a real social impact.

- In the trunk lines of the countries which serve to carry all communications around (or along,in chilean case) the country, developing countries can jump directly to fiber optics using existing microwaves links as back up. With this application all new services can be potencially applied in everywhere, increasing the communications facilities, i.e. producing a great growing in the economy.

- Currently, developing countries have been a lot of problems with the access to the scientific information. High prices, little diversity and delay in the arriving of the scientific information were serious problems. Now, the FAX, the electronic mail and the access to international data bases make the scientifics around the world can work together, in real time. Obviously, this effect cause influences on the technology and economy of the country.

- However, there are some debatable effects of application of new services of the telecommunications in developing countries such as:

  Developing countries lose their cultural identity due to the internationalization of the information.

  In fact, a lot of i.formation on one person not necessarily make him more communicative or friendly, then we can see the opposite effect.

  Communications break frontiers between countries (for example, latinoamerican case) and permit social and economic integration.

- Finally, we can say that it is very important to analize the effect of application of the telecommunications new services in developing countries, because the "global village" is taking place, and it would be necessary to use the simplest concept "exchange" instead of "import" and "export".

INTRODUCTION

It is well known that there is clearly a direct correlation between telecommunications and the social and economical development of a country and the phenomenon of cause and effect that can be verified between them.

The new services of telecommunications are playing day to day a very import role respect to the best use of the present systems of telecommunications, in the incorporation of new technologies in these systems and in the social and economical effects of the telecomunications.

On the other hand, in developing countries have in this context, an unique and important advantage on the developed countries: The possibility to avoid certain steps in the improvement of services, jumping directly to the tested technology and lower costs.

For that reason, it is important to analize how these new services can be applied in developing countries to facilitate the economical growing and to prosecute the social effects.

In this work is presented some definitions ..nd principles under which will be carried out the future analysis.

Then, it will be presented the new services of telecommunication in according to an arbitrary but adequate division to study their direct effects.

Also, it will be indicated the most important effects of each one of these services in economical, government and social aspects at individual and group levels.

Finally, this work presents the main conclusions that derive from the performed analysis, enhancing the most direct and useful actions to apply in developing countries to obtain the best profit of the new services of telecommunications.

BASIC PRINCIPLES AND DEFINITIONS

Information: Any kind of signal that arrives to the human brain through the sensors of the body. These signals use the association capability and the memory of the brain (i.e. audio and image signals). On the other hand, information is also any kind of signal generated in the human brain and expressed through the human body.

According to this definition, the data transmission between computers is a particular codification of the information received (generated) from (to) computer CPUs. These units have a small association capability, but they can perform the operations at a very high speed.

Communication: Information exchange between an emitter (man or machine) and a receiver (man or machine). The information can be generated in several forms, such as voice, image, graphics, physical signal representing a specific phenomenon, etc.

The information can not be transmitted in its natural form through the communication systems. For this reason, it is necessary to modulate a physical signal prepared to propagate by the choose channel which is between the emitter and the receiver.

In the modern communication systems this physical signal is an electromagnetic wave with a symbolical (digital) representation of the information.

Communication systems: The above concepts enfatize the known definition: the communication systems are the extension of the man beyond of his local sensorial capacities.

Telecommunication: is a communication between an emittier and a receiver separated for a distance so that the exchange of information can not be directly verified. Therefore, it is used the following variables and channels:

Electric signals: copper wire
Radioelectrical signals: coaxial cable or free space.
Optical signals: optical fibers.

Local communication: antiquated concept about physical limit to a voice transmission. This definition was specified using the simplest physical line: the copper telephonic line.

At this moment, with the enormous technological development of fiber optics and optical amplifiers, all communications the world would be local communications.

Telecommunications demand: Persons and entities claim their needs of telecommunications systems through this process.This concept has a particular characteristic in telecommunications: It is not possible to separate the demand with the offer. In fact, offer in telecommunications produces demand, making a progressive cause - effects phenomemon.

Specifically, all new useful service which can be massified in the market produces an exponential increase in demand because the need of integration between the users.

Hierarchical networks: The hierarchical organization existing at the present in the management of the telecommunications tends to decrease due to the utilization of optical fibers, synchronous networks and digital cross connect(DCS) equipment.

Competence: The accumulated experiences in the world by the communications administrations indicate that the telecommunication increases strongly in volume and quality in a competitive environment, making the prices go down and the quality go up to the users.

Telecommunication services: If there is a consolidated telecommunication network with a real competence between enterprises, it is better to say that they are selling "reliability" instead of "services".

In fact, the cost of a short interruption of the communication represents monetary, through the enterprise image, more money than the price of the service for a long period of time.

SERVICES DIVISION

A useful form of separating the telecommunications services that permits to analize the impact of the new services in developing countries is the following:

Traditional services: They are those services very extended in the world by public users, such as: voice transmission by telephonic line, video transmission through radioelectric waves, data transmission by switched public network, etc.

Introducing services: These services have born as an extension of the facilities of the traditional services plus new services that can become possible due to new technologies applied in transmission or in other part of the network.

Future services: In this case, we are talking about services that could have some possibilities of massive introduction in the market, impacting strongly in the demand. (Some of they could be no possible with the up-date technology).

In the Table 1 are presented introducing services as a derivation from the traditional services.

Future services ideas:

- HDTV video-telephone by line
- Celular video-telephone (standard and HDTV quality)
- HDTV by radio
- Integrated services of digital newtworks (ISDN) by optical fibers. (These systems include all traditional services and the introducing services by physical line indicated in the Table 1).

TECNNICAL AND ECONOMICAL EFFECTS OF NEW SERVICES

1. The celular telephony complements the stationary telephony:

   - At the city, celular telephony makes the prices of stationary telephony go down. In cases where there is a strong competence between celular companies, (Chile is an example) the cost of celular telephone is near of the stationary telephone.

   - The celular antennas installed along highways make possible to use this kind of communication in medium size rural areas. In this case, the cellular telephony incentivates economical activities, as agriculture and other related works.

   On the other hand, the private networks in the cellular area can be integrated to the public and international networks.

   - Another impact of cellular telephony can be verified in the tourism. In fact, a lot of beautiful places in developing countries have cellular telephony to satisfy to tourists with more resources. However, this form of communication can be used not only by the rich persons, because medium resources tourists can share the cost of the service. Particularly, in Chile it is a very common fact to use a cellular telephone as a public one at the beaches or in another touristic places, with a great demand.

2. Computers and the associated networks (LAN, MAN, WAN) have had a great impact in the management of the different entities such as the following:

   - A very good interaction between the central and the regional government, producing higher administrative order.

   - Improvement of the data bases of the tax entity and civil register, making possible a a good service in any phace of the country without bureaucracy.

   - Banks and financial institutions, which were not very efficient in the past, now they have an excellent management and they offer the most advanced technology to the users. (automatic cashier, FAX and telephone informations about accounts, etc.). All services can be used in any place of the country through in line, on real time networks.

   - The industry and the commerce have experimented a continuous growing due to the computers and the associated networks. In this case, the technical, commercial and management activities use computers and networks. (stocks, customer files, CAD/CAM systems. etc.)

   - Finally, in public and private institutions of health also have marked important advances, mainly in the institution management, clinic historical, telemedicine, etc.

3. The use of the FAX is very known, meanwhile its economical impact represents, nowadays, a tool of work almost so important as the telephone, all this considered in a stationary or a movil system.

   However, it is easy to think that the use of the FAX will be more massive when all the countries consider the FAX print a legal document. This situation will help to eliminate the bureaucracy and to produce economy.

4. The satellital rural communications produce economic effects because they integrate to the market to a great number of people and improve the production through teletraining programs.

5. The parabolical antennas to free reception from satellites have done an important impulse of the tourismm, although is necessary to regulate in both national and international level these receptions. There are two aspects to consider in services regulation: legal installation of antennas and the payment of rights.

6. The electronic mail have produced a revolution in the possibilities of communication to the users of personal computers (wich have day to day more penetration in different groups and social levels) because they dispose a global system to national and international exchange of information.

   Due to the low cost of electronic mail, the use of this service have impulsed the research in universities and center of technological

Traditional service	Medium	Capacity (Bandwidth)	Character	Introducing service
telephony	physical line (L)	narrow	bilateral	PC communication
telephony	L	narrow	bilateral	Intelligent public telephone
telephony	radio (R)	narrow	bilateral	Satellital rural communications
telephony	L	narrow	bilateral	FAX
Data transmission	L/R	narrow	bilateral	Electronic mail
Data transmission	L	narrow	bilateral	Local area networks (LAN)
Data transmission	L/R	wide	bilateral	Metropolitan area networks (MAN)
Data transmission	L/R	wide	bilateral	Wide area networks (WAN)
Television	L/R	wide	bilateral	Video-telephone
Radio	R	narrow	unilateral	International radio (1)
Satellite service	R	narrow	unilateral	Navigation aids (2)
Public telephony by radio	R	narrow	bilateral	Cellular telephony
Teleaction	L/R	wide	unilateral	Telesurvillance
Teleaction	L/R	narrow	unilateral	Telecontrol
Teleaction	L/R	narrow	unilateral	Telemeasurements

(1) International transmission in local programms
(2) Airplanes, ships and cors

Table 1. Telecommunication services classification.

development in the catch of the information as in the contact and team work in the groups with scientist of other countries.

An important aspect of the electronic mail is that, when there is a high penetration of personal computers would transformer in a massive use service in the future.

The impact of the electronic mail can be compared with the that have had the FAX but to more selected users.

7. The system of teleaction have an important use in the automatisation of process (for example, in the generation of electric energy), but no represent a great impact to national level, neither in the economic, nor in the social viewpoint.

8. The phone video is a new service that would no have been for technical and economical reason in developing countries, it is considered that developing countries does no represent an aspiration of short form and, therefore, it will not verify as impact in the inmediate future.

9. Other services like: cable television, high definition television via satellite for helping navigation; these services will be hardly massive in developping countries since they would be a restringed market due to their high cost; therefore, their national economical influence is not considered an important one.

SOCIAL EFFECTS OF NEW SERVICES

1. Telephone cellular, linked to fax, electronic mail, teleaction represent for individuals a simultaneous and virtual presence in many places, fact that converts people who possess these media in a high category human beings for whom space and time have absolutely different measure.

   Nevertheless, each individual privacy diminish when shares transmissiom media in open space with other people.

2. Cable television, international television via radio, and international radio produce,as it is already known, a cultural identity lost of less developing countries, what it means a new colonisation through maintaining hegemony in cultural and commercial values.

   In this case, the international radio introduction in local radiodifussion and news and entertainment programs in local television has a greatly powerful socio-cultural effect since accesibility to those media is nearly universal in developing countries.

3. Anyway new telecommunication services give more wellbeing and entertainment to different social levels; for example, intelligent telephones that allow people communicate directly to other different places from their city and, in a small degree, but socially important, these telephones allow receiving calls without necessity of having a telephone line. These aspects represent an implicit value of human being, mainly for lower-wages groups that tends to insert themselves in a completely unknown society.

4. Fax use in social ground also allows a human revalorisation from delivering the possibility of manuscript texts, draws, etc. This characteristric makes more friendly the use of communication machines; notwithstanding, traditional mail concept wins newly actuality but with a different carrier.

5. Many studies have been carried out about the integration effect mainly directed to rural and/or marginal sectors, ethnic groups, etc., that can be performed through satellites. A main criticism is the strong cultural shock that is produced on individuals and social groups, that ends in the own question about its function in the environment they act.

   Some harmful effects are country-city migration, creation of false values and even seriously identily disorders.

   Teleducation and teletraining are rational ways of introducing integration to economical society that can bring them a best life standard (health, primary provision, etc.) without losing cultural and ecological values.

   The described social effect is also produced to microscopic level between developed and developing countries.

6. A particular social impact on the individual is produced in the case of "managers", who practice in a lesser degree personal communication due to selection that they do of useful means. In this case, they use more personal computer, telephone, and videoconference (in all fixed or movible cases) and they communicate with other managers who have the same means what diminish the diversification of inf., increasing the communication through devices. All that implies a lesser degree of communication between members in the family, human communication, and, in general, lesser sensibility what means an isolation of real world and of cultural values of their environment.

7. For a lower-wage person who accounts for unilateral communication (radio and television) it is possible to verify a loss of spontaneity, adoption of inexplicable life ethic pattern and isolation feelings.

8. For people who live in a developed country, the fact of having a bilateral communication media (for example, telephone) is converted in a life necessity rather than a mere business.

9. In the developed countries' integration context, it is interesting distinguish that satellite services allow such integration mainly to cultural level but that are costly for massive use in small-scale business.

   Arrival of optical fibers in submarine wiring around continents open borders and eliminates legal problems, acceding gradually to such cable all countries according their technical-economical possibilities. It is wellknown that once amortized transmission systems via optical fibers, these are cheaper than satellite systems; therefore, large perspectives of regional integration to social, economical and political level are opened.

   An example of what we mention above is UNISUR cables in the Athlantic Ocean that will link Brazil, Argentina, Chile and the Americas II on the Pacific Ocean, and that besides would link Perú, Ecuador, Colombia, Caribe and México completing the integration of Latinoamerican communication medias and, therefore, of economical-financial means.

   A high level of communication are the basis of regional cooperation markets and simplify the burocratic frontiers between developing countries.

CONCLUSIONS

The complementation of the traditional and new services of telecommunications allows to the man to be present in many places at the same time, so that this requires a review of the social and economical schemes of developing countries to verify that they do not stop this great capability, but prosecute it to obtain the development that everybody wishes.

There are services of telecommunications that give additional profits containing many more users and solving problems of external plants such as: cellular telephony and rural satellital communications. The telecommunications administrations of developing countries could make comparative studies to promote investments in such services. The same case is verified in new methods of transmission, such as: the optical fibers.

It is a very important fact the transference of the point to point traffic from satellites to the optical fiber wich is allowing to dispose free capacity to rural communications.

Traditional services such as FAX and the electronic mail should be massified in developing countries in order to improve the management and the creation, aspects that normally present great deficiencies in such countries.

The optical fiber submarine cable installation represents a very attactive cooperative investment between the latinoamerican developing countries, because they have advantages of gradual access and they eliminate the cable passing across different cities on which depends the reliability of the links.

It is absolutely necessary that the increase of the methods of telecommunications not became in a unilateral increment of the information received from developing countries, but promote the great activity of communications in the region, so that it increases the economical development and also the maintenance of the cultural identity.

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The Telephone in Daily Life: A Study of Personal Telephone Use in the United States

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1. ABSTRACT

The results o'' a national diary survey of personal telephone use in the United States are presented. Basic statistics about individual telephone usage patterns and adoption of innovative telephone services and products are included. Implications for policy, marketing and future multinational research are examined.

2. TOWARD THE PERSONAL TELEPHONE

Advances in telephone technology and services are altering the character of telephone use in many countries around the world. Once a shared household appliance, the telephone is evolving into a highly personalized communications medium. Multi-line phones, multiple extensions and cordless phones give many telephone users a sense of having their own personal telephone even in multi-person households. The diffusion of answering machines, unlisted numbers and custom calling features gives users new abilities to control their communications to match individual life styles. New services such as the Integrated Services Digital Network (ISDN), Custom Local Area Signalling Services (CLASS), voice mail and Personal Communication Networks (PCNs) will make it possible to further adapt the operation of the telephone for personal needs. The telephone is evolving away from McLuhan's characterization (1) as the "irresistible intruder" and is turning into an automated personal assistant which helps us to manage our social environment.

In the century since the telephone was introduced there has been little sustained social research into the personal uses of the telephone (2). The available published research is based on highly localized samples, uses the household rather than the individual as the unit of analysis or relies upon potentially unreliable retrospective self reports of individual telephone use (3). Unpublished proprietary market research studies about telephone use abound within the corporate annals of the telephone industry, but often also share one or more of these limitations.

The primary goal of the present study is to fill this void in published research about telephone behavior. This paper focuses on describing the basic dimensions of personal telephone use and explores interest in new services that are just now being introduced into public networks in the United States. Implications of the findings for policy and marketing issues are discussed. The data were collected in the spring of 1991 under a grant from the Bell Atlantic Corporation. However, the opinions expressed in this paper are those of the authors and do not necessarily reflect those of Bell Atlantic.

3. RESEARCH METHODS

The survey was directed to a national sample of telephone households, with an over-sampling of homes located in the Bell Atlantic Region. Random digit dialing techniques were used to recruit the respondents by phone. At the time of the initial contact, a brief questionnaire was administered to the telephone decision maker in each household to determine household characteristics. The telephone decision maker was defined as that person in the household responsible for making decisions about telephone service. A package containing cash incentives for the respondents, a cover letter, a separate diary for each member of the household age 12 and older, and a return envelope was mailed to each household that agreed to cooperate with the study. Specimen questionnaires and details of the research methods and findings of the study are available in a technical report (4).

Completed mail surveys or diaries were received from 503 households, or 45 percent of those who agreed to receive the package. In all, 747 responses were received from these households, including those completed by the telephone decision maker and other household members age 12 or older. Since the overall response rate was low and an intentional bias had been built in to oversample homes in the Bell Atlantic region, the sample was weighted against available census and survey data. The age and sex characteristics of the sample were compared with 1988 U.S. Census estimates (5). Data about household characteristics, including household size, income and location (by Bell operating region) were compared with data from the Current Population Survey, as compiled by the Federal Communications Commission to examine the characteristics of telephone households in the United States (6).

4. THE TELEPHONE IN THE AMERICAN HOME

The telephone is a commonplace item in the American home. Only about one-quarter (24%) of the respondents had a single telephone in their homes. Almost two-fifths (38%) had two telephones and nearly as many (37%) had three or more telephones in their households. The average number of telephones per household in the survey was 2.55. The kitchen (44%) and the living room (22%) are the most common locations for the primary telephone. Ten percent of the homes in the survey reported that they had more than one telephone line in the home. American homes are filled with various telephone-related paraphernalia, including about two-fifths (39%) with an answering machine or a cordless phone (38%). One in twenty homes had personal computers with modems and facsimile machines had made an appearance in one percent of the homes surveyed at the time of the study. The American consumer's telephone is relatively "feature rich." Over half of the homes surveyed have phone instruments with touch-tone (67%), last number redial (69%), ringer switch (69%) or speed dialing (50%) capabilities.

The telephone is the largest single household telecommunications expenditure. The average monthly total expenditure for telephone services and equipment in a "typical month" was $49.83. The average expenditure for cable television service was $24.06, while an average of $7.61 was spent on home video.

Abuse of the telephone by children is an important concern in many U.S. households. In only about a fourth (26%) of the households with children were there no rules governing the use of the telephone. Half (54% reported a ban on 900, 540 and 976 calls. In three-fifths (58%) of the homes with children present, calls were not permitted at certain times. "Local calls only" was the rule in two-fifths of these households.

There are also growing concerns in the United States about unwanted calls that enter the home. Over three-fifths (62%) of the respondents received telephone solicitations from a charitable organization during the month preceding the survey. Nearly two-thirds (65%) had problems with callers who hang up on them when they answer the phone. About six-tenths also received telemarketing calls (59%) and almost a fourth (23%) were surveyed by telephone (not including our survey) during the previous month. Almost three-tenths (28%) of the respondents reported receiving unwanted calls from someone they knew while an eighth had abusive or obscene calls.

5. INDIVIDUAL USAGE PATTERNS

All participants in the study were asked to make note of the phone calls they made and received in their homes for a period of one week. Each household member age 12 or older was provided with a personal telephone diary in which they recorded the time and date of each call, the area code and exchange of the other party to the call and its length. They also identified the outcome of the call, their relationship to the other caller and the purpose of the call. Finally, they made note of the activation of any special call features associated with each call.

Three different types of analyses were conducted to characterize calling patterns. First, the outcomes, relationships, purposes and features used in almost 13,000 calls recorded in the diaries were tabulated by select individual and household characteristics. These analyses were based on the total number of calls, rather than on the total number of respondents contained in the sample. Next, numerical indices of individual telephone use were computed from the diary data and these were cross-classified by selected individual and household characteristics. Finally, multiple regression analysis related the quantitative measures of telephone usage obtained from the diaries to demographic and household characteristics.

5.1 CALL CHARACTERISTICS -- WHO, HOW, WHY?

Who do Americans call, for what purposes, with what means and with what results? Family members accounted for over a third of all calls placed or received in the home. Personal friends accounted for about three tenths of all calls. Business or professional calls were another fifth of all calls made (Figure 1A). Calling patterns differed markedly by individual and household characteristics. Older adults, ages 50 to 64, communicated by phone with family members more than other age groups, concentrating over two-fifths of their calls in this category. Young respondents under age 25 made about half their calls to personal friends.

Why do they call? About a fourth of all the calls recorded were to chat or socialize. Another fifth involved the exchange of information. Calls in which appointments were made, news was exchanged, tasks were coordinated or problems discussed each accounted for about a tenth of the calls recorded in the diaries (Figure 1B). Call purposes varied almost linearly by age, with the most marked departures from the average at either end of the age spectrum. Teen respondents devoted two-fifths of their calls to socializing, while respondents over age 75 had socializing as the primary purpose in only about a seventh of their calls. Both teens and older seniors shared a higher than average propensity to exchange news in the calls they made. Teens seldom had calls in which appointments were arranged, tasks coordinated or problems discussed. Females used the phone to chat or socialize more often that did males.

How do they call? Four-fifths of all calls were completed without the activation of any special call features. Answering machines, Speed Dialing and Call Waiting were each reported used in about one call in twenty. Call features were activated most often by young adults, 18 to 24, but hardly ever by those over age 75 or between 50 and 64. Speed dialing was especially popular among younger seniors, age 65 to 74.

5.2 INDIVIDUAL CONSUMPTION PATTERNS

A series of individual telephone usage statistics were compiled from diary data (7):

Total Calls are the total number of calls recorded in the diary. A maximum of 60 calls could be recorded. Twenty respondents completed more than 60 calls during the survey week.

Total Minutes are the total number of call minutes aggregated across all calls listed.

Intra-Exchange Minutes are the minutes of calls in the same local exchange and area code as the respondent.

Local Inter-Exchange Minutes are the number of minutes in the survey week spent on calls that are in the same area code as the respondent, but not in the same local exchange.

Distant Inter-Exchange Minutes are the number of minutes spent on calls to other area codes.

Note that the latter three categories are both mutually exclusive and exhaustive, but do not conform to conventional definitions of the scope of calls in the United States. For example, distant interexchange calls do not include all calls that pass between Local Access and Transport Areas (LATAs), since some area codes include multiple LATAs. Thus, these are not the same as "long distance" calls as usually defined. International calls (there were about thirty of these in all of the 12,000 calls) were counted together with other distant interexchange calls.

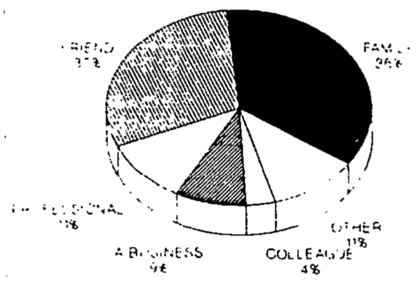
On average, respondents recorded about nineteen total calls (Mean = 18.81) during the survey week. The average time spent on the phone was slightly over two hours (Mean = 126.29 minutes), or about 18 minutes per day. This is almost exactly half the amount of time that respondents themselves estimated they spend on the phone in a typical day (Mean = 37.83 minutes). About half this time (Mean = 69.58 minutes) was spent on local inter-exchange calls, defined as those inside the same area code as the respondents but outside their local exchanges. The remainder were split between local intra exchange (Mean = 27.54 minutes) calls and distant interexchange calls to other area codes (Mean = 28.98 minutes).

5.3 MULTIPLE REGRESSION ANALYSIS OF PHONE CONSUMPTION

To better understand patterns of relationship between individual and household characteristics and patterns of telephone usage, a series of multiple regression analyses were performed. Multiple regression is a statistical technique which allows the researcher to explain variation in a dependent variable of interest from a

RELATIONSHIPS OF CALL PARTNERS

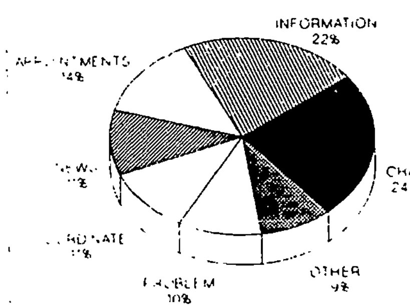
FIGURE 1A



BASED ON 12,902 CALLS.

PURPOSES OF CALLS

FIGURE 1B



BASED ON 12,902 CALLS

combination of independent, or predictor, variables. The independent variables included a wide array of standard personal and media characteristics (8). The dependent variables were the telephone consumption statistics.

In addition to standard demographic and household characteristics, the independent variable set included three types of variables of special interest. Respondents were classified according to the family life style of the home in which they lived. For example, Starting Out Singles are singles between 20 and 34 with no children. In the same classification scheme, Empty Nesters are married couples in which the telephone decision maker is between 50 and 64 but in which there are no young children. Families with Children, Families with Teens, Young Couples, Mature Singles, Young Seniors and Older Seniors are the other categories in this set.

Respondents were also classified according to their orientation to two basic motives for using the telephone. Social Enjoyment Seekers are those who agree with statements like "I use the phone because I enjoy it," and "To show others I care." Utilitarians are those who agree "The phone is good in emergencies," and that they use the phone to save time or money (9). Finally, respondents were classified as Social Networkers or Information Processors according to patterns of telephone set and service features found in their homes, as described below.

What groups have much higher than average levels of weekly telephone use? These include homemakers (203 minutes per week), females (174), persons aged 25 to 34 (158), Social Enjoyment Seekers (185) and persons in homes that score in the mid range of the Social Networkers innovation cluster (170). Other groups had much lower than average levels of telephone use. These are persons those who scored low on Social Enjoyment Seeking (76 minutes per week) or Utilitarian (90) phone usage motivations, males (83) and individuals over age 75 (62). Only group means that differed from the overall mean by two standard error units were regarded to have a significant difference from the group means.

Multiple regression results help to clarify these complex patterns of relationships. Figure 2 shows the multiple regression results for total phone consumption. Total telephone minutes recorded in respondent diaries were best predicted by sex, age, Utilitarian and Social Enjoyment phone motives and media habits. Females, heavy moviegoers and those scoring high on utilitarian and enjoyment motives also tended to have high levels of telephone consumption. Teens and persons age 75 or older had relatively low levels of total telephone use.

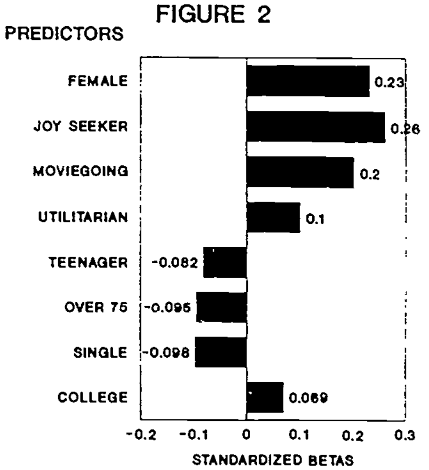
Total calls (not shown in figures) were predicted by sex, age, family life style, marital status, and utilitarian motives. Females, persons between the ages of 25 and 34, Starting Out Singles and Utilitarians tended to have more calls while singles (apart from those living in Starting Out Single households) and those over age 75 had lower calling levels. Distant inter-exchange minutes were predicted by marital status, education, sex and enjoyment motives. Females, better educated respondents, those with high phone enjoyment scores, young adults 25 to 34 and females tended to have more long distance minutes. Singles and persons with more than a college education (after controlling for other variables) tended to have lower long distance usage. Time spent on local intra-exchange calls was predicted by sex, education, media habits and telephone motives. Females, those with some college education and those scoring high on utilitarian and enjoyment motives also tended to have high local calling levels.

5. TELEPHONE INNOVATIONS

The public telephone network is in the midst of a transformation from "plain old telephone service" to an all-digital "intelligent" broadband network. As these new technologies are deployed, there is a danger that economically disadvantage households will be left behind, further widening the gap between rich and poor. Therefore, an important issue is equitable access to new telecommunications products and services. To examine this issue, household income was used to cross-classify selected results presented below.

With respect to currently telephone set and service features that are currently available, the gap between rich an poor is relatively modest. In homes were the total annual income is $10,000 or less, the incidence of features like answering machines, ringer switches, last number

TOTAL MINUTES
MULTIPLE REGRESSION RESULTS
FIGURE 2



MULTIPLE R=.52
SIGNIFICANT PREDICTORS, p < .001

redial and call waiting is about the same as it is in the general population. However, the availability of cordless phones, touch tone phones and speed dialing features is considerably under the overall average incidence rate.

5.1 INTEREST IN NEW TECHNOLOGIES

To establish patterns of interest in new technologies, telephone decision makers were asked to rate eight telecommunications innovations on a seven-point scale, with 1 meaning "no interest" and a 7 "very interested." The services were described as follows:

◄ **Voice Mail** which functions much like an answering machine, allowing you to record and retrieve messages from home and remote locations. You will also be able to transmit messages to multiple parties simultaneously and to leave personalized messages for individual callers.

◄ **Videophone** which will allow you to see pictures of the people you call as you talk to them.

◄ **Personal Communications Networks (PCNs)** which allow you to carry a lightweight cordless phone with you and place calls from wherever you go.

◄ **Caller ID** which will display the number of the parties who call you on a miniature computer screen next to your phone.

◄ **Data Base Gateway**, offering access to a variety of computerized banking, shopping, entertainment and home information services.

◄ **Digital Telephone (ISDN)**, which will let you conduct telephone conversations and high-speed data transfers simultaneously on a single phone line.

◄ **Energy Monitoring** will let you monitor utilities and control heating and cooling systems in your home and give reduced rates to users who limit their energy consumption at times of peak demand.

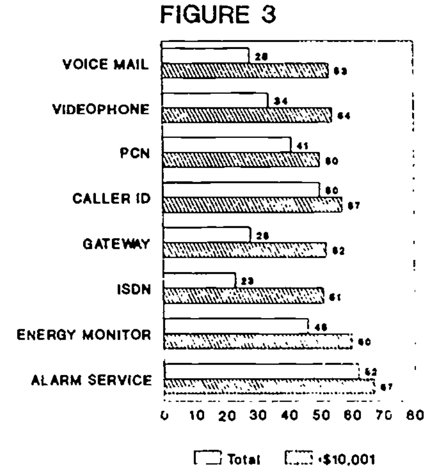
◄ **Fire and burglar alarms** connected to your home phone.

Of the services tested, fire and burglar alarm service attracted the most interest, with three-fifths of the telephone decision makers rating them above the midpoint of the scale (Figure 3). About half are interested in Caller ID and energy monitoring, while two-fifths are interested in Personal Communication Networks. A third of the telephone decision makers are interested in videophone service, and a fourth are interested in voice mail, videotext gateways and ISDN.

Figure 3 also shows interest in new technologies by household income. The most striking aspect of these results is the high levels of interest expressed by telephone decision-makers in low income households. Their interest in voice mail, ISDN and data base gateways is particularly keen, almost twice the levels of the entire sample. Homes in the lowest income category include a surprising number with personal computers, so it appears that many of the low income respondents are interested in telephone services that will extend the power of computer technology. About a third of the low income homes are comprised of students, which helps to explain this somewhat surprising finding. However, interest in these new technologies is still much higher than average in the non-student low income homes. Perhaps others saw these services as a means to substitute for investments in answering machines and computer technology. It should also be noted that no prices were mentioned for the various new products and services.

Homes with between $35,001 and $50,000 in annual household income were generally the least interested in new products and services. Personal communication networks were the single exception. Upper income homes generally had about average levels of interest in all of the innovations tested, with the pointed exception of video telephone service. Perhaps upper income consumers can better afford to substitute travel for telecommunications and may be more familiar with the prices (and technical limitations) of the videophones currently available.

NEW TECHNOLOGIES
AND LOW INCOME HOMES
FIGURE 3



PERCENT INTERESTED

5.3 INNOVATION CLUSTERS

Are there "innovation clusters" which may predict the adoption of new products and services comparable with those already adopted? Prior research (10) suggests the existence of interrelated subsets of information technology and service products which may predict the adoption of new products which are compatible with those already adopted. In the present study, awareness and adoption of telephone set features and custom calling services were factor analyzed to detect underlying clusters of innovations. Two distinct factors were found:

Social Networkers are consumers who have already adopted or who have high levels of awareness about products and services that are especially useful in managing and maintaining social communication networks. These include answering machines and phone sets with speed dial, speakerphone, conference call, and last number redial capability. The currently available custom calling features (speed dialing, 3-way calling, call waiting and call forwarding) are also included.

Information Processors are consumers who have or have heard of telephone features and services which give them access to information processing and display functions which are used to manage telephonic communication. Many of these also seem to have a privacy management function in common. These include lock out devices, and timer and called party number displays. The related network services are CLASS services such as Call Trace, Caller ID, Call Block and Distinctive Ring -- but not automatic redial.

To examine the relationship of these two segments to other characteristics, a categorization scheme was created based on taking the interquartile ranges of an additive scale based on the number of innovations in each category that had been adopted in the household. That is, Social Networker homes were defined as those in the top quartile of scores on a numeric scale formed by counting the number of innovations in that category that were present in the home.

Social Networkers had distinctive telephone usage patterns. They tended to use the telephone more frequently than respondents in the total sample when they had something important to say or had good news to report and when they wanted to communicate anger. They also tended to call toll-free 800 numbers from home more frequently than others. Social Networkers were likely to seek information from the telephone network. When not wishing to receive call at certain time, they were likely to screen calls with their answering machines rather than turn the ringer off. In Social Networker homes with children, a special set of rules prevailed. Restrictions on audiotext calls were almost universal and restrictions on the time of calls and the scope of calls (i.e., local calls only) were also highly prevalent. Social Networkers tended to be concentrated in blue collar occupations.

Among respondents who have been categorized as Information Processors, there was a greater number of households with personal computers and modems than among the total sample. More Information Processor households had monthly total telephone bills less than $35 than in the total sample. They were less interested than average in the various new telephone services described in the preceding section. Information processors appear to prefer using the telephone to communicate anger more than other groups in the sample, although they were more likely to state that there were no situations in which they particularly prefer the telephone. In their homes, the rules for children tended toward time of day and call length restrictions (hence, the call timers and phone displays?). When not wishing to receive call at certain time, they would turn the ringer off or unplug the telephone rather than screen calls. When problem calls persisted, they notified the phone company rather than rely on their answering machines. They seldom used information-oriented audiotext services but seem to be very heavy users of adult entertainment, dial-it polls and contests offered over 900 and 976 numbers. Demographically, the Information Processors included concentrations of professionals and persons with graduate degrees.

6. DISCUSSION

Finally, we turn to the potential marketing and policy implications of these results and suggestions for future research.

6.1 MARKETING IMPLICATIONS

What changes in consumer telecommunications marketing practices might be in order as we make the transition to the personal telephone in the United States? Perhaps the most obvious implication is to refine the focus on heavy telephone users and to move away from simplistic demographic and usage-based marketing strategies. For quite some time now, long distance carriers in the United States all seemed to concentrate on volume-based discounts aimed at heavy long distance users. Recently, long distance consumer marketing has taken a new tack, focusing on recruiting entire networks of telephone users with plans like MCI's "Friends and Family." In the context of the current study, these appeals are likely to work well with the "Social Networkers" and "Social Enjoyment Seekers," but are likely to miss those with more practical and information-related orientations to the telephone that are more common in upscale homes.

In the U.S. local exchange service market there has been little incentive to concentrate on high volume callers, since local telephone calls are usually not subject to message unit or per-call charges and are typically included in the flat monthly charge. This is beginning to change with the advent of usage-sensitive consumer tariffs and local exchange competition. In three-fifths of the homes in the survey, the heaviest phone user and the telephone decision-maker were one and the same. Thus, even where usage sensitive pricing is not found there is still an incentive to develop customer relationships with the heavy users to protect against competitive marketing.

The apparent existence of two distinct "innovation clusters" for telecommunications equipment and services also has some potential marketing implications. The appeal of new consumer telephones and network services might be enhanced by packaging them with other, similar service features. For example, the most "feature rich" consumer telephones today tend to have a mixed bag of features that are likely to appeal to both the Social Networkers (e.g., speakerphone capability) and Information Processors (e.g., LCD displays) among us. However, it is possible to find consumer telephones with seemingly every possible variation of feature combinations. The innovation cluster concept suggests that four basic configurations might be the most efficient: a basic "plain old telephone," one with Social Networker features, one with Information Processor features and one with both sets.

Looking forward to new telephone features which will be possible with the future evolution of the public network, phones marketed with the Social Networkers in mind should have "feature buttons" that will substitute for network services that appeal to the social networkers, such as a 3-way calling capability, call forwarding and call waiting, which today are available only as network services. For the Information Processors, feature buttons and display options should be provided for the so-called CLASS services (e.g., Caller ID, Call Block, Distinctive Ring). Equipment manufacturers might wish to create phones that perform these functions themselves with internal software which operates on Automatic Number Identification information, rather than leaving network service providers to program these functions on their central office switches.

For their part, network service providers also have some obvious "packaging" opportunities. At this point, it appears that bundling all the new CLASS services with existing custom calling features is NOT an especially good idea, since these two feature sets seem to reflect quite different sets of needs. To counter the ability of equipment manufacturers to create hardware substitutes for network services, telecommunications carriers might think about bundling the auto redial CLASS feature -- the only such feature which fits into the Social Networker cluster -- and voice mail with existing custom calling features. Auto redial as a telephone set feature seems to fit well with the Social Networker life style and they seem to rely heavily on their answering machines, so auto redial and voice messaging as telephone service features could work well here. Telephone services for the Information Processors might entail new varieties of information to project on the telephone display screen. Calling Party Name -- in addition to calling party number -- is one obvious possibility. Displays of actual connect time (as opposed to off-hook time that telephone sets display), the running total cost of a long distance calls in progress and the time of day at the calling destination are some other possibilities. Telephone lock out devices also fit into the Information Processor innovation cluster. In the form of a network service, this might translate into a personal identification number that would enact varying levels of service restrictions (e.g., local calls only, no 800 or 900 calls).

The extension of the present research to the many other countries comprising the world consumer telecommunications market might also prove insightful, especially as a means of adjusting assumptions about telephone use developed in domestic markets to international markets. To cite but one example, the results of a recent study in Japan showed remarkable differences in telephone behavior between U.S. and Japanese households (11). Only half of Japanese homes, compared with three-fourths of U.S. homes have multiple telephone sets, for example. Calling behavior also differs considerably. Total weekly telephone consumption is slightly higher in Japan, but there are very marked sex differences, with extremely low usage for males over 30, about an eighth of the usage rate for females. There are sex differences in the United States, too, but they are much less pronounced, more on the order of two or three to one.

If, as a Japanese consumer electronics manufacturer, we took our cue from the domestic market we might churn out phones laden with "Social Networker" features that appeal especially to the female heavy telephone user, but neglect the male information processors who constitute a large slice of the U.S. market. Likewise, comparing our U.S. data to that collected in Germany and France (12), it appears that Americans are much heavier telephone users overall and that telephone instruments are much more ubiquitous in the American home than in Western Europe. A European-based manufacturer aiming for the international consumer telephone market might well miscalculate by offering expensive, but durable and aesthetically pleasing instruments suitable for use as the household "main station," but unsuitable for the role of ubiquitous -- but virtually disposable -- phones that fit in with American life styles.

6.2 POLICY IMPLICATIONS

The present study has possible implications for several important policy issues relating to the future of telephone policy in the United States: local calling plans, privacy, and the future development of Universal Service.

Regarding local calling plans, an important issue is their potential impact on groups with limited or fixed incomes. In the present study we found that members of low income households were rather heavy telephone users. Persons living in households with annual incomes of $10,000 or less made about fifty percent more calls than the average and the time spent on intra-exchange calls was also well above average. Thus, calling plans which impose message unit or per-call charges could substantially increase the cost of service for those who are least able to afford it. In fact, time spent on intra-exchange calls generally exhibited an inverse relationship to household income -- the lower the household income, the more time spent on local calls. This income pattern did not hold for local inter-exchange calls, however. Senior citizens ages 65 to 74 have average levels of intra-exchange calling, but are well above average in the local inter-exchange category, so they might also be adversely affected by message unit charges.

The present study has several interesting implications for the current controversies about telephone privacy. First, the overall incidence of nuisance calls is quite high on a monthly basis. Current measures aimed at curbing telemarketing calls only address one of the three most frequent types of problem calls, however. Solicitations from charitable organizations and hang ups are even more frequent, but have received relatively little attention. Significantly, the incidence of problem calls was relatively low in the Bell Atlantic region, which at the time of the survey was the region with the widest availability of Caller ID. It is interesting to speculate whether this availability and the attendant publicity was the cause of the lower nuisance call rates. In this same vein, there is considerable interest in Caller ID throughout the entire sample, perhaps suggesting that the average telephone consumer is much more receptive to the service than the civil liberties and consumer advocates who have so vigorously opposed it.

Finally, regarding the future evolution of universal service, it is interesting to note the relatively widespread interest in several prospective new services, even among lower income households. Results such as these could be used to argue for a relatively "feature rich" Universal Service, perhaps one that would include ISDN, voice mail and alarm service.

6.3 RESEARCH IMPLICATIONS

In closing, we call upon our academic colleagues and telecommunications professionals in Pacific Rim countries to assist us to replicate and extend our study within their own national territories. The value of data like these as tools in marketing and policy decisions has already been discussed. In fact, we suspect that the value is so obvious that many telephone administrations around the Pacific Rim have already carried out studies of their own on related issues. By making more such studies public and by replicating them in the spirit of cross-cultural scholarship, we can perhaps create a shared body of knowledge that can guide the future evolution of the world's telephone service to the benefit of all.

Further replication of this research also offers fertile ground for comparative research with more scholarly ends in view. For example, it would be interesting to understand the factors that are responsible for the marked difference in male telephone behavior between Japan and the U.S. or which lead Americans to be much heavier telephone users than Europeans. A host of economic, policy and cultural hypotheses come to mind, which the addition of further "cells" of the study in other countries might help to sort out.

With the entire world now on the threshold of the age of the personal telephone, we also have a unique opportunity to examine the social and economic effects of the telephone. In this light, it would be instructive to compare telephone behavior in countries with the most advanced telecommunications infrastructures, such as Singapore and France, with those, such as the United States, who are now somewhat "behind the curve." This would answer questions about the social impacts of the telephone which are of intrinsic interest to social scientists, but might also give policy makers in various countries useful information as they make decision about the future development of their own information infrastructures. Additional time points and more narrowly focused metropolitan area studies would also help to examine the effects of the introduction of new technologies on human behavior.

7. NOTES

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2. Following the ground breaking collection of essays edited by Ithiel de Sola Pool, <u>The Social Impact of the Telephone,</u> in 1976 (Cambridge, MA, MIT Press), Herbert Dordick reported on "The Social Uses of the Telephone" in <u>InterMedia</u> in 1983 (Vol.11, No. 3), followed by Frederick Williams and Dordick's 1985 study, "Social Research and the Telephone" (Annenberg School of Communications, University of Southern California).

3. For example: Singer, Benjamin D., <u>The Social Functions of the Telephone</u>. Palo Alto, CA: R&E Research Associates, 1981.
Taylor, Lester D., <u>Telecommunications Demand: A Survey and Critique.</u> Cambridge, MA: Ballinger, 1980.
Mahan, Gary P. <u>The Demand for Residential Telephone Service.</u> East Lansing, MI: Institute of Public Utilities, 1979.
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5. U.S. Bureau of the Census, Current Populations Reports, Series P-25, Nos. 519, 917.

6. Belinfante, Alexander, "Telephone Penetration and Household and Family Characteristics", Common Carrier Bureau, Federal Communications Commission, May, 1989.

7. About five percent of the calls recorded did not have area code information, while seven percent lacked local exchanges.

8. The following independent variables were included in these analyses. Stepwise multiple regression was used with a minimum F to enter of 3.84.

AGE 12-17, coded 1 if between 12 and 17, 0 if not.
AGE 25-34, coded 1 if between 25 and 34, 0 if not.
AGE 75 UP, coded 1 if 75 or over, 0 if not.
COLLEGE, coded 1 if attended college without graduating, 0 if not.
EDUCATION, a seven-level ordinal scale of educational attainment.
GRAD, coded 1 if more than a college education, 0 if not.
TELEPHONE ENJOYMENT, an additive scale of enjoyment motives for telephone use.
MOVIES, the number of movies attended in the preceding month.
NSI SEGMENTS, coded 1 if a member of a group, 0 if not.
KIDS are families with young children
TEENS are families with teens
START are starting out singles
COUPLES are young couples
MATURE are mature singles
EMPTY are empty nesters
SENIORS are young seniors
OLDERS are older seniors, 75 or older.
PAPER TIME, the amount of time spent reading the newspaper the previous day.
RADIO TIME, the time spent listening to radio the previous day, in minutes.
SEX, coded 1 if female, 2 if male.
SINGLE, coded 1 if never married, 0 if not.
TELEPHONE APPREHENSIVE, an additive scale measuring telephone apprehension.
UTILITARIAN, an additive scale of utilitarian motives for telephone use.
WORK AT HOME, scored 1 if there is a home worker, 0 if not.
WORK STATUS, scored 1 if employed, 0 if not.

9 Additive scales were constructed through the process of factor analysis. The Social Enjoyment scale was constructed from nine items, while the Utilitarian scale had six items.

10. Rogers, E. **Communication Technologies**, New York, The Free Press, 1987.
LaRose, R. and D. Atkin, "Audiotext: Discovering a new mass medium" **Journalism Quarterly**, 68(3), 1991, pp. 354-362.
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IS THE WORLD READY FOR THE GO-ANYWHERE TELEPHONE?

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Inmarsat's introduction of the world's first truly mobile, global telephone system, offers the prospect of huge new markets and great benefits for telecoms agencies trying to provide wide-area coverage of thin-route markets; but these opportunities can only be realised if regulatory, administrative and licensing issues are resolved.

Inmarsat has just started operation of the first telephone system that is not only truly mobile but that can also provide seamless, global coverage. The introduction of this system, which is known as Inmarsat-M, coincides with high profile publicity for hand-held satellite telephone systems that are planned for the late 1990s.

Many such systems have been mooted, most of them involving new satellite constellations in low earth orbits. What they all have in common is that they are intended to offer convenient, low cost voice, facsimile and data communications via terminals that are small, light and cheap enough to be fitted onto any vehicle or small boat, besides being hand carried or used in fixed roles.

It has been widely hypothesized that the market for such a product may be in the millions of users. It is certain that it will take billion dollar investments and several years before such market potential can be realised. Yet it is possible to achieve many of the objectives of such systems right now and at very low cost, by the application of Inmarsat-M and its existing global satellite network, complete with an international support infrastructure that is already well-developed.

In terms of basic services and functionality there is little difference between what Inmarsat-M offers today and what is being proposed for hand-held systems towards the end of the decade. Digital voice services will be provided at a vocoded data rate of 4.8 kbit/s, producing a speech quality that has proved highly satisfactory.

Voice quality has indeed proved to be one of the early triumphs of the Inmarsat-M system. Originally it was intended to provide only communications quality voice but due in no small part to the voice codec developed by US company DVSI, what has actually been achieved is something much closer to toll quality.

The proof lies in customer perceptions, and exhaustive tests of the new system have been made, from small yachts and fishing boats in rough northern seas to tests aboard the world's most famous luxury liner, the QE2; and from vehicle-mounted systems driven across the length of Europe between Norway and Spain to a system mounted on a railway carriage and used along the length of the Trans-Siberian railway and right into China.

Customer perceptions of telephone call quality have consistently rated the service as being superior to cellular radio and in many cases have placed it as being as good as or better than any other international telephone calls the customer had made by other means. As these customers have included users of twenty different languages, as well as a broad range of ages and of course both sexes, we can assert with some confidence that acceptance of the go-anywhere telephone will not be held back by any considerations of voice quality.

In addition to the telephone, Inmarsat-M will support Group-3 facsimile at a data rate of 2.4 kbit/s, as well as real-time data communications at the same data rate.

A fax rate of 2.4 kbit/s is rather slow of course but quite adequate for someone who wants to send just a couple of pages and in any case there are many parts of the developing world where the terrestrial networks may not be able to deliver a faster service. On the data side, Inmarsat-M will be ideal for linking to well established E-mail systems such as X.400 and to the X.25 data networks.

The telephone service is operational now, whereas the fax and data services will come into operation during the course of this year. This reflects the fact that Inmarsat-M is first and foremost a telephone system. Although many other services are to be offered on both it and the hand-held systems of the future, customer surveys show that it is a good, basic, reliable telephone service that is far and away the most important requirement.

Indeed, the guiding principle in the development of Inmarsat-M has been that is should work like the telephone or fax machine in the office. The user will not require any training in order to make a telephone call or send a fax and the way the calls are routed from the mobile terminal via the satellite to a land earth station and thence into the international switched telephone or data networks will be invisible to him (see system diagram attached).

Terminals can be readily integrated with GPS chip sets to provide position fixing and many will have an integral Inmarsat pager, part of the world's first global paging service which is due to start operation in 1994. This will be particularly important for the international business traveller, enabling him to receive messages even when the terminal is switched off or when he is inside a building and out of sight of the satellite.

The terminal equipment is available in a wide range of versions to suit many different market sectors. The most numerous are expected to be briefcase versions, some examples of which are shown in the photographs associated with this paper and in the conference exhibitions. These are intended for international business travellers and also for aid workers, journalists, emergency services and anyone who has to operate in areas where fixed communications systems are unavailable or unreliable.

Briefcase terminals of this type weigh under 10 kilos and can easily be carried aboard an aircraft as hand luggage. They will become even lighter and more compact over the next few years, just as had happened with portable PCs. They are entering the market at prices of between US$12,000 and US$20,000 and again, prices will fall within a year or two as volume production is achieved.

Usage charges start at US$5 to US$6 per minute (a huge reduction on the US$8 to US$10 per minute charged for the system's predecessor Inmarsat-A) and these charges will fall as traffic volume increases until a level of around US$3 per minute is likely to be reached in the late 1990s. Inmarsat operates an open-access system, which means that competition between service providers will ensure keen pricing with concomitant benefits to the customer.

It is anticipated that the number of users of this kind of terminal will pass 100,000 by the late 1990s and could be as high as 250,000. A very high proportion of these users would be operating some or all of the time within the Pacific Rim area and even the most conservative estimates would indicate that there will be some thousands of people owning or renting these terminals and wishing to use them in the countries of the region within the next two years. The implications for regulatory, billing and administrative systems are the central issue of this paper.

The markets for Inmarsat-M and the issues that it raises are not limited to briefcase terminals, however. There are at least three other large and important market sectors.

Inmarsat-M is essentially a Mobile communications system and thousands of terminals are being built specifically for installation on road vehicles, including not only heavy commercial vehicles such as long-distance trucks but also luxury private cars. In this respect the system's role will be identical to that of cellular radio but aimed principally at areas where that service is not available, although Inmarsat-M may make more widespread use of data communications than has been the case with cellular.

Inmarsat has already experienced large numbers of customers fitting their vehicles with its low-cost data communications terminal Inmarsat-C for use in trans-border communications between fleets of trucks and their head offices. This is proving a major benefit not only to commercial efficiency but also to security against hijack, theft and for the monitoring of dangerous loads.

In the European Community there has already been an agreement allowing the use of such terminals in any EC member state provided that they have been licensed by any other member state. Similar agreements are under consideration in several other regions and are of course similar to those being reviewed for cellular radio where compatible systems are operational in different countries.

This is an important consideration, for it is unlikely that a single global digital cellular standard will emerge and developing countries, in striving to meet pressing mobile communications demand, tend to have diverse analogue cellular systems which make technical compatibility an additional factor limiting international roaming agreements. Inmarsat-M, in contrast, is a global standard requiring only commercial and political agreements to achieve international roaming. Furthermore, it is planned to make future versions of the Inmarsat-M system capable of interworking or dual mode operation with a variety of digital cellular systems.

Two types of Inmarsat-M antenna systems are being developed for vehicle mounted operation. Terminals with flat, plate-type, phased array antennas have been developed that can be readily built into the sun roof of cars. Other terminals use low-profile directional antennas that use azimuth steering to track the satellite. These will be commonly seen on truck cab roofs.

As with briefcase versions, within a year or two national officials such as customs officers and telecoms licensing agencies will be faced with thousands of customers arriving at their frontiers with sophisticated two-way communications systems, in this case built into their vehicles, which are difficult to recognise and of great commercial and personal benefit to the users and the companies and organisations of which they are a part.

Maritime applications are similar to the vehicle mounted or land-mobile ones and here at least the regulatory and licensing arrangements are well established, following more than ten years of operation of the Inmarsat-A communications system.

However, whilst Inmarsat-A is fitted to about 15,000 of the world's largest ships and follows long-established precedents for licencing and billing that were developed for conventional radio systems decades ago, Inmarsat-M will be fitted on scores of thousands of small fishing boats and private yachts and will precipitate significant changes in the established practices.

Firstly, they will often not be familiar with the billing process used for international maritime communications whereby all bills are sent to a recognised International Accounting Authority which pays the bills and reclaims the money, plus a commission, from the customer. Instead they will want to pay the service provider directly, probably by credit card. In this they reflect the requirements of the land mobile customers also.

Secondly, they will fit the new terminals in such numbers that existing staff and facilities in the national routing organizations responsible for issuing licences may prove inadequate to the task, especially in countries that have only ever processed one or two applications for satellite communications systems a year in the past. Worldwide, Inmarsat systems are operational today in 120 countries, but only 50 of these have more than 10 applications a year. By the mid 1990s these numbers are likely to swell to hundreds of applications a year in most countries of the Pacific Rim.

Finally, they will be fitting terminals that are small and easily moved from boat to boat or from boat to land. Whilst maritime terminals are not really suitable for land mobile or portable applications, they are very suitable for installation in, for instance, the head office of the shipping company, on the roof of the yacht owner's office, at the port authority, the customs house or the ship chandler.

These types of installation will be very popular, because they will enable quick, secure and reliable communications directly between boats at sea and their most common communications partners ashore, without going through the national fixed telecoms networks. This raises the vexed question of bypass.

The bypass issue is critical for the last major market sector, which is the application of Inmarsat-M to rural or thin-route telephony schemes.

Inmarsat-M is not intended as a direct competitor to either cellular radio or conventional fixed telecoms networks. The terminal costs and usage charges clearly preclude that. It does, however, offer a means of providing telecoms services to rural or remote areas prior to the development of those conventional services and by giving instant coverage of areas not yet covered by them, it enables service providers to develop an optimised strategy for the expansion of cellular and fixed systems. In short, by instant provision of essential thin-route services it can allow expensive investments in cellular and fixed networks to be concentrated in high traffic areas that justify the cost.

One of the key advantages of Inmarsat-M is that it is part of a global system whose infrastructure costs have already been met. The satellites and network coordination centres are in operation, the land earth stations or hubs are in place or being built and anyone, whether or not their country is a member of Inmarsat, can buy a terminal and use the system. It is not necessary to have a land earth station within the country, since there is open access to the system via the international switched networks and land earth stations in other countries. It is not necessary to lease capacity that may be greater than the initial demand, because the system works on a pay-as-you-use basis.

Thus the benefits of mobile communications with global reach can be realised now, with low capital investment, low risk and incremental build-up of services in line with actual market demand. The real question thus becomes not the size of the market or the size of the investment required to realise it, but whether or not the world's telecommunications, regulatory and administrative bodies are ready to meet the challenge of allowing access to systems such as Inmarsat-M. In fact, Inmarsat-M poses the immediate challenge of making possible the changes in the telecoms environment that will be absolutely essential if the proposed global hand-held telephone systems of the future are ever to become viable.

Let us examine each of the key issues in turn and propose some ways of meeting the challenge.

INTERNATIONAL TRAVELLERS & BRIEFCASE TERMINALS

If the issue is customs import regulations on communications equipment that stop the traveller from bringing his terminal into the country, one simple answer is to set up rental agencies that will rent a portable briefcase terminal to travellers at the airport, just like a car. This is often better for the traveller - he doesn't have to take the thing on the plane. If he does want to use his own terminal, then set up a standard licence fee that can be paid in advance or at the airport on arrival. The money made from either of these approaches should offset any loss of revenues from bypass of fixed networks.

VEHICLE-MOUNTED TERMINALS & TRANS-BORDER USE

If there is substantial trans-border trade, then the commercial benefit to both countries of allowing mobile communications across the border should be obvious. The solution is equally so: a mutual agreement between the neighbouring countries to recognise licences granted in either country for use of specified terminal equipment that is type-approved for use in the Inmarsat system. There are good examples already in place in the Pacific Rim for cellular roaming; for instance between Singapore, Hong Kong, Australia, New Zealand and Canada and between Thailand and Malaysia.

If the equipment also has position reporting facilities (as will generally be the case), this could actually help make security and policing of international road transport better than it is at present.

INCREASE IN NUMBER OF LICENSE APPLICATIONS

Every license granted represents a commercial opportunity, not just for increased telecoms traffic between the mobile terminal and the country's fixed networks, but also for licence fees. The administrative burden can be greatly reduced by a facility Inmarsat provides known as the

Routing Organization Electronic Commissioning System (RO ECS), basically a computerised means of processing applications with minimum effort.

MOBILE-TO-MOBILE COMMUNICATIONS

This should be seen as the biggest opportunity presented by the new system, rather than as the biggest threat. The essence of the demand for mobile communications is that it is NEW demand, not a replacement for existing systems. Customers want mobile satellite terminals because they offer something that is not available at all currently.

A recent market research workshop among national telecoms organizations from the Asia/Pacific region highlighted this point. The conclusions of the workshop included the statement that the expansion of cellular systems has a natural limit based on cost of setting up a cell, the terrain as well as the population density to be served. In addition, cellular systems are showing a worsening profile for revenue per subscriber, a declining customer growth rate, as well as higher costs due to declining cell sizes, hostile economics re population density and difficult geographical terrain.

The workshop went on to observe that while some countries are investing substantial sums into building up the telecoms infrastructure, the pace of economic development outstrips that of infrastructure growth. This creates a pent-up demand for both fixed and mobile communications. As the transport networks improve, much intra-country business travel will prevail, leading to further demand for mobile communications within the country and to some extent within the region. (Report of Inmarsat Project 21 Asia Pacific Market Research Workshop, 3-4 August 1992, attended by representatives of 13 national telecoms companies in the region.)

Inmarsat-M offers the chance to build up this market demand until cellular or fixed networks become economically viable. It also enables service providers to concentrate their cellular and fixed investments on areas that are profitable, rather than having to spend huge sums for socio-political reasons on supplying uneconomic service to thin-route areas. Most important of all, Inmarsat-M makes it possible to take action on meeting demand in these areas NOW, without either large investments or long delays.

OPERATING A NATIONAL LAND EARTH STATION

One further possibility is to build and operate an Inmarsat-M land earth station within the country. This will cost around US$4 to US$5 million from any one of nine potential suppliers and will give the opportunity not only to avoid bypass of national networks but also to bring in substantial revenue from foreign markets. As the Inmarsat system is truly global and each LES operates to a satellite that covers about a third of the earth's surface, there is major potential for providing service not just across the whole country but to neighbouring countries and adjacent sea areas as well.

CONCLUSION

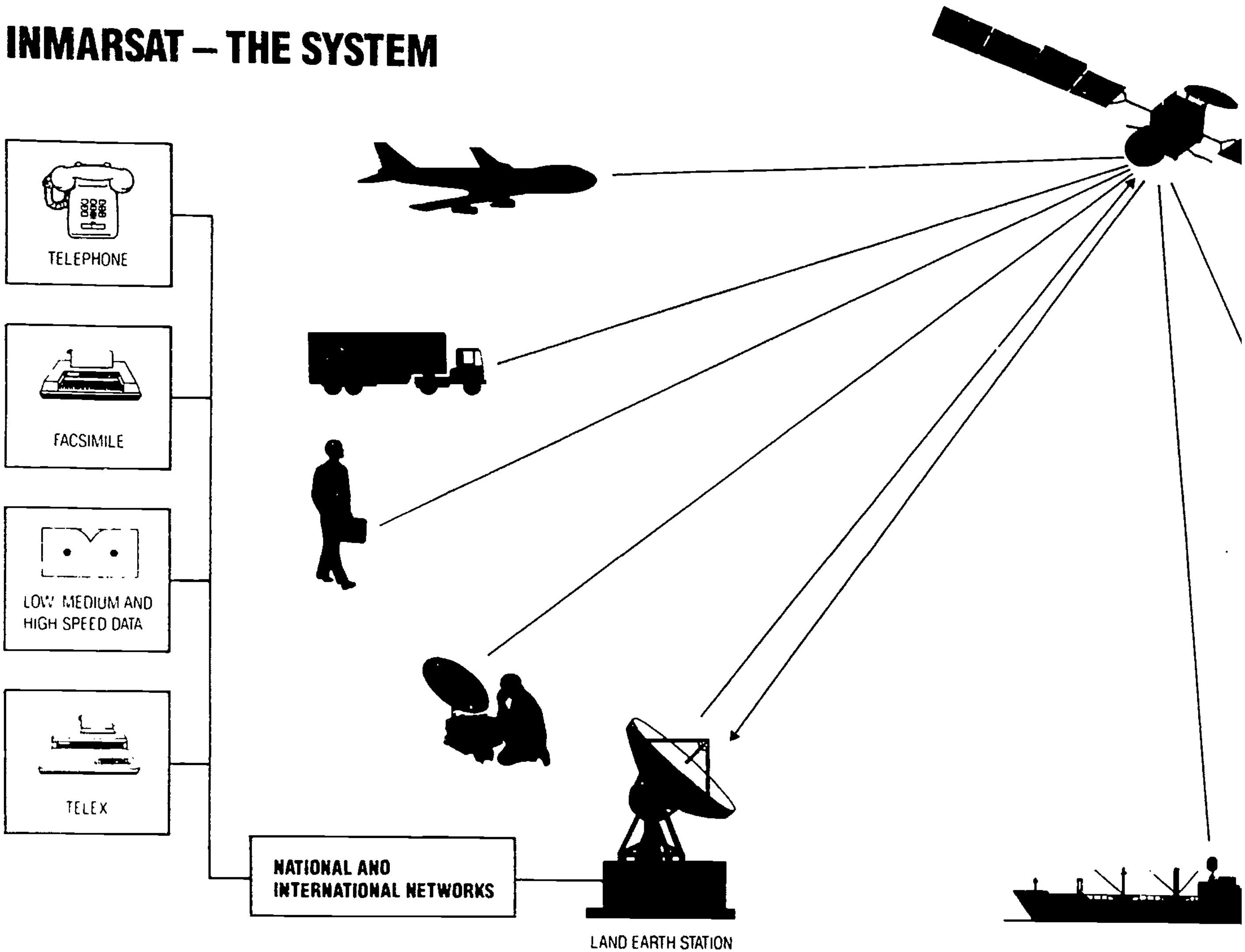
By the end of 1993 there will be thousands of briefcase terminals being carried around the world by private individuals and thousands of vehicles fitted with unobtrusive terminals, all of which will be capable of making and receiving calls to and from anywhere in the world. There will also be thousands of terminals fitted aboard small boats operating within territorial waters and the potential to meet thin-route telecommunications demand through small transportable or semi-fixed terminals with antennas of less than one metre diameter.

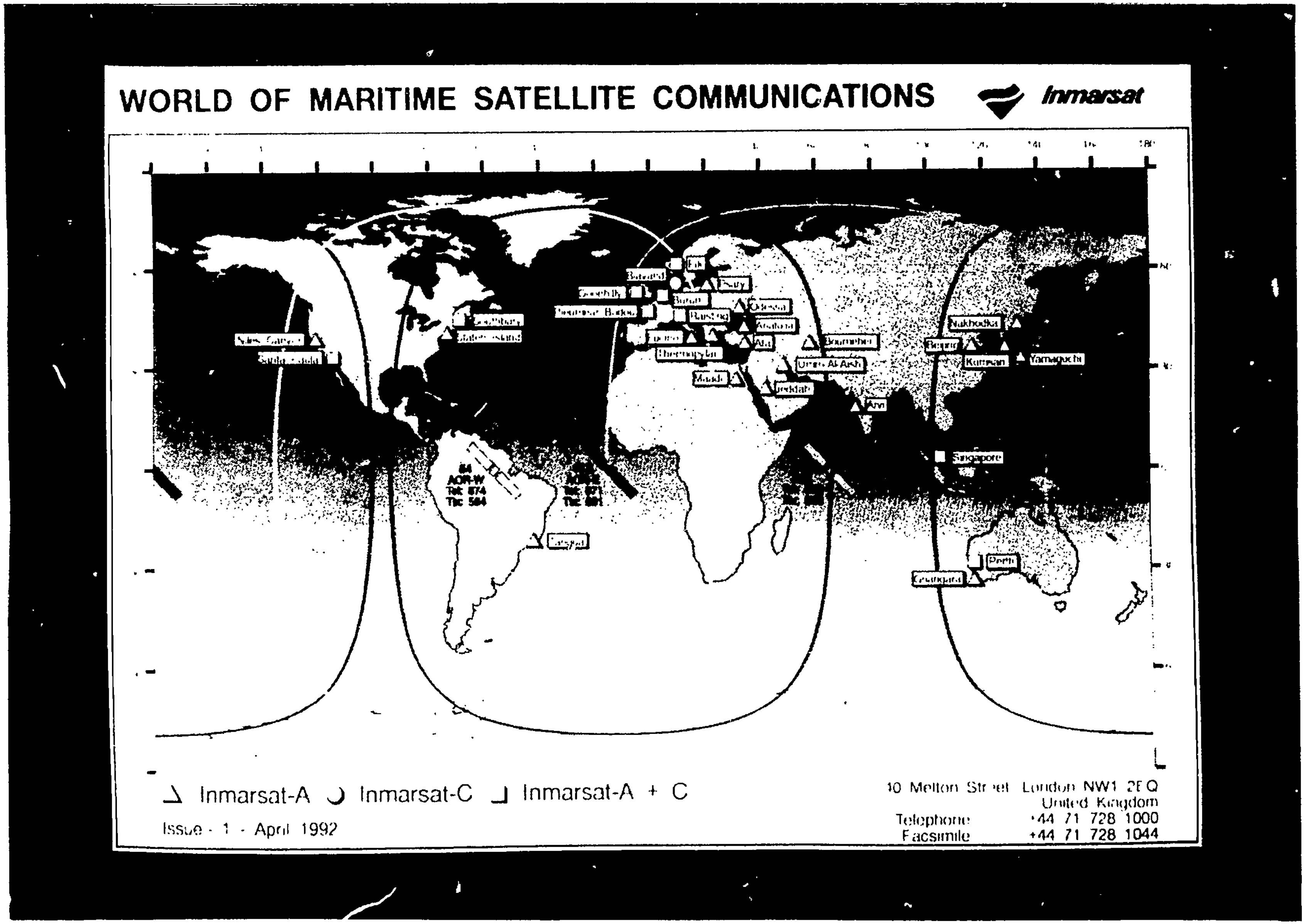
Given the explosive growth that continues in the mobile communications markets, the proliferation of such equipment will require national regulatory and administrative bodies to develop their response very quickly, for the well-proven link between telecommunications development and economic growth will count heavily against countries that adopt a restrictive position against the spread of global, mobile communications, whether by intent or by slowness to adapt to change.

We do not have to wait until the late 1990s for the era of truly global, truly mobile communications. Indeed, we do not have that luxury. The technology already exists, the infrastructure is already in place and the product is already being marketed. The demand is undoubtedly strong and the services and prices are right to meet it. The real question is simply, are we ready to profit by it?

LIST OF ILLUSTRATIONS

INMARSAT – THE SYSTEM





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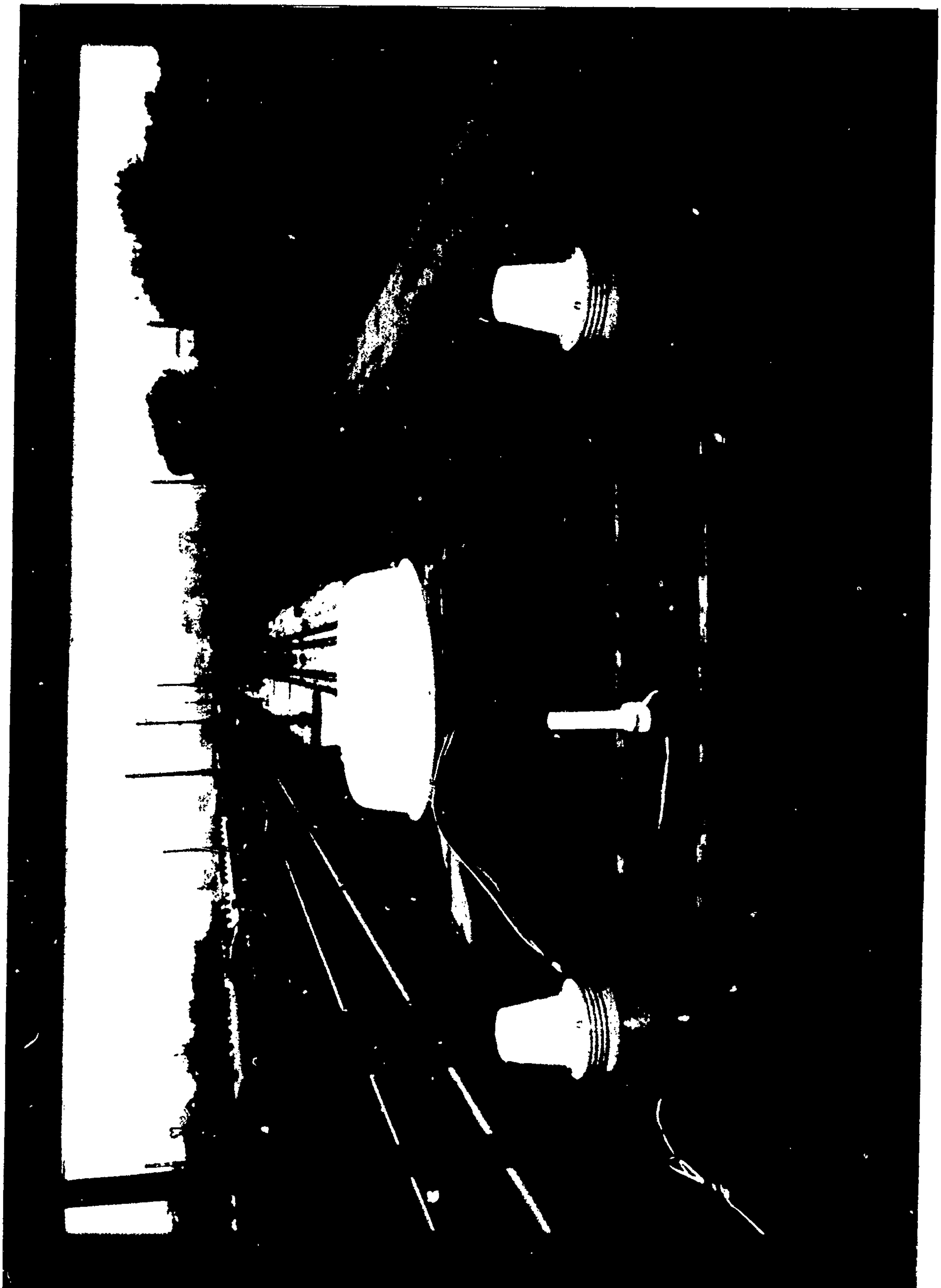

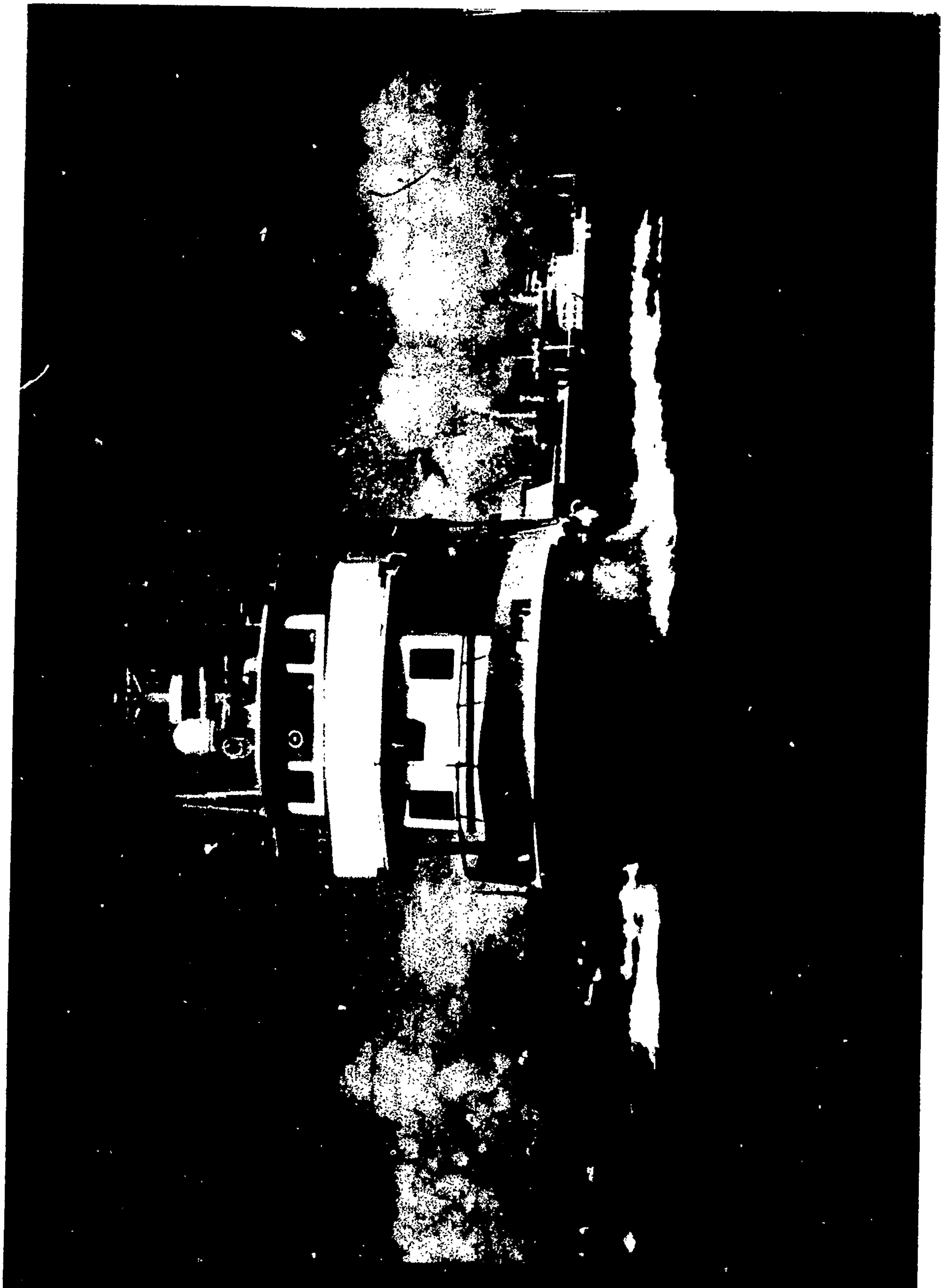

INMARSAT-M PORTABLE MES

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1. ABSTRACT

An overview of the Inmarsat-M Portable Earth Station(PES) design is presented in this paper. The antenna, modulator / demodulator, power subsystem and packaging are some of the critical elements whose design influence the size, weight and operation of the terminal. The trade-off between the antenna gain, power amplifier size and the overall dimension is described in the paper. This PES is designed for lower production cost along with acceptable weight and size. Ease of set-up and operation is one of the consideration given in designing this terminal which is also outlined in this paper.

2. INTRODUCTION

This paper describes the new mobile satellite communication system , Inmarsat M , being implemented by Inmarsat. The critical element of the system is the Portable Earth Station (PES), the development of which is detailed in this paper. The paper concentrate on the techinical aspect of the Portable MES design and the trade-off parameters and key technologies used to achieve a compact, light weight portable terminal.

Inmarsat has been providing communication to ships from late 70s and is now actively implementing new systems for use on land, in air and at sea. These new systems can provide near global communication for anyone on the move. By 1993 four new systems will provide telephony, telex, data, group calls and facsimile at affordable costs to a very wide range of users. Inmarsat A is an analog based voice system which has been designed primarily for maritime use. However, in recent years, Inmarsat A has been extensively used in land based applications, mainly in news gathering and reporting. There are numerous applications other than voice, have been developed for Inmarsat A.

Two other systems are in operation for the past two years ; one to serve the aeronautical community with voice, data and facsimile ; the other, Inmarsat C, low speed data only, service to serve the land and maritime community. Inmarsat has been developing Inmarsat M, a digital based voice, facsimile and data system, which will be compact in size, but will provide adequate voice quality in the mobile environment and serve a wide range of maritime and land users.

3. Inmarsat-M Network Overview

The Inmarsat-M system is the new mobile satellite communicatons system, being implemented by Inmarsat. This system provides the following major services to its terrestrial based and mobile subscribers.

(1)Duplex telephony service using 6.4kb/sec IMBE digital voice coding scheme.

(2)Group-3 facsimile service at 2.4 kb/sec in both duplex and terrestrial originated simplex modes.

(3)2.4kb/sec data service in both duplex and and terrestrial originated simplex modes.

In addition to these services, the system provides several additional services such as group call (broadcast call originated from the terrestrial subscribers) and distress call (SOS call originated from the maritime mobile users).

The Inmarsat-M system consists of four basic elements for each satellite ocean regions, an operational satellite, MES(Mobile Earth Station) a Network Co-ordination Station(NCS) and Land Earth Stations(LES).

Figure-1 illustrates the Inmarsat-M network configuration.

An operational satellite
The Inmarsat-M system uses the same satellite which is currently used for other systems such as Inmarsat-A and share the same frequency bands assigned to the satellite mobile communication systems. The expanded frequency band based on the definition at WARC MOB 92' will be available from the 3rd generation satellite.

Network Coordination Station (NCS)
NCS is the reference earth station which controls and monitors the overall Inmarsat-M network and includes the following functions.
- -Transmission of the signaling messages for channel assignments for SCPC communications channel
- -Channel assignment for SCPC channels
- -Transmission of the Bulletin boards with global system status information
- -Reception of the MES-originated signaling messages
- -Inter-station signalling with each LES
- -Maintaining lists including MES "Busy" status within the network, and frequecy assignment for each satellite network.

Land Earth Station (LES)
LES is the satellite gateway earth station which is installed between the satellite and terrestrial gateway facilities such as the international telephony exchange or international telex exchange. Therefore LES provides access to the international terrestrial communications networks for the mobile terminal subscribers.

Mobile Earth Station (MES)
Two classes of Inmarsat-M mobile earth stations are supported in the system.
(1) Maritime Class MESs
(2) Land Mobile Class MESs

This paper describes the Inmarsat-M portable terminal which is categorized as one of the land mobile class MES.

4. Main features of the developed Inmarsat-M Portable MES

The developed new portable satellite terminal is designed to be carried easily and to provide the medium quality telephony, facsimile and data services throughout the world. In order to make the unit compact, compromise between an HPA and an antenna gain is required. Although high output power can reduce the size of the antenna, it increaces the power consumption and the size of the terminal and reduces the battery operational period.
To solve this problem, this terminal adopted the folded type flat antenna to minimize the size of the antenna and increase the gain.

(1)Compact design
The small compact terminal with its telephone can either be installed outdoors or inside by a window. The single package terminal incorporates a flat antenna, transceiver and rechargeable battery pack.
Because of its compactness, it is extremely easy for an international business traveler to carry the terminal by himself.
In addition, setup of the terminal on site before operation is not necessary because all the components are integrated into a single unit.

(2)Easy antenna pointing
The elevation angle adjustor is provided so that the antenna pointing can be accomplished very easily with the use of the attached compass and signal level indicator, and communication services can be established within a few minutes.

(3)Folded type antenna design
In order to reduce the total power consumption, the two-folded type antenna design is adopted. With this design approach, longer battery operation period and smaller mechanical size are achieved.

(4)Multiple power source
In addition to the battery operation, it is also possible to use the AC mains with AC/DC adaptor.

The major advantages of the Inmarsat-M portable terminals compared with Inmarsat-A or Inmarsat-C terminals are as follows.

(1)Compared with Inmarsat-A terminals
The mechanical size and total weight are significantly reduced so that it is much easier to carry the terminal.
It is also expected that the communications charge(tariff) will be reduced greatly, compared to that of the Inmarsat-A service, because the occupied satellite bandwidth per SCPC channel is much narrower than Inmarsat-A.

(2)Compared with Inmarsat-C terminals
The Inmarsat-C terminal is very useful for the message communications, however it can not support voice communications which on some occasions is essential and very useful for actual field operation. The Inmarsat-M terminal provide voice communications .

5. Overall terminal configuration

The developed Inmarsat-M portable terminal consists of the flat antenna, duplexer, High Power Amplifier(HPA), Low Noise Amplifier(LNA), modulator, downconverter, Baseband processor(BBP) with access control software, voice interface unit and handset. The accomodation space and the interface for the future addition of the facsimile and data interface units are also provided. Figure-3 shows the overall block diagram of the portable terminal and Table-I summarizes the the major performance.

6.Equipment Description

Antenna

A fold type antenna achieves high gain of 18 dBic with patch array. It reduces the power consumption extremely and achieves high G/T of -9dB/K. The power fed to each of the antenna elements is controlled to achieve low sidelobe performance, especially in the vertical plane, because the antenna length in vertical plane is shorter than that of the horizontal plane. It also gets a good axial ratio less than 2 dB by adjusting the phase fed to each element.

HPA & LNA

HPA & LNA are connected to the antenna via a low loss compact dielectric duplexer which achieves the compact RF block and high G/T. The output power of the HPA was set to meet the lower level in the specified eirp range so as to reduce the power consumption. The output power of the HPA can be switched down by 6 dB for the spot beam application.

Modulator & Down Converter

The newly developed Hybrid Integrated Circuit is adopted as the modulator which can directly convert the base band signal to the RF signal and modulate. In the down converter, the RF signalis converted to baseband signal via 100 MHz IF signal and it is sent to BBP to be demodulated.

Baseband Processor

Baseband processing is implemented with Digital Signal Processors (DSP). The DSP provides the flexibility and speed required to operate. The functions executed in BBP are transmit frame information, multiplexing data and control signals, demodulation, receiving frame syncronization, and demultiplexing data and signals. Considerable use of custom LSI's in the BBP has enabled the overall size of the BBP to reduce.

ACS controller

The ACS controller, using NEC's V50 microprocessor, provides all the signalling protocol for call establishment as defined by Inmarsat-M system requirements. It also provides the control of the user interface (LCD and switches) as well as monitoring and controlling all the terminal components. The ACS portion is physically incorporated into the BBP and closely monitors the BBP functions. It also acts as the control interface to the voice codec, handling hook, call type and service address type information. The ACS controls both call setup and clearing of all service types for both MES originated and Fixed originated calls.

Voice Codec

The Voice codec provides the voice, fax and data interface to the terminal. The voice codec uses the 6.4kbps IMBE algorithm developed by DVSI. The voice codec consists of one 2-wire port for telephony and fax use as well as an RS232 type contor for data service use. To differentiate between telephony and fax calls initiated from the 2-wire port, the user must first select the call type they wish to use i.e telephone or fax. This is done through a push type switch on the terminal unit. This voice codec is capable of detecting DTMF digits received from the 2-wire port as well as regenerating any terminal received digits to the 2-wire port. It also provides a ring signal to the 2-wire port. Other features of the voice codec include on/off-hook detection, service tone generation.

Furthermore, it performs the echo-cancellation, and can adjust the tone level by 2 dB steps.

Fully compatible G3 facsimile is also supported. The data port will appear as a modem to an attached terminal and will conform to a selected set of hayes compatible commands.

Power Supply

The newly developed power supply can achieve high efficiency of greater than 85 % and the total power consumption can be greatly suppressed. The Nickel-Cadmium rechargeable battery can also be installed inside the unit and it can be charged by an AC/DC adaptor attached as an accesory in an hour.

7.Conclusion

A portable type terminal which meets the Inmarsat-M specification was developed. This terminal was designed for land mobile use and easy to set-up. To achieve this purpose, the folded flat type antenna was adopted and also the high effciency power source was developed. It can provide medium quality telephony communications, G3 compatible facsimile and data communications with light weight and compactsize. It is suitable to carry it to areas where telecommunications fascilities are neither available nor reliable.

It will be possible to reduce the size and weight furthermore in the future by using the custom LSI technology, low ioss duplexer and high efficiency battery like Nickel-Hydrigen etc.

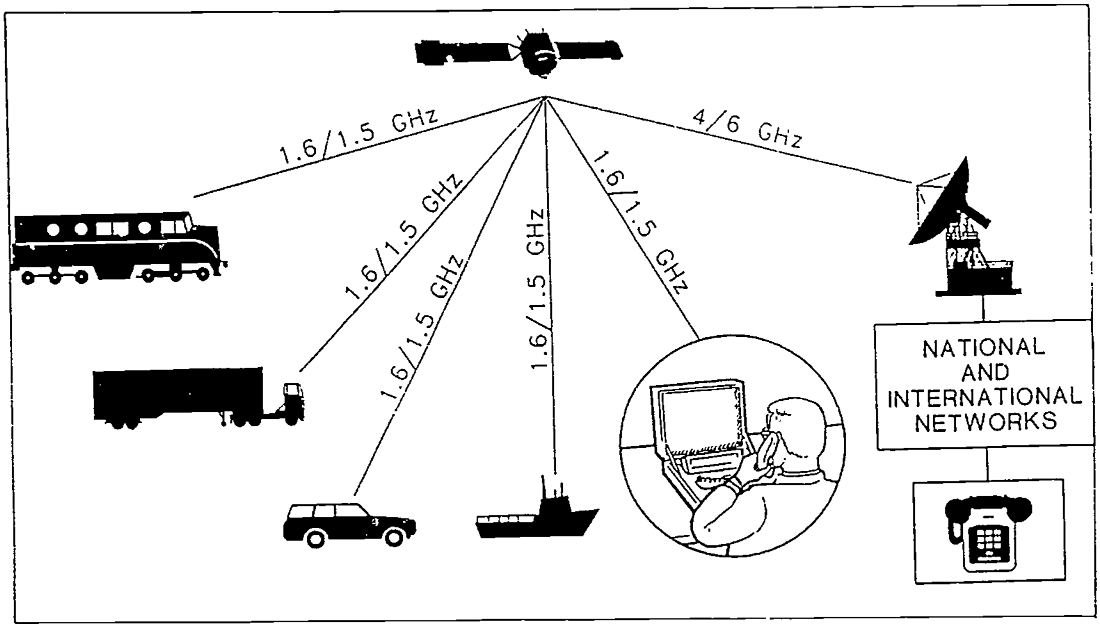


Fig. 1 The Inmarsat-M Network Configuration

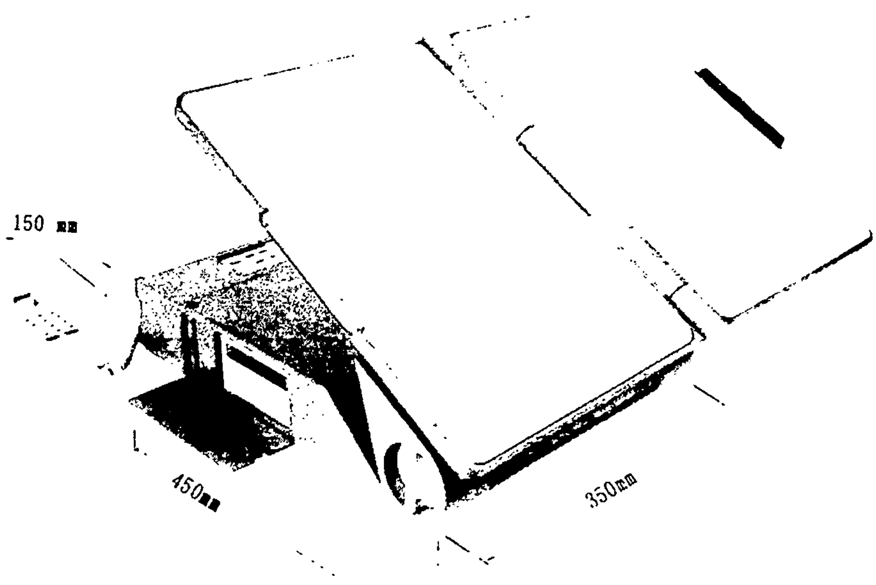
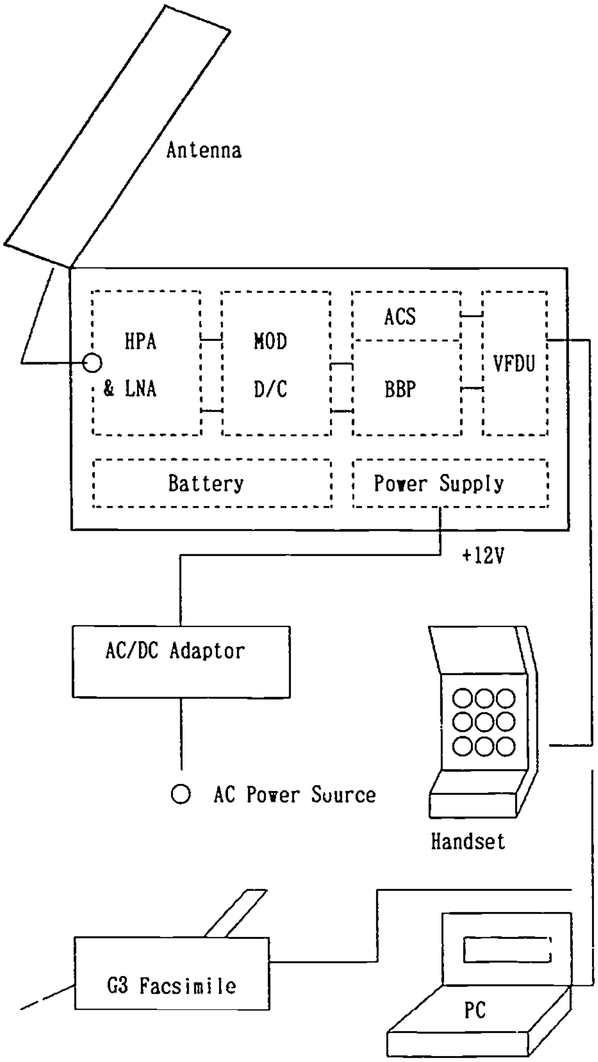


Fig. 2 The Outside View of the Developed Inmarsat-M Portable Terminal



HPA : High Power Amplifier
LNA : Low Noise Amplifier
MOD : Modulator
D/C : Down Converter
ACS : Acess Control Software
BBP : Base Band Processor
VFDU : Voice, Facsimile & Data Interface Unit

Fig.3 Block Diagram of Portable Terminal

Items	Performance
1) Frequency	TX; 1626.5 ~ 1660.5 MHz RX; 1525.0 ~ 1559.0 MHz
2) G/T	-9.0 dB/K
3) Eirp	23 dBW
4) Polarization	Right Hand Circular Polarization
5) Axial Ratio	≦ 2.0 dB
6) Modulation	Forward Signaling Channel BPSK 6Kbps (FEC; R=1/2 Convolutional Encoding Constraint Length= 7) Return Signaling Channel BPSK 3Kbps (FEC; R=3/4 Convolutional Encoding) Communication Channel OQPSK 8Kbps
7) Channel	Voice Channel Coding Algorithm; Improved Multi-Band Excited (IMBE) Coding Voice Coded Data Rate; 6.4 Kbps Facsimile /Data Channel Data Rate; 2.4 Kbps
8) Power Supply	+12V DC
9) Operational Period with Built-in Battery	Transmission Mode : 1 hour Receiving Mode : 2 hours
10) Satellite Elevation Range	5° ~ 90°

Table-1 Summary of the Major Performance

Fig. 4 The Image of the Applications

BRIDGING THE GAP

J C Bell
Manager, Regional Business Development
Inmarsat

ABSTRACT

For more than a decade Inmarsat has operated the world's only global mobile satellite system. The paper looks at the development of mobile satellite communications, its applications and the recent introduction of the Inmarsat-M system, which will bring telephone, fax and data services within the reach of many new users.

Historically, due to the size and cost of earlier systems, satellite communications for mobile users could only address a limited market. Now, the Inmarsat-M system makes it feasible to install such equipment on small sailing boats, in a car, truck or when packed in a briefcase to be carried by an individual. For those within the Pacific Basin, it will, for the first time, provide individuals in remote areas with reliable direct dial telephony and data communications with the rest of the world at an affordable price.

INTRODUCTION

When Satellite communications were introduced some thirty years ago a new era began as, for the first time, people worldwide were able to contact each other by telephone any time of the day or night and in any weather conditions. The ability to beam television between continents overnight changed our view of news and other world events. Today we take such things for granted with many homes now able to receive direct broadcast satellite services. However, direct access to the international public switched telephone network through personal satellite earth stations has until now been limited to the privileged few. The first users were at sea, where in the late seventies Ship Earth Stations operating first through the Marisat system enabled vessels at sea to make and receive calls. Unfortunately, the size and cost of the equipment precluded its widespread use until more recent times when technical developments and lower costs brought the benefits of satellite communications to a much wider user community. Now with over 20,000 Inmarsat-As in worldwide use mobile satellite communications has become an accepted part of life. Undoubtedly this awareness was accelerated by reporters widespread use during the Gulf War which brought it to the wider attention of the public and business community.

Today, the Inmarsat system is used by all types of vessels, trucks, trains, business users, and now civil and general aviation. Already a large number of corporate jets are able to make and receive calls anywhere in the world and over the coming years such capability will become commonplace on virtually all the major long-haul airlines.

During the last few years data communications through the Inmarsat-C system has brought tremendous benefit to trucks, ships and journalists who need to be in contact at any time. Such small equipments with their low power consumption have brought the advantages and awareness of satellite communications to a wider user community although the absence of a telephone service has been a drawback to some potential users.
Now with the introduction of the Inmarsat-M system, personnel satellite communications (with direct dial telephony, data and facsimile) are finally able to bridge the gap and address the needs of the average business and industrial user on land and at sea. Size, weight and power consumption have been minimized so that a cost effective solution now exists for those not directly connected to the public network to keep in touch at all times from anywhere in the world.

BACKGROUND

Till now, the technology available meant that to be cost effective, a mobile satellite terminal carrying voice traffic had to be fairly substantial. The large antenna was required to enable the satellite transmit power to be minimised and so keep call costs down. The Inmarsat-A uses 50kHz of bandwidth for its FM telephony channels and this limits the number of calls that can take place simultaneously in the 7.5 MHz of bandwidth originally allocated. The new Inmarsat-M system is able to take advantage of the latest digital techniques so that only one fifth the bandwidth is required for a call while at the same time the satellite power is almost halved. Like so many good ideas the Inmarsat-M concept has been around for a long time, but it is only the recent maturity of the technologies employed that have enabled a cost effective solution.

THE INMARSAT-M SYSTEM

Inmarsat-M is an all digital mobile satellite communication system providing telephony, fax and data connections with any terrestrial subscriber via the International public followed by the country, area code and subscriber number. In practical terms the Inmarsat-M mobile is simply an extension of the global terrestrial network but instead of plugging the phone into the wall socket the antenna is pointed towards the satellite. In this way the Inmarsat-M may be compared to a cordless phone but with unlimited range.

VOICE CODING ALGORITHM

To keep user costs down it is necessary to digitally compress the spoken word as much as possible while still retaining speech quality and voice recognition. This was achieved using an improved multiband excitation model voice coding algorithm specially developed (and selected following an international competition in 1990) by Digital Voice Systems Inc (DVSI). The algorithm uses a voice codec operating at 4.2 kbps which with the addition of FEC results in a coding rate of 6.4 kbps. Sub-band signalling and preambles then take the overall channel rate up to 8 kbps. Unlike voice coding algorithms previously used in fixed links this one had to be robust enough to operate in the difficult land mobile environment where fading of the incoming signal and occasional blockage will impact performance. The final results indicate that speech intelligibility can be maintained in channels with an error rate up to 6% and a burst error rate to 20%.

CHANNEL CHARACTERISTICS

Digital modulation is used for the Inmarsat-M signalling and communication channels. The basic modulation and coding is filtered off-set quadrature phase-shift keying (O-QPSK) used in both directions to carry the communications on Single Carrier Per Channel (SCPC) carriers. The signalling channels use binary phase-shift keying (BPSK) which is filtered in the forward direction (calling the mobile) and unfiltered in the return direction (calls originating at the mobile).

The Channel format is specially designed to be robust in the land mobile environment. A frame length of 240ms is used while a short CW preamble in each 60ms subframe allows the demodulator to reacquire very quickly after short blockages. Forward Error Correction (FEC) convolutional coding of constraint length K = 7 with rate ½ and ¾ is used in all signalling and sub-band channels to improve error rate.

CCITT Group 3 facsimile and data are transmitted at 2.4 kbps over an 8 kbps channel using O-QPSK modulation and punctured coding at rate ¾ FEC (with time diversity).

Channel spacing in the Inmarsat-M system is 10kHz though the synthesizer steps are in 5kHz steps across the whole 34.5 MHz of spectrum allocated to maritime and land mobile communications.

A satellite EIRP of 17 dBW is used in the forward direction. Mobile Earth Stations (MES) transmits a minimum EIRP of 25 dBW in land versions and 27 dBW for maritime ones. This leads to a G/T of -10 dB/K for maritime terminals and -12 dB/K for the land mobile versions. The practical effect is that a small antenna about 0.5m diameter can be built to meet these criteria. With so many manufacturers developing terminals it is interesting to see the ingenuity that has occurred in this area with technology being pushed to the limit. Typical antennas range from planar arrays to short backfire designs for the maritime versions and from linear cavity-backed types to electronic beam formed mobile versions. This latter type results in a very low profile antenna that has been successfully trialed in a Volvo estate car in the space normally occupied by the sunroof.

NETWORK CONFIGURATION

The Inmarsat-M system comprises four independent communications networks (Satellite Ocean Regions), each network containing an operational satellite, mobile earth stations (MESs), a network coordination station (NCS) and land earth stations (LESs), the latter providing access to the international terrestrial communications networks.

LAND EARTH STATION (LES)

Land earth stations act as gateway between the PSTN and Inmarsat space segment. These are owned and operated by Signatories, who are also responsible for land line connections to the PSTN. Each LES has a parabolic antenna with a diameter in the range of 10-13m for transmission to /from the satellites. Uplink is at C-band and includes Automatic Frequency Compensation (AFC) System. LES transmit and receive frequencies are unpaired and operate in bands compatible with the Inmarsat satellite transponder characteristics. The LES synthesizer step size (5 kHz maximum) is compatible with the minimum operational SCPC channel spacing used in the Inmarsat-M system of 10 kHz.

NETWORK CO-ORDINATION STATION (NCS)

Inmarsat-M NCS Services are provided at a designated Land Earth Station in each of the four satellite network regions. Each network co-ordination station is connected via terrestrial links to the Inmarsat Network Control Centre (NCC) in London. The NCS plays a key role in the network and is responsible for co-ordinating the access to communications channels between all LESs and MESs within the network, thereby ensuring full connectivity. The major NCS functions include SCPC call processing, monitoring of proper operation of signalling channels, database management and housekeeping, etc.

In the event of NCS failure, each stand-alone LES within the network is able to maintain the full capability for serving mobile-originated calls. Announcements for land-originated calls are transmitted by individual stand-alone

FIGURE 1.

VOLVO ESTATE CAR USED TO TRIAL BALL AEROSPACE LOW PROFILE ANTENNA

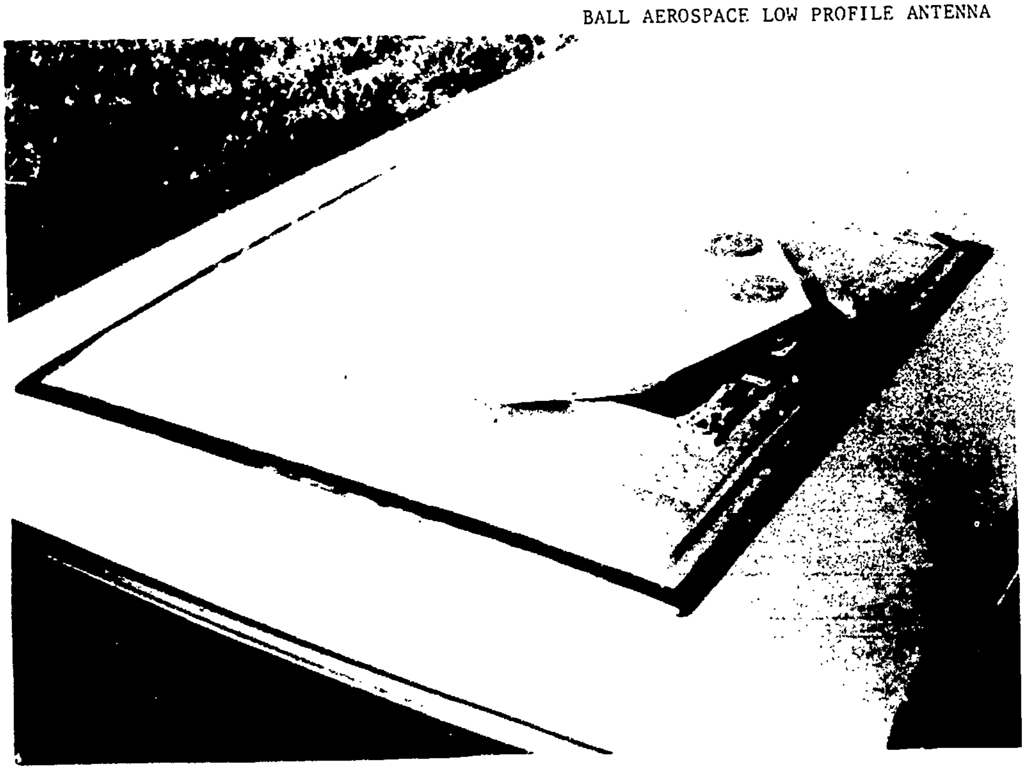


FIGURE 2.

BALL AEROSPACE LOW PROFILE ANTENNA INSTALLED IN VEHICLE SUNROOF APATURE

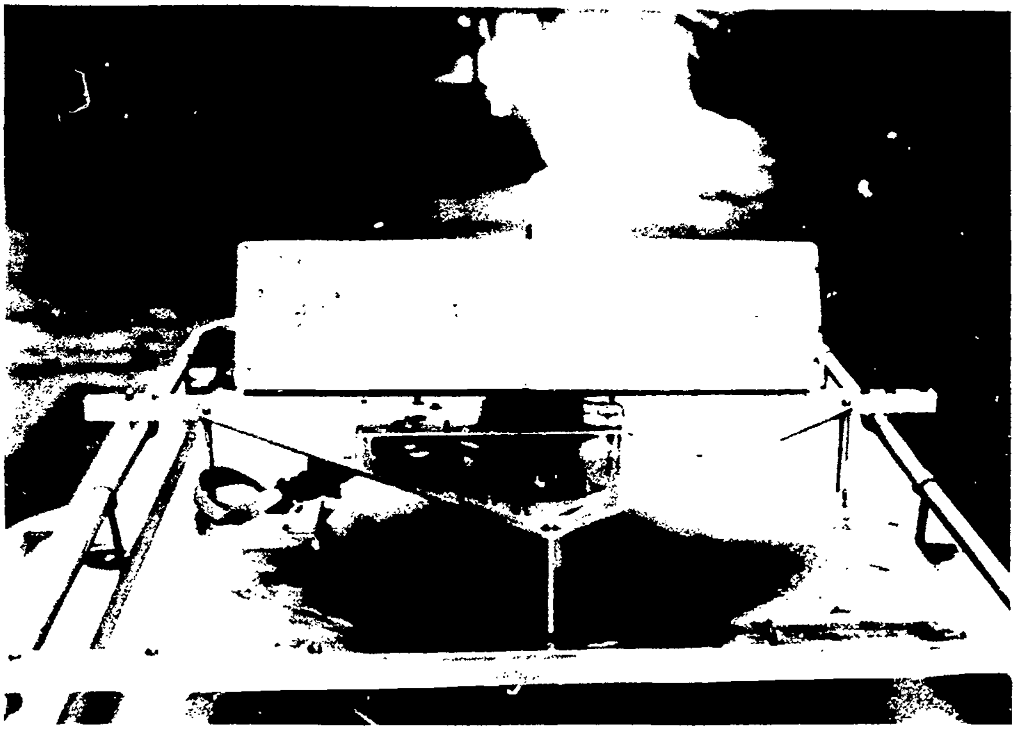


FIGURE 3.

NEC PROTOTYPE INMARSAT-M INSTALLED IN TEST VEHICLE WITH ANTENNA RADOME REMOVED

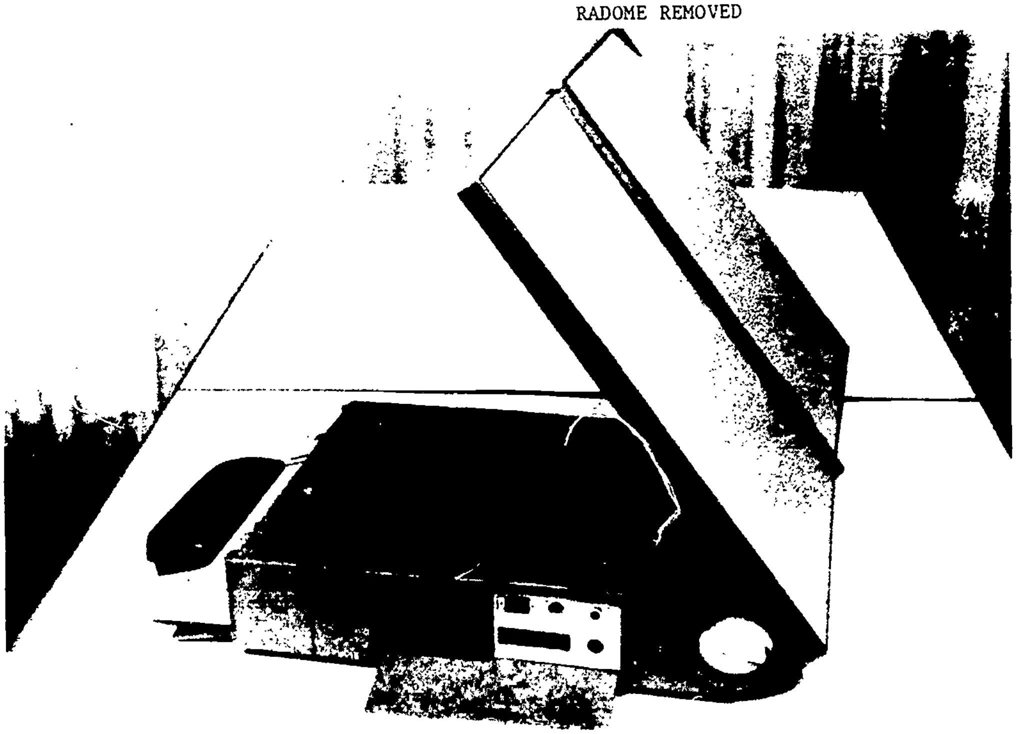


FIGURE 4.

NEC BRIEFCASE INMARSAT-M

FIGURE 5.

GLOCOM INMARSAT-M BRIEFCASE
TERMINAL

FIGURE 6.

GRINAKER INMARSAT-M BRIEFCASE

LESs. Although full connectivity for land-originated calls is not maintained, the network is not disrupted by NCS failure.

MOBILE EARTH STATIONS

The mobile equipment can be designed and manufactured by any company. Inmarsat provides such companies with a System Definition Manual (SDM) which is freely available and provides the specifications required to design equipment to work with the systems. When the development is essentially complete and before the equipment can operate through the satellite it must first be type approved by Inmarsat. This is to ensure that it complies with the system definition and will not cause harmful interference to other users, the satellites or the Land Earth Stations. No licensing or royalty fees are payable to Inmarsat so once type approval is obtained manufacturers compete with each other in a free global market which helps ensure a healthy and competitive market environment.

About twenty companies are or have developed MESs for the maritime, land mobile and transportable markets. An update of the models which have been type approved can be found in the Transat and Ocean Voice publications of Inmarsat which are freely available (see footnote).

A major determining factor is the overall system design was the land mobile antenna requirements where the size of antennas dominated the consideration. These practical constraints, giving drastic size reduction limit the gain to around 12.5 dBi to 13 dBi. Also, the small antenna size reduction makes antenna pointing less critical, thus allowing the antenna tracking system to be simplified.

As in the maritime environment land mobile systems require an antenna that can be steered in the direction of the satellite to compensate for heading changes. As vehicles generally operate in a given region for a long period of time it is normally not necessary to adjust for elevation as the vertical beam width of the antenna is wide enough to cope with a substantial range. Transportable systems employ a fixed antenna which needs to be manually aligned to the satellite. This can easily be accomplished from a general knowledge of satellite location and the users orientation. Once the satellite is acquired a signal strength indication allows more accurate pointing of the antenna. (Figures 1, 2 & 3 show typical land mobile antennas while figures 4, 5 & 6 show a transportable configuration.) The electronics required in a Inmarsat-M are small enabling them to be easily packaged into a briefcase or small enclosure for mounting out of the way in a vehicle under or behind the drivers seat. A cellular or conventional type of telephone handset can be connected to the MES to make and receive phone calls while standard auxiliary connectors allows a fax machine or personal computer to interface with the terminal.

For vehicle installation the equipments are designed to run off 12/24 VDC battery supplies while transportables may have an internal battery for limited use plus charging facilities able to operate from any mains voltage or from a vehicles DC supply while others may run permanently off a solar power system. Initial costs for equipment are expected to be around twenty thousand US dollars, but this is expected to drop significantly as more equipment reaches the market in the coming year. Most terminals will be single channel systems i.e. they can only handle one telephone, fax or data call at a time. For those with requirements for handling multiple simultaneous telephone, fax and data calls, special versions are already being developed which will be capable of handling up to twelve calls at a time. This type of terminal uses an antenna about 2.2 metres in diameter, it will also attract lower user charges making it ideal for those applications where high volumes of traffic may by generated.

Typically land-mobile MESs will be expected to work over a wide range of temperatures, from -25°C to +50°C and with relative humidity up to 95% at 40°C. Externally mounted equipment (EME) will be specified to withstand the effects of ice, rain, snow, wind and sunlight, as well as enabling the antenna to maintain track under the influences of vehicle motion, vibration and power supply fluctuations.

APPLICATIONS

The availability of low cost easy to operate MESs for land and maritime use will create a whole new category of users. In particular the significantly lower users charges (Ref.1) will make the system much more attractive to the general public who work, live, holiday or take recreation in areas not served by fixed or cellular services.

TRANSPORTABLE USERS

For the businessman, engineer, surveyor, reporter, public and emergency services and even an individual holidaying in remote areas the availability of an Inmarsat-M transportable (briefcase) MES will be lifeline. No longer will people need to be worried or concerned about being out of contact as the ease and speed with which such terminals can be set up will ensure they are never beyond reach.

Many different designs of briefcase terminals exist. Some have their antenna built into the lid of the case which simply needs to be elevated and pointed towards the satellite to establish communication. Others have removable antennas that can be set up away from the electronics, telephone and fax. Some use bigger antennas than is technically necessary so that power consumption is minimized which in turn enables the unit to operate for longer periods of time on its own internal battery. Novel approaches have also been adopted including antenna designs which open like a book to increase the surface area when transmitting and receiving yet able to fold up into a small case for transport.

THIN ROUTE OPERATIONS

Many transportable and other versions of the Inmarsat-M terminals will find their way into remote area thin route service where other forms of telecommunications are not available. For those isolated land locked or small island communities the introduction of the new Inmarsat-M system heralds a breakthrough that makes it feasible to provide them with an affordable and reliable direct dial telephone service with the rest of the world.

The availability of good communications is a major factor in the development of trade, industry and tourism in remote areas while for those living in areas subject to the threat of natural hazards such as cyclones, hurricanes, storm surges, flooding, tsunami, earthquakes and volcanic eruptions, the availability of an Inmarsat-M could provide an essential lifeline. In particular it could help ensure both early warning of an impending disaster and assist in establishing appropriate co-ordination of subsequent relief operations. In other remote areas facilities such as game parks, rural hotels, lodges and farms will benefit from the availability of cost effective communications for their own purposes and their guests. For tourists the availability of an Inmarsat-M at a game park or lodge will also make it easy for a travel agent anywhere in the world to confirm a reservation in real time. This in turn should lead to better occupancy rates and increase tourist revenues. For such tourists the ability to communicate with the outside world by phone, fax or data could be important or even a determining factor in whether or not to take the holiday. For the game parks, lodge owners, hotel or farm it will also make provisioning more reliable and when an accident does occur, ensure that medical assistance or evacuation can be promptly organized. Likewise, farms and small mining and industrial complexes in remote areas will achieve substantial commercial benefits from the availability of a time real telephone, fax or data service.

Although power may be a problem in many remote areas the ability of the Inmarsat-M system to operate from a DC power supply means that it can be left operational twenty-four hours a day when connected to a solar or thermoelectric power generator.

LAND MOBILE USERS

It is likely that the majority of long distance truck operators will rely on Inmarsat-C for their communication needs because the data readily lends itself to direct input to computer fleet management systems. This also reduces costs as base stations manpower can be minimized. There does however, remain a substantial number of other users for whom voice communications are very important. Such users can be categorized as public services including police, fire and ambulance in remote areas, forestry personnel, utility field teams inspecting power lines on water systems along with oil and gas pipeline teams. Also, some trucks carrying certain cargoes may benefit from having a driver able to communicate verbally to identify problems. Further under some conditions the dispatcher may even be able to detect stress in the drivers voice.

Private vehicles operating in remote areas can also install Inmarsat-M without spoiling the vehicles appearance by the installation of a low profile antenna. It is interesting to note how many vehicle installed Inmarsat-As are already in service in spite of their very high cost. It would therefore not seem unreasonable to assume that this previously small and specialized market could be significantly increased by the availability of Inmarsat-M. In the future, such uses may extend to vehicles used by government officials operating outside urban areas while in the same context embassy staff and heads of state could similarly benefit when travelling in lessor developed areas.

RAILWAYS

There are many applications for Inmarsat-M in the railway environment. These include communications with the driver and the provision of passenger telephone, fax and data services on the train. Already a number of railway operators around the world have plans or are investigating the possibility of such installations.

Inmarsat has already conducted extensive trials of Inmarsat-M and C on railways in China, Russia and Australia with great success. Further trials are now underway or planned in Southern Africa and Europe.

Where trains operate in the open, installation of antennas poses no problem but many trains pass through tunnels with minimal clearance so it will be necessary to carefully consider the profile of the antenna and its projection before installation.

Track maintenance crews operate under very difficult conditions and safety risks are high when trains are operating in the area and the crews cannot be reached. Transportable or vehicle mounted Inmarsat-Ms would provide a reliable way of being able to contact the maintenance crews at any time.

Accidents also occur on railways and frequently happen in remote areas void of any viable communications. Again, transportable Inmarsat-Ms would provide an ideal communications solution for the accident teams, repair crews and inspectors who need to communicate from the incident site.

THE INMARSAT ORGANIZATION

Inmarsat is an internationally-owned cooperative which provides worldwide mobile satellite communications. Established in 1979 to initially serve the maritime community its role has evolved and its Convention has been amended so that it is a global provider of mobile satellite communications for commercial, distress & safety applications at sea, in the air and on land.

The Inmarsat organisation is headquartered in London and as of November 1992 has 66 member countries. The Inmarsat services are usually provided to the end user by these signatories (international telecom operators).

The Inmarsat systems are able to support services including direct-dial telephone, telex, facsimile, electronic mail and data communications. Other specialist applications include automatic position reporting, high speed data (56/64 kbit/s) & point-to-multipoint data services. Other custom service capabilities can be provided when required to meet specialist applications of the user.

Public services provided through the Inmarsat system conform to agreed international standards. This enables the mobile user to roam and operate throughout the world, subject only to national licensing requirements where applicable. This has very important benefits for the user whose terminal can be used anywhere thus simplifying operating procedures and minimising capital costs by reducing the number of different equipments that would otherwise be required to operate in different countries and regions. Manufacturers also benefit by being able to build equipment for a worldwide market where economy of scale can have a dramatic impact on the production and eventual cost of user hardware.

THE INMARSAT SYSTEM

The three essential components of the Inmarsat system are:-

- the Inmarsat space segment - the satellites and ground support facilities - which is the responsibility of Inmarsat and funded by Signatories;
- the Land Earth Stations (LES) which provide an interface between the space segment and the national and international fixed telecommunications networks and are funded, generally, by Signatories;
- the Mobile Earth Stations (MES) - the satellite communications terminals, which are purchased or leased by individual owners/operators.

Fixed-to-Mobile communications are in the 6 GHz band (C-band) from the LES to satellite and in the 1.5 GHz band (L-band) from satellite to mobile. Mobile-to-Fixed communications are in the 1.6 GHz band from mobile to satellite and in the 4 GHz band between the satellite and LES.

THE SPACE SEGMENT

To provide the space segment required to operate a global mobile communications system, Inmarsat currently uses its own dedicated satellites as well as capacity leased from three other organisations.
These are:-

- Inmarsat-2 satellites which provide the operational capacity in all ocean regions, namely the Atlantic (W) at 55°W longitude, the Atlantic (E) at 15.5°W, the Indian Ocean Region at 64.5°E and in the Pacific Ocean region at 178°E. The Inmarsat-2 spacecraft were built by a consortium headed by British Aerospace and have three to four times the capacity of the first generation satellites used by Inmarsat.
- The European Space Agency (ESA) for the lease of the MARECS-B2 spacecraft which is used as a "spare" in the Atlantic at 55.5°W.
- The International Telecommunications Satellite Organisation (INTELSAT) for the lease of the maritime communications sub-systems (MCS) on three spacecraft. MCS-D is the spare in the Pacific at 180°E; MCS-B is the spare Atlantic satellite at 34.5°W while MCS-A is the Indian Ocean spare at 66°E.
- Comsat General for the lease of two original MARISAT spacecraft which provide capacity at 72.5°E and 106°W.

Inmarsat's total of ten operational and spare satellites ensures that sufficient capacity is available to meet current user needs. The launch of the fourth and final Inmarsat-2 in April 1992 and its deployment into the Atlantic Ocean (W) region completed Inmarsat's current launch plans to provide sufficient global satellite capacity for the coming years.

To provide additional capacity in the second half of the decade Inmarsat has signed a US$350 Million contract for four Inmarsat-3 satellites to be launched from 1994 onwards. These satellites will be eight times more powerful than the Inmarsat-2s now carrying service. Each Inmarsat-3 will have a global beam and five spot-beams. The power and bandwidth can be dynamically reallocated between antennas depending upon communications traffic requirements. Inmarsat-3 will also be the first commercial satellite system to be able to support mobile-to mobile links and in addition will also carry a navigation payload.

CONCLUSION

The introduction of Inmarsat-M brings mobile satellite telephone, data and facsimile communications within reach of most potential users on land and at sea. The commercial benefits that are derived from good communications are well known and Inmarsat-M will play a major role in overcoming the difficulties previously faced by those not well served by fixed telephone or cellular radio services.

FOOTNOTE:

Inmarsat publishes 'TRANSAT' a free bi-monthly publication. That provides interested parties with the best way of keeping informed of all the latest developments in the field of land mobile satellite services. Regular features provide details of ways in which the system is being used, LESs in operation, new equipment available and lists manufacturers who supply equipment. Copies can be obtained by writing to: The Editor, 'Transat', Inmarsat, 40 Melton Street, London NW1 2EQ, England. Tel: +44 71 728 1450. Fax: +44 71 728 1179. Telex: 297201 INMSAT G.

Ref.1 Comsat in the USA has announced a tariff of US$ 5.50 per minute for the initial service and US$ 3.95 per minute for calls originating from big-dish multichannel systems.

FIGURES

1. Volvo estate car used to trial Ball Aerospace low profile antenna.
2. Ball Aerospace low profile antenna installed in vehicle sunroof apature.
3. NEC Prototype Inmarsat-M installed in test vehicle with antenna radome removed.
4. NEC Briefcase Inmarsat-M.
5. GLOCOM Inmarsat-M briefcase terminal.
6. GRINAKER Inmarsat-M briefcase.

DIAL M FOR SERVICE
BY
EDWARD R. SLACK
COMSAT MOBILE COMMUNICATIONS
WASHINGTON, D.C., USA

1. ABSTRACT

At the end of 1992 an advanced form of mobile satellite service was introduced which reduced the cost of voice communications by almost 50%. The start of Inmarsat-M service was not due to any sudden technological breakthrough, but resulted from years of development involving service providers, equipment manufacturers, systems engineers and end users which enabled this new service to evolve. The same approach is now being taken in evaluating the move to the next stage of evolution--hand held communications receivers.

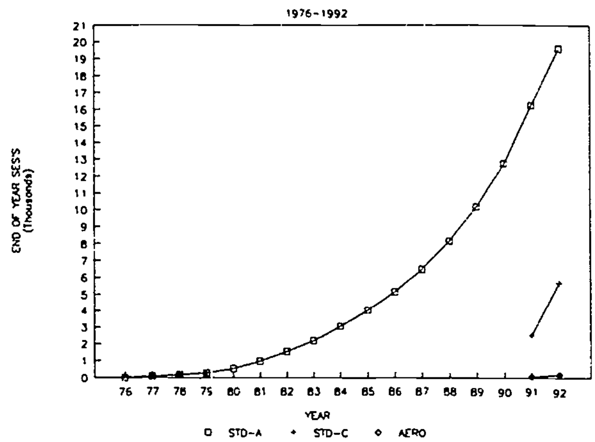
2. INTRODUCTION

Mobile satellite communications advanced beyond the image portrayed by science fiction writers to reality in 1976 when COMSAT introduced its MARISAT system which enabled voice and data communications to take place from ships at sea to any place in the world through the public switched telephone network. By the end of 1976, three operational satellites provided an essentially global service, covering the Atlantic, Pacific and Indian Ocean Regions. This was made possible by taking a low-risk strategy towards serving an uncertain marketplace, wherein COMSAT piggy-backed a commercial communications payload onto the UHF satellites it was providing to the U.S. Navy to provide communications on a novel leased service approach. The initial contract for service to the Navy was for the Atlantic and Pacific Ocean regions, with a spare satellite constructed for use in the event of a launch failure. The success of the first two launches and the growing requirement for military communications resulted in the launch of the spare to cover the Indian Ocean region.

Concurrent with the manufacture of the satellites, COMSAT also undertook the development of mobile equipment to permit users to have the necessary technology to communicate. After running a competitive procurement for the first 200 units of equipment, it was decided to permit other manufacturers to develop equipment to operate with the system, provided the equipment met the specifications established for system operation and became type-approved. This permitted other manufacturers to develop their own equipment and encouraged competition for the sale of user hardware.

Within two years, agreement had been reached to establish a new International Maritime Satellite Organization, known generally as Inmarsat. Today, Inmarsat, through its 66 member countries and Signatories and coast earth station operators, provides service to mobile users on sea, land and in the air. The original service introduced by COMSAT in 1976 is now known as Inmarsat-A, and had 19323 users as of end November 1992, of which 4860 (25%) were land-based users. Inmarsat-C, which was introduced only three years ago, had a subscriber base of 5433 as of the same date, with 2055 (38%) operating in the land mobile environment. Aeronautical satellite service, which recently completed its second year of service, is available on a total of 177 airplanes--103 commercial aircraft (4 of which are equipped for both voice and data), and 74 general aviation planes. Figure 1 shows the growth of users in the Inmarsat system.

FIGURE 1.INMARSAT USER STATIONS BY TYPE



3. NEED FOR EVOLUTION

The continuing battle for the marketplace puts pressure on suppliers to improve their product and/or performance, and to reduce costs. We have seen in the communications industry over the past 20 years substantial changes/improvements in technology brought about by competition. Many of today's service providers were not in business 20 years ago, and there have been a substantial number of new entrants even in the past two years.

Inmarsat and Intelsat, the two major international satellite organizations, have found a number of new competitors for service. Particularly, in the case of Inmarsat, its success in developing mobile satellite communications services has been recognized by others who would like to capitalize on that success, and have proposed a number of alternative communications systems and services.

Inmarsat has long been aware that in order to satisfy increased market requirements and customer desire for lower priced service, changes would be required in both technology and cost. One of the pressing requirements on both Inmarsat and its competitors had been the availability of frequency spectrum and the efficient use thereof. The last WARC helped somewhat with respect to the frequency spectrum problem. On the matter of more efficient use of that spectrum, Inmarsat and its rivals have moved towards digital techniques for communications and the use of spot beams on satellites to permit frequency reuse, as well as other factors such as use of spread spectrum. The various Inmarsat services introduced in the last several years have been based upon digital means, as with Inmarsat-C and Aeronautical communications. Inmarsat has undertaken further developmental work, and is now introducing its Inmarsat-M service, which is also digitally based.

4. INMARSAT-M

Inmarsat-M is a new service available initially through COMSAT and later through other coast earth station operators which will permit the cost of communications to be almost halved. Developed concurrently with Inmarsat-B, also a digitally based technology, telephony services including facsimile and data can be provided through the Inmarsat satellites and the public switched telephone system to any point in the world. The service is a natural evolution of the Inmarsat-A service. Figures 2 and 3 show the progression of technological change in the Inmarsat system.

FIGURE 2. PROGRESSION OF INMARSAT STANDARDS

Characteristic	Inm-A	Inm-C	Inm-M	Inm-B
Type of Communications	Analog	Digital	Digital	Digital
Year Introduced	1976	1989	1992	1993
Antenna Type	Stab. Direct.	Fixed Omni	Stab. Direct.	Stab. Direct.
Above Deck Equipment				
Size of Antenna (in.)	54Hx54W	6Hx17W	24Hx24W	54Hx17W
Weight (lb.)	200	<10	80	200
Below Deck Equipment				
Size (WxHxD in.)	14x18x14	5x8x10	6x16x10	TBD
Weight (lb.)	80	5	10	TBD
Voice Capability				
Type	FM	N/A	4.8kbps	16kbps
Quality	Excellent	N/A	Good	Excellent
Data Capability				
Maximum Rate	56kbps	600bps	2.4kbps	16kbps
Fax Rate	FM	TBD	2.4kbps	9.6kbps
Approximate End User Costs (US$):				
Terminal Price	30-40K	6-10K	15-20K	TBD
Telephony/Minute	7-10	N/A	4-5.50	4-?
Telex/Minute	4-5	4-5	N/A	TBD

As was the case for its -A and -C standards, Inmarsat-M has been designed to operate in both marine and land-based environments. The substantial reduction in antenna diameter from 0.8 to 1.0 meters to 0.4 to 0.45 meters and cutting the weight of equipment from approximately 100 kg to only 25 kg makes the installation attractive for smaller vessels such as yachts and fishing vessels. Additionally, the reduction in cost from the Inmarsat-A level of US$30,000-$40,000 to only US$15,000-$20,000 makes the installation more affordable. Coupled with service cost reductions of almost 50% of the US$8.00 to $10.00 per minute charges for -A service, users will be able to place international calls to any place in the world at prices less than they pay in many hotels.

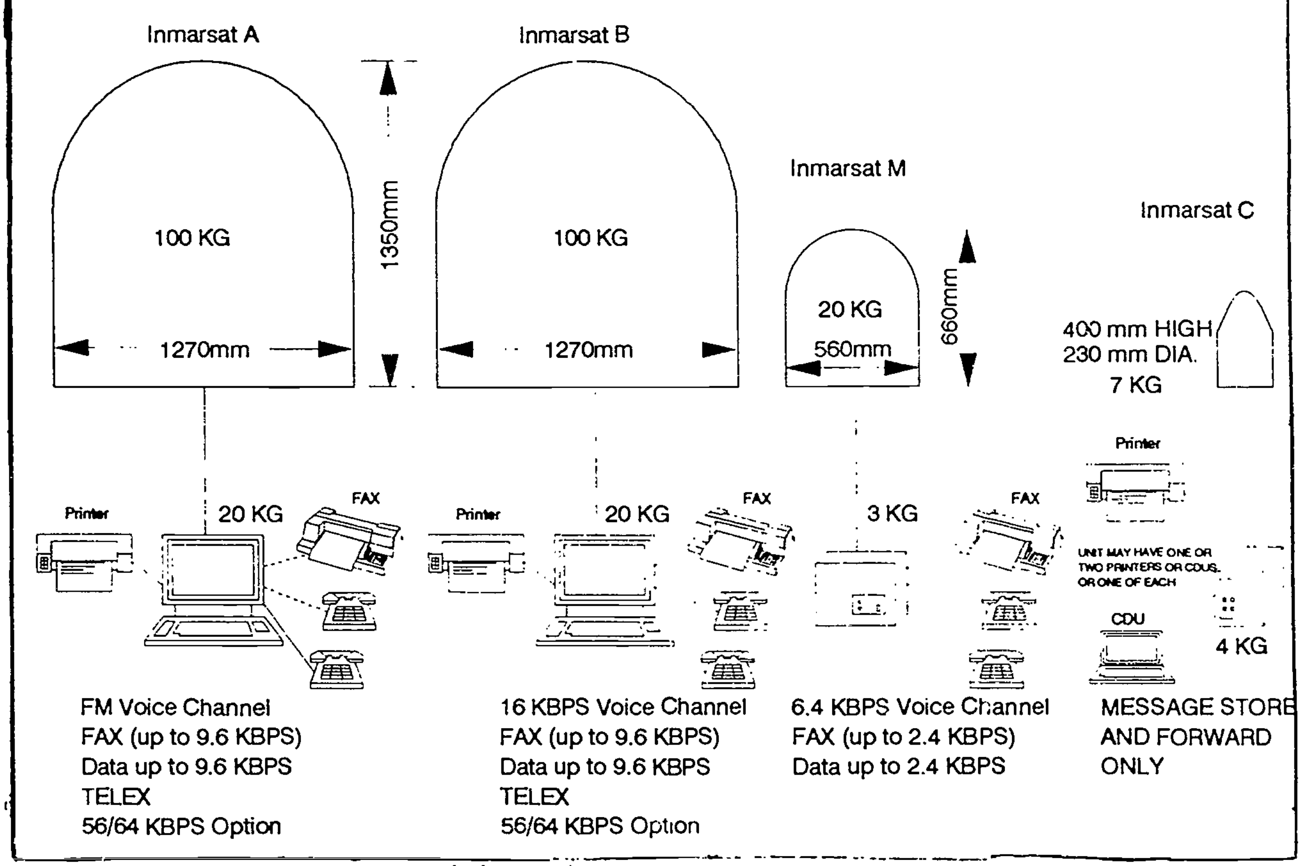
The land based environment is where Inmarsat-M is expected to far outstrip the use of Inmarsat-A. The lower costs mean the service is within reach of users in thin route locations, and who often suffer from poor quality service because of the high cost associated with more advanced technologies. The Pacific Rim is the very type of environment for which this service was designed. The many islands with poor interconnectivity to large centers of population and international networking capability can now achieve high quality service at affordable prices. The ability to connect such systems to a small local network can make the service available over a larger geographic area than a single location.

COMSAT has developed a variation of the -M design to accommodate users with high communications requirements, similar to an approach taken for Standard-A. Under this variation, a multi-channel Inmarsat-M unit utilizing a large antenna will be able to handle 4 or more calls simultaneously. Because of the ability to use less satellite power per transmission, the cost of a telephone call will be less than US$4.00 per minute, making this a very desirable form of service for such locations.

Most service requirements can be satisfied. The telephony capability enables computer data transmission as well as facsimile and basic voice service and is especially well-suited for languages based upon use of characters rather than a Western-type alphabet. The broadcast group call features also permit a wide area dissemination of information, similar to that used in both Inmarsat-A and -C. One of the important applications for service is expected to be in conjunction with aviation requirements, which are woefully inadequately served on most of the Pacific islands.

A key element of the Inmarsat approach to developing services is the open invita-

FIGURE 3. INMARSAT SHIP EARTH STATIONS



tion to manufacturers to participate in the development of service specifications and to have available those requirements in order to provide their own version of a standardized product meeting these internationally agreed designs. This technique has served Inmarsat well by letting it be known that no manufacturer need be excluded from serving the market if they are able to meet the design criteria established by the organization. This helps the system as a whole through creating competition (by lowering prices), and results in substantially increased sales calls to customers for Inmarsat equipment as the manufacturers seek to sell their products. As with earlier standards, a number of manufacturers have stated their intention to provide equipment. To date, this list includes the following 11 companies:

- ABB Nera
- Furuno
- Japan Radio Co. (JRC)
- Glocom
- Magnavox/NavCom
- Mobile Telesystems, Inc. (MTI)
- NEC
- Rockwell I ternational
- Scientific Atlanta
- Sperry Marine
- Toshiba

It is expected a number of additional manufacturers will come forth with additional models and features.

Obtaining permission from national authorities to use Inmarsat-M equipment in a marine environment will be similar to use of Inmarsat-A or -C. The situation for land-based operation has been very different. National authorities express substantial concern about use of communications equipment within their areas of jurisdiction. Those concerns are generally based upon either national security issues or loss of revenues due to bypassing of the domestic and international communications networks.

Inmarsat has undertaken initiatives in the various regions of the world to develop cross-border agreements under which individual users will be permitted to take the equipment in and out of countries without the difficulties encountered in the past. With 66 countries now members of Inmarsat, the chances of developing such agreements on regional bases are enhanced.

5. FUTURE DEVELOPMENTS

: -ogression of service capabilities ·re Inmarsat system has been an evolution of technologies driven by market forces. Even at this point when a new service is being implemented, work is progressing on further future capabilities. The industry is currently focused on development of hand-held user equipment, and much is made of interconnectivity with cellular systems. The truth of the matter is that Inmarsat systems have had such capability for years. COMSAT has provided equipment for use aboard ships which can also communicate through cellular systems when in range. They have also entered into arrangements for aeronautical service under which planes will have telephones which will use satellite or terrestrial systems based upon the service available.

Project 21 is still under consideration, with final decisions to be made early in the second half of 1993. As in the past, the defining of this service is going to be based upon the form of technology which makes economical sense to satisfy user requirements. Yet, as we have seen with Inmarsat-A and Inmarsat-C, the initial designs of Inmarsat-M will be improved upon by manufacturers during the next several years with additional service features incorporated to accommodate user needs.

6. CONCLUSIONS

Communications technology for mobile satellite communications is not standing still, and will continue to evolve for years to come. Market forces will serve the user as equipment and service costs are lowered to compete for revenues, with attendant improvements in quality of service. The user will have broader choice to obtain the equipment which best serves his requirements.

Telecommunications Infrastructure - Is It a Catalyst for Growth in Malaysia?

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1. ABSTRACT

This paper examines the effect of investment in Telecommunications infrastructure on domestic growth and overseas investment in Malaysia. Malaysia is moving from a primary commodity-based economy to a manufacturing-and industrial-based one. Telecommunications is one of the factors influencing overseas investment decisions and a domestic telecommunications industry is developing in parallel.

2.0 Introduction

The development of telecommunications infrastructure contributes to economic growth in two ways - by developing the domestic telecommunications equipment and service markets, and by encouraging overseas investment by multinational corporations.

Malaysia at the time of independence had an economy dependent solely on primary commodities, mainly rubber and tin. To these were added petroleum, palm oil and cocoa. The Government policy has been to shift to a manufacturing based economy and this has now been largely accomplished as primary commodities (excluding petroleum) now amount for less than 10% of the GDP (Gross Domestic Product).

In attracting investment by foreign multinationals, the main factors are political stability, fiscal environment, availability of labour and infrastructure.

The Malaysian telecommunications, network was previously operated as a Government department. In 1987 it was privatised, and 1990 the shares were on the floated on the KLSE (Kuala Lumpur Stock Exchange). This has occured at a time of rapidly increasing demand for basic and value-added telecommunications services, resulting in the opening of opportunities for local companies to enter the market as service or equipment providers.

3.0 Growth Through Foreign Investment

The South-East Asean countries can be classified according the level of telecommunications infrastructure, as in Table 1.

Table 1: Classification of S.E. Asian Countries

Hong Kong Singapore	Highly developed infrastructure - matching or exceeding developed countries.
Malaysia Taiwan South Korea	Intermediate development of infrastructure.
Thailand Indonesia Phillipines Vietnam Cambodia (Kampuchea) Laos Burma (Myanmar) North Korea	Low level of infrastructure development.

Hong Kong and Singapore are both city states, and both have focused on telecommunications as a key industry to encourage entrepôt activities, such as regional networking headquarters. They have telecommunications facilities which exceed many developed countries as a result of their being small urban environments.

The remaining "Asian Tigers", Malaysia, South Korea and Taiwan have telecommunications infrastructures generally higher than most developing countries and it is these countries that are rapidly industrializing. Taiwan and Korea have largely relied on domestic industrial growth, whilst Malaysia has attracted foreign investment, especially in the semiconductor and electronics sectors.

Consequently Malaysia finds itself competing with Indonesia, Thailand and the Philippines for such investment. Prospective investors face a choice of good infrastructure but limited and expensive labour in Singapore and Hong Kong at one extreme, and cheap labour but poor infrastructure, as in the Philippines and Thailand, at the other extreme.

Malaysia lies between the two positions, having relatively cheap labour, but reasonably developed infrastructure, and so has been successful in attracting 'higher technology' investment, such as semiconductor manufacturing.

The dynamics of this scale are expected to change as industry becomes more dependent on information technology and global networking.

The garment and toy industries in Hong Kong provide a foretaste of this, where designs from the U.S.A. or Europe are sent electronically to Hong Kong factories, as are orders.

This electronic transfer of design information, as well as the adoption of EDI, will increasingly favour countries who can provide both cheap labour and developed infrastructure.

Incidently, Malaysia is now suffering from full employment, a problem which many countries would wish to have, but which restricts availability of labour for new factories.

The number of foreign investment projects has grown as is shown in figure 5. Electronics and semiconductor sectors account for about 25% of these projects.

The capital investment over this period (1986-1991) has risen from M$5 billion to M$28 billion. The effect of the worldwide recession starting in 1991 was to hold the 1991 level to the same as the 1990 level[4].

4.0 The Domestic Telecommunications Industry

This market has been opened following the privatisation of the PTT, and currently the successor company, Telekom Malaysia Berhad, has an equity structure of 82.4% Government ownership, 17.6% private ownership[1]. It retains monopoly rights for basic telephone services.

The basic network capacity has grown quickly over this period (see figures 1-4), at approximately 10% per year.

The provision of services is regulated by a Government agency, Jabatan Telekom Malaysia, which awards licenses for basic and value-added networks.

Amongst the projects that Telekom have implemented over this period are a nationwide digital radio (microware) network, a nationwide fibre-optic backbone, parts of the ASEAN submarine fibre network, VSAT, digital leased line (64 Kbps and 2 Mbps) service.

There has been, however, an explosive growth in value-added and data services.

The market has been opened to other carriers, and several local companies are providing services: TRI (Technology Resource Industries) with a 900 MHz cellular radio network, Binariang with a proposed VSAT network based on a to-be-launched Malaysia Satellite system (MEASAT-1 and -2)[2] and INC (Information Networking Corporation) with a VSAT network based on Palapa satellites.

A license is expected to be awarded for an 800 MHz cellular radio network and for EDI services.

Telekom Malaysia, and other local telecommunications companies, including TRI and Sapura (a local equipment manufacturer) are now looking to expand their markets overseas, especially to developing countries, in the areas of consultancy and equipment supply. An example of this is the recent award of a contract by the Laotion Government to TRI to build-operate-transfer a telephone network in Laos.

An interesting side-effect of privatisation and liberalization of the telecommunications industry can be seen in the investment figures.

For the five year period, 1986-1990, the total investment in the telecommunications Sector was M$4,211 Million, of which M$779 Million was Government investment. For the five year period 1991-1995 the total investment is projected as M$5,352 Million, but only M$41.3 Million will be Government investment, the balance in each case being the private sector investment[3].

4.1 Projections of Future Growth

During the period 1991 to 1995, the number of direct exchange lines is projected to rise from 1.5 Million to 3.0 Million. In the same period the number of leased circuits is projected to grow from 15,000 to 40,000, and the number of public X.25 subscribers is projected to grow from 1,125 to 2,640.

This level of growth and the investment of over M$1 billion per year will obviously spur local development. An example of such development is the opening of a Malaysian Fibre-optic cable factory at the end of 1992.

Growth in the diversity of services is expected, for example, an ISDN network will be launched in 1993, as well as 800 MHz cellular radio service.

Table 2 Value Added Services in Malaysia

Name	Type	Provider
MAYPAC	X.25 Network	Telekoms Malaysia Bhd
MAYCIS	X.21 Network	Telekoms Malaysia Bhd
Telemail	E-Mail	Telekoms Malaysia Bhd
Telita	Viewdata	Telekoms Malaysia Bhd
ATOR 450	450MHz Cellutar	Telekoms Malaysia Bhd
(not yet launched)	VSAT	Telekoms Malaysia Bhd
(to be launched in 1995)	VSAT	Binariang
INC	X.25	Information Networking Corporation Sdn Bhd
INC	Database Access	Information Networking Corporation Sdn Bhd
INC	FAX messaging	Information Networking Corporation Sdn Bhd
INC	E-Mail	Information Networking Corporation Sdn Bhd
EDI Malaysia	EDI	Electronic Data Interchange (M) Sdn Bhd
VANS	EDI	Value Added Network Services
Celcom ART900	900 MHz	Technology Resources Incorporated (TRI)
Video conferencing	Video conferencing	Telekom Malaysia Bhd

5.0 Conclusions

The rapid development of telecommunications infrastructure encourages growth in two ways: by making the country more attractive for foreign investment and by encouraging the local telecommunications industry.

To make a developing country attractive for foreign investment, good infrastructure, including telecommunications, needs to be coupled with availability of labour and other factors.

The importance of telecommunications infrastructure as a factor will increase as technologies such as CAD (Computer Aided Design), CAM (Computer Aided Manufacturing) and EDI (Electronic Data Interchange) become key in more and more industries.

The privatisation of the PTT and the opening of market to the service providers, has encouraged the growth of the domestic telecommunications industry, and has allowed the level of overall investment to be raised.

References

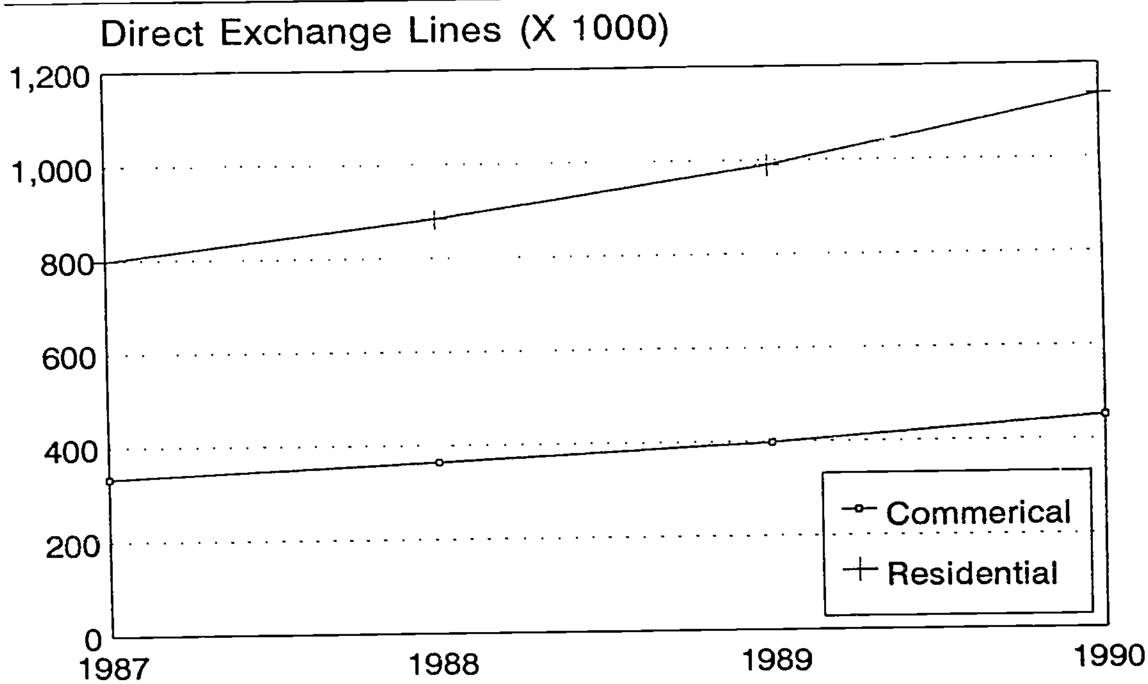
[1] Telekom Malaysia Annual Report, 1990, pp 10-11

[2] Malaysia Business Novermber 1992, pp 34-35

[3] Sixth Malaysia Plan 1991-1995 (Rancangan Malaysia Kenam 1991-1995), 1991, Government Printing Office

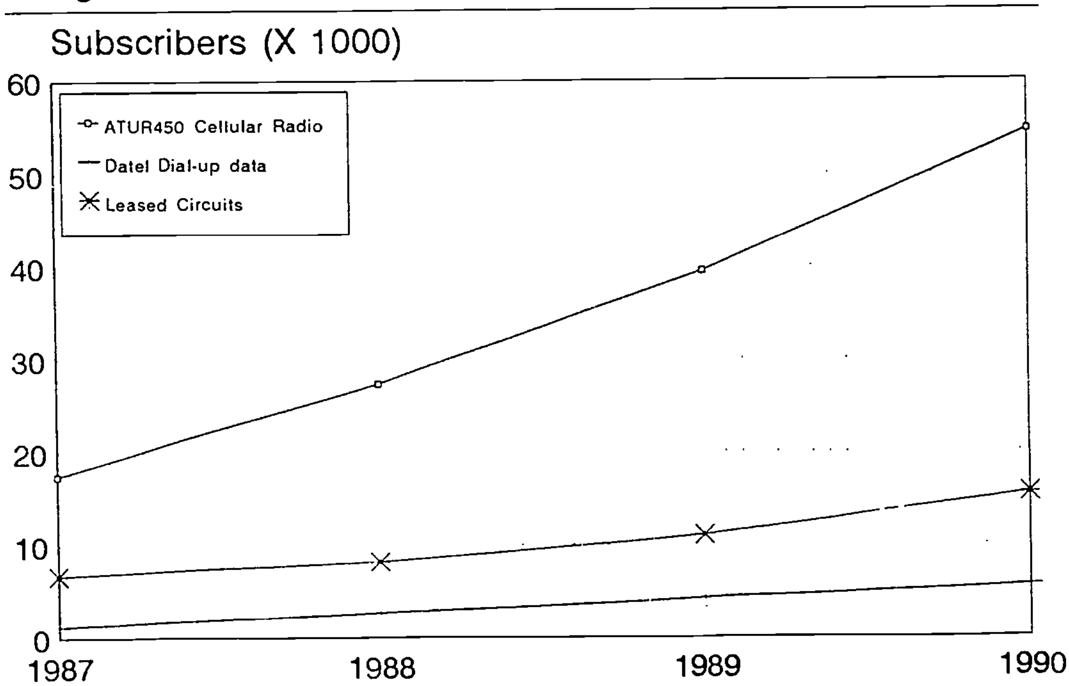
[4] Statistics on the Manufacturing Sector in Malaysia (1986 - May 1992), MIDA (Malaysian Industrial Development Authority)

Figure 1 : Growth in Basic Telecom Services (Malaysia)



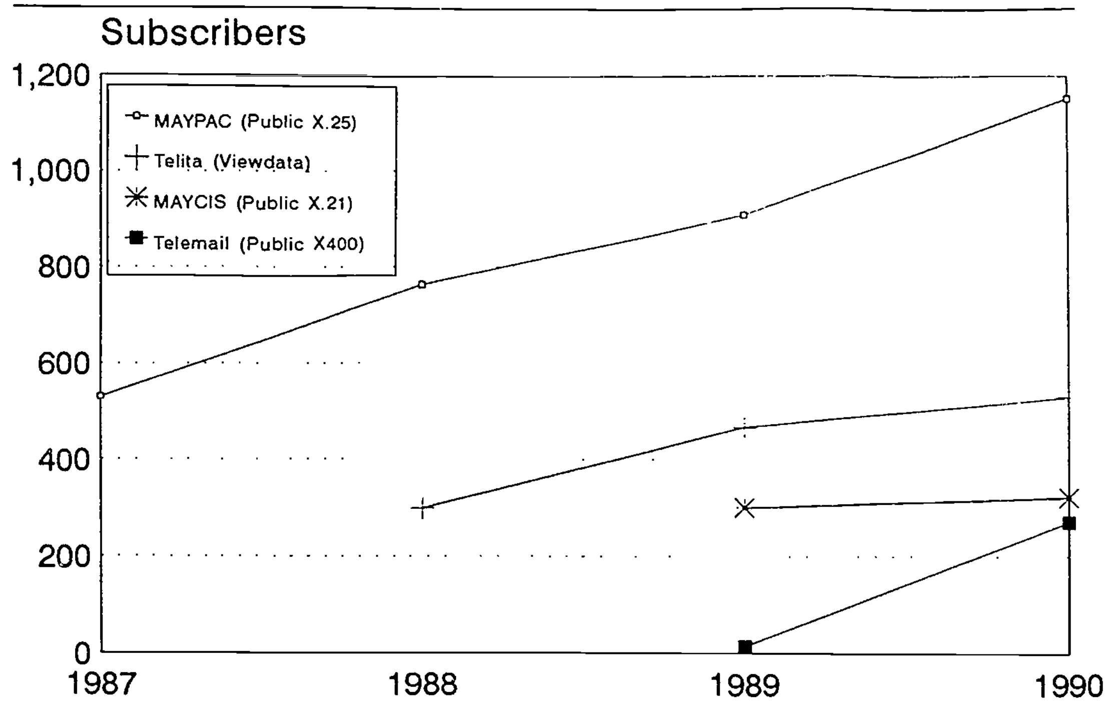
(Source : Telekom Malaysia)

Figure 2 : Growth in Other Telecom Services (Malaysia)



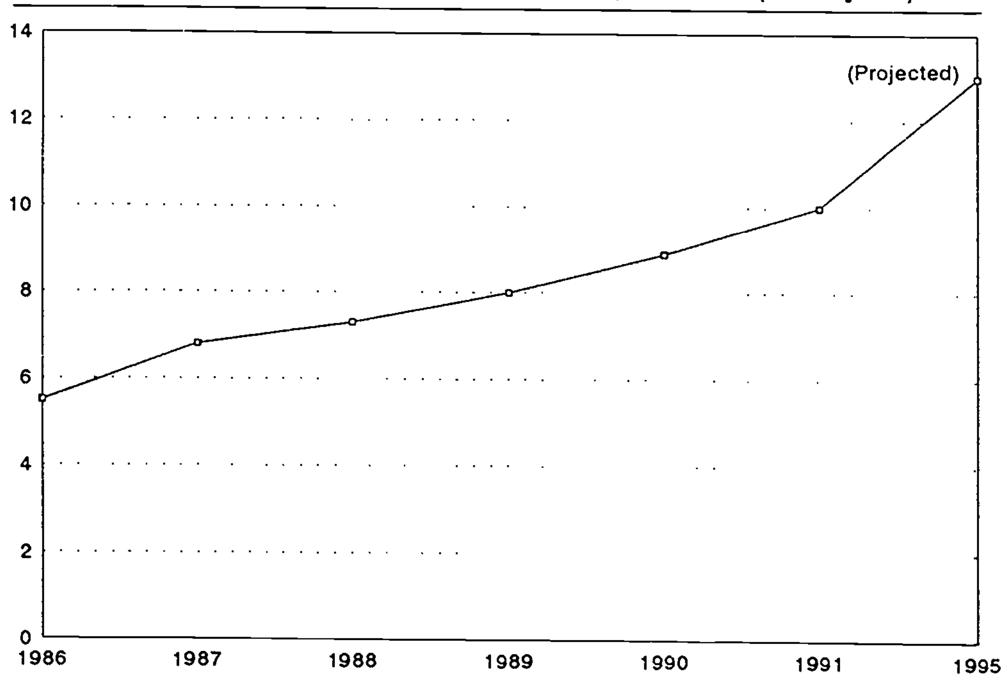
(Source : Telekom Malaysia)

Figure 3 : Growth in Data Network Services (Malaysia)



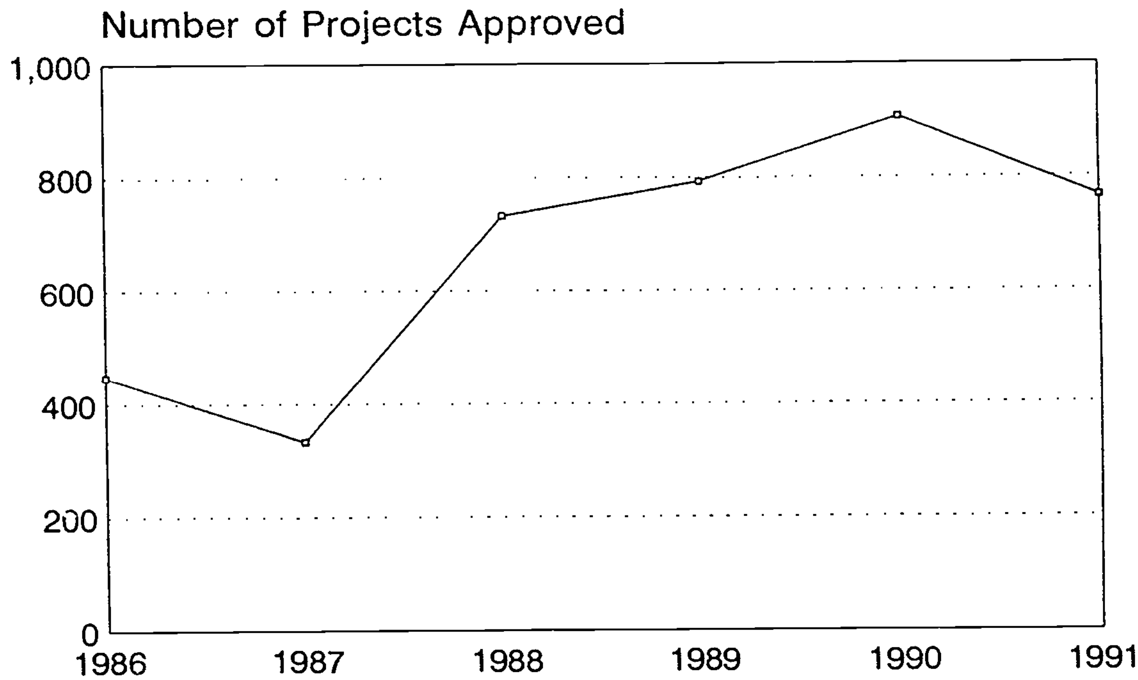
(Source : Telekom Malaysia)

Figure 4 : Telephones per 100 Population (Malaysia)



(Source: Telekoms Malaysia)

Figure 5 : Foreign Investment in Malaysia - Manufacturing



(Source : MIDA)

COMMUNICATIONS IN THE RUSSIAN FAR EAST

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ABSTRACT

Russia faces many obstacles in trying to develop a viable economy. Business development is hampered by the current lack of communications. This paper describes the present communications infra-structure in the Russian Far East and Siberian Regions. A model for modernization is presented along with the current Russian communications policy.

INTRODUCTION

The global society in which we live was created by the two technologies of transportation and communications[1]. The need for modern and efficient communications is a major obstacle in Russia's struggle to develop a democratic society and a market economy. Communications is the most important factor of the economic infrastructure of any country[2]. Without communications, economic development is difficult.

GEOGRAPHICAL PERSPECTIVE AND RESOURCES

The Russian Far East is an area of over six million square kilometers. It is most closely compared to Australia for an area of similar size and population.

It is not a separate physical region, and its borders with eastern Siberia are arbitrary (See Map). The Russian government considers it as a planning region and a unified economic entity within the Russian Republic.

The Russian Far East is sparsely populated. The majority of the population is concentrated in the southern areas of the territory. Similarities in distribution of population can be made to Canada and Alaska where the majority of the population lives in the southern extremes.

Political Units	Area Sq. Km.	Population	Population Density per Sq. Km
Maritime Kray	165.9	2,260	13.6
Khabarovsk Kray	824.6	1,824	2.2
Amur Oblast	363.7	1,058	2.9
Kamchatka Oblast	472.3	466	0.9
Magadan Oblast	1,199.3	543	0.5
Sakhalin Oblast	87.1	709	8.1
Yakut ASSR	3,103.2	1,081	0.3
Russian Far East	6,216.1	7,941	1.3

In Thousands

Colonization of the Russian Far East took place during the final stage of the Russian expansion that began in the late 16th century. The Russian Far East provided a large amount of natural wealth. First furs, and later minerals, provided some of the impetus for expansion.

Country	Population	Square Miles	Population Per Square Mile
Russian Far East	7,941,000	2,400,094	3.3
China	1,130,065,000	3,696,100	305.7
Australia	16,646,000	2,966,200	5.6
Source; Pravda 1989			

The Russian Far East is isolated from the day-to-day activities of European Russia by virtue of its distance. There is a seven to ten hour time difference from Moscow depending on the particular area of the Russian Far East being considered. Air travel from Moscow is equivalent to a transoceanic flight. Flying time from Khabarovsk to Moscow is approximately nine hours and twenty minutes. In comparison, it is approximately two hours to Seoul or Tokyo from Khabarovsk and six hours to Anchorage.

The land is rich in gold, coal, diamonds, and oil. Gold and coal replaced furs as the primary economic opportunity during the 19th century. During the Soviet period, the number of different minerals extracted in the region increased from seven to almost eighty[3]. Fishing is another important resource of the Russian Far East. Varieties include herring, salmon, and cod. Exportation of all these natural resources is proving to be a major source of revenue for the local and national economies.

Oil and gas development will likely prove to be the most dominant resource related activity during the next two to three decades. The area on and around Sakhalin Island is rich in petrochemical deposits. Other areas within the Russian Far East probably contain large deposits as well. Unlike areas in Siberia and the Northern Komi region, the previous petrochemical development has been rather minimal. New development by major oil companies is occurring today on Sakhalin Island. Further lease

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sales are planned for the near future.

RUSSIAN COMMUNICATIONS HISTORY

The following is a brief outline of the history of telecommunications in Russia according to the Russian Ministry of Communications[4]:

•1855 The first telegraph was established between St. Petersburg and Moscow.

•1882 The first city telephone stations began to work in St. Petersburg, Moscow, Odessa, and Riga.

•1899 The first rural telephone network was erected in Labedinsky district of Kharkovsk province.

•1926 The first automatic telephone switch was put into operation in Russia.

•1939 The longest area intercity telephone in the world was constructed between Moscow and Khabarovsk (approximately 9000 kilometers).

•1959 The first multiplexed city telephone channels were put into operation.

•1962 The first system of mobile radio telephone communications was put into operation.

•1965 The first communications satellite was launched. The first international automatic telephone communication between Moscow, Warsaw, Prague, and Berlin was put into effect.

•1975 The first geostationary communications satellite was launched.

RUSSIAN COMMUNICATIONS STATISTICS

The Russian Ministry of Communications estimates that 1,100,000 people are involved in the communications field within Russia[5]. There are 21.2 million installed telephones within the Russian Federation. The number of installed telephones per 100 individuals in Russia places them in 33rd place with respect to other countries[6].

There are currently about 15 million requests from people who want a telephone installed in their home[7]. The Ministry estimates that 50 - 60 million people are waiting to get telephone service. Currently, the annual increase of installed telephone apparatuses is 1,000,000. This equates to a 15 year wait for a telephone at the current annual increase.

The current system 41,000,000 international telephone calls per year[8]. Until recently, all international telephone communications was made through one automatic station in Moscow. There are approximately 4000 communications channels for the purpose of providing international telephone calls. International telephone lines are provided through a network of ground channels through the Ukrainian and Belarussian territory, radio-relay transmission to Finland, underwater cable from Nakhodka to Japan, and satellite access through Intersputnik, Intelsat, and Eutelsat.

There are about 33,500 automatic telephone switches in operation in the country. The switches have a total capacity of 22 million numbers. Of the 15, 000 automatic telephone stations (ATS) serving local networks, the overwhelming majority are coordinate mechanical systems. The Intercity network is composed of approximately 270,000 channels. Approximately 65% are operated on cable, 30% by radio-relay and 3% through satellite[9]. Radio-relay includes microwave and short-wave transmission.

COMMUNICATIONS IN THE RUSSIAN FAR EAST

The automatic telephone switches (ATS) that are in operation in the Russian Far East today consist of step relay and strowger type installations. Until recently, there has been no direct dial international telephone service available. The direct dial service that is available today is confined to the overlay networks. All other international calls are routed through operators with a wait of from several hours to days before being able to obtain an international circuit.

Only 50 percent of Siberian and Russian Far East intercity telephone communications are automated. More than 30 percent of the regional centers have no automatic intercity telephone station guaranteeing connections for subscribers in district centers. The average intercity telephone network serves approximately one billion conversations per year. Comparable figures for other countries are the USA at 68 billion and Germany at 12.6 billion[10].

Intercity channels using digital transmission systems comprise less than 1 percent of the overall number. Fiber optic cables are not yet in use in the Far East Region of Russia. International public switched voice communications to and from the Russian Far East and Siberia transit through a single Moscow station with only 4,000 channels. This station serves 41 million calls per year[11].

Individuals who do not have telephones or are on the waiting list to obtain one use one of the phone centers located in the urban areas. The telephone centers are typically located in conjunction with a central office and provide a mixture of intercity and local telephones that are available for use. The centers are all well used. There is usually a wait for people to access the available phones.

The Russian Ministry plans to construct fiber optic lines between Russia and three countries. The first line will connect Russia to Denmark. The second will be installed between Palermo, Italy and Novorossiysk, and the third is to connect Nahodka with Japan and Korea[12]. The latter is a joint project of KDD, Korean Telecom, and Telecom Denmark.

Three new international telephone stations are also currently being constructed. Two of these are located in Moscow, and one is in St. Petersburg. The total design capacity of these stations is approximately 10,000 channels. Additionally, international telephone stations are planned for construction in Eketerinburg, Novosibirsk, Samara, Khabarovsk, and Nogerod.

Currently, many independent overlay networks are being constructed throughout the Russian Republic. The overlay network is a telecommunications system that does not provide regular access to the Russian Public Switched Telephone Network

(PSTN). The overlay networks are being used to provide dedicated services to clients that require international telephone service and access to advanced communications services (ISDN).

Inmarsat terminals are being used in most developing economic areas and urban centers. Many companies involved in the natural resource industry use Inmarsat terminals to make their international telephone calls. These companies find Inmarsat as the practical and immediate solution to their international communications needs. Installation of Inmarsat terminals became a major business activity for startup communications companies within the Russian Republic during the past two years.

New internationally accessible overlay networks have been completed in Khabarovsk and on Sakhalin Island. These networks are presently extending themselves to urban centers throughout the Russian Far East. Additionally, a major international satellite station is planned for Vladivostok for 1993. Currently, there are two international earth stations operating in Khabarovsk, one in Nakhodka, one in Anadyr, and three on Sakhalin Island.

Competition is already finding its way into the communications marketplace. This has drastically changed the cost of an international telephone call in the Russian Far East region. It is anticipated that connections between some of these satellite communications facilities will provide enhancement of the domestic communications network as well. Plans for cellular telephone systems are already being drawn up for all of the major urban areas in the Russian Far East. Khabarovsk and Vladivostok are included on the recent Federal cellular licensing lottery. US West was the only applicant to bid on all of the locations currently available as of the writing of this paper.

RUSSIAN COMMUNICATIONS POLICY

The Russian Ministry understands that communications networks are an integral part of the market economy of the country. The Ministry of Communications of Russia has stated that it intends to employ the following policy of reforms in the field of communications.

1. Flexible tariffs for communications services.
2. Introduction of liberal tariffs to the extent of deepening and enlarging of economic reform.
3. Establishment of dedicated communications networks for providing services to market structures of the economy.
4. Privatization of communications enterprises to the fullest extent possible.
5. Foundation of joint-stock and private communications companies. This includes those with allocated foreign capital.
6. Application of modern western know-how in the field of communications at the expense of bringing in the foreign capital and modern industrial technologies.
7. Working with foreign partners to conceptualize and engineer communications projects.
8. Training of Russian communications specialists in educational centers of western countries.

IMPLEMENTATION

We propose that the fastest and most efficient method of implementing a major upgrade of the telecommunications within the Russian Far East is to accomplish the following.

1. Decentralization of the existing international network configuration by running fiber optic cables and building satellite earth stations and new International Gateway Stations.
2. Creation of a regional VSAT network.
3. Construction of cellular radio systems and mobile telephone communications occupying the 830 - 890 MHz frequency with VSAT connections between cells.
4. Opening business centers with advanced communications networks.
5. Support the establishment of private information systems.

Decentralization Of The International Network

In Figure 1, we present the conceptual configuration for the future Siberian and Russian Far East network. Fiber optic cable from Seoul and Tokyo will run to Nakhodka and on to an international

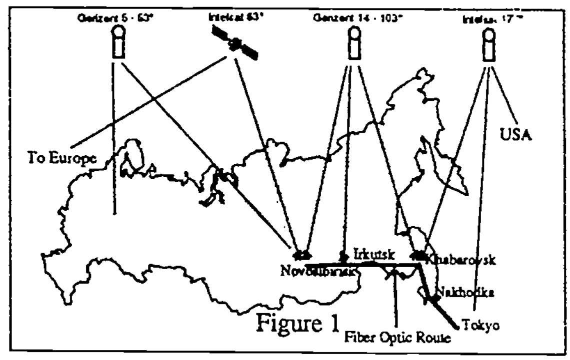


Figure 1

station in Khabarovsk. The proposed international telephone stations in Vladivostok, Novosibirsk, and Irkutsk are connected by fiber optic cable between Novosibirsk and Khabarovsk. Emergency restoral of the fiber optic line is provided by Gorizont or Intelsat satellite circuits. This allows the provision of a secure and highly reliable network.

Regional VSAT networks

The Russian Far East has seen a rapid rise in the use of satellite communications to meet network development needs. AmRussCom, using the latest technology, has designed a low cost, multichannel digital earth station, for use with the world's commercial communications satellite systems; Gorizont, Intelsat, and Eutelsat. Our two way satellite terminal uses an advanced microwave radio link system from Skydata, Inc. Modular solid state electronic components and digital transmission technology are used to provide network operators with a dynamic system. The terminal supports connections for telephone trunks, synchronous data, and digital video for public switched or private line networks.

In the Khabarovsk region, we will start with a Star network. In a Star network configuration, network heirarchy becomes a factor as the hub station uses a larger antenna and often higher power transmitters than remote site terminals.

Transmission between the remote node and the hub can occur at various data rates ranging from 9.6 Kbps through 128 Kbps. The most satisfactory 16 Kbps voice quality currently available is obtained using a frequency-domain hybrid coding technique known as Adaptive Transform Coding (ATC). At 16 Kbps, most users rate the voice quality as equal to a local call. We are using the CS8000 voice and data multiplexing equipment manufactured by Pacific Communications Sciences, Inc. (PCSI). The CS8000 provides a minimum of 4 data ports with up to 8 voice cards. Transparent support of Group III fax transmission is provided on the voice paths.

The Star network is ideal for thin-route applications. A typical project is linking remote villages, mining camps or oil platforms into the switched network. This often occurs through a so called "mini-hub". A Star network is useful in the beginning and can fulfill basic network requirements without large investments in master stations. Transition to a more highly interconnected network topology like DAMA can occur as the traffic warrants it. A typical mini-hub can accommodate up to 20 SCPC circuits to remote terminals. Each channel is permanently assigned to a corresponding VSAT terminal.

When network traffic grows, or as more locations are added, the need to move from a Star network to a full mesh DAMA network may become an operational requirement. A full mesh network will allow any station to connect to any other station through a limited channel pool allocated on demand by a master control station. For DAMA network applications, VSAT terminals are combined with a DAMA master station controller, digital 16 Kbps modems, and remote DAMA controllers. This type of VSAT network can meet the needs of the largest regional network.

Cellular Telephone with VSAT Connectivity.

The global growth of cellular telephony has driven the cost downward. This fact makes cellular a rural network development tool. For AmRussCom projects, a standard 830 - 890 Mhz AMPS cellular telephone system has been chosen. Microwave and satellite connections among the cells and the Base Station Controller (BSC) are used.

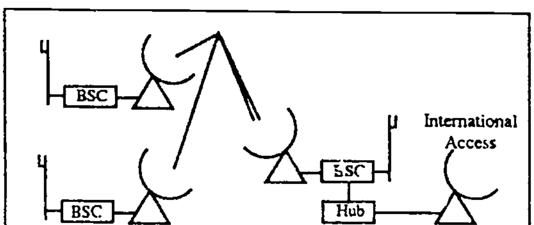


Figure 3

Private Company Information Systems

Russian experts in production and management are sure that introducing new means of communications will raise labor productivity by at least 40 percent. This approach is particularly important in Siberia and the Russian Far East. It is becoming increasingly clear that in order to operate in the borderless international market, Russian businesses will require high capacity networks that provide real time global links. As a result, there is an increasing demand for more reliable networks. The move toward integration of voice, images and data in multimedia environments provides ever increasing demand on the facilities of the most modern telecommunications network.

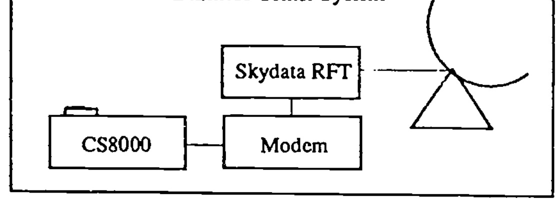
Business Centers

The building of business centers with advanced communications services provides a temporary solution to provide communica tions necessary for economic expansion. The business center is not a core of the future information and communications development. It can provide a significant portion of the immediate needs of given area. The following communication services are included as components of advanced, ISDN type, business center networks:

- LAN (office network)
- WAN
- Videotext
- Video phone/Video Conferencing
- Image processing system
- G4 Facsimile
- Electronic newspaper
- Electronic mail

Due to the lack of digital terrestrial channels, a technical approach is required that can economically accommodate ISDN subscribers in an area that is far from the service access point. For immediate nationwide and international connection of ISDN services satellite communications is the method of choice. ISDN

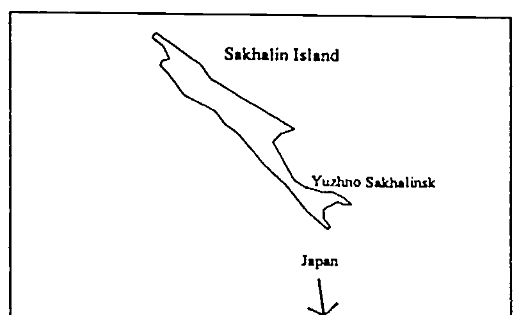
Figure 2
Business Center System



subscribers can be accommodated by installing an earth station at the customer's premises. Figure 2 shows the network structure using satellite communications systems. We are assuming that ISDN services will become universally available and will be a dominant factor in the now rapidly emerging world of public switched, data, and data related communications.

CASE STUDY-SAKHALIN ISLAND

This example provides a glimpse of one emerging overlay network located on Sakhalin Island. This network is located within



the Sakhincentr business complex in the city of Yuzhno-Sakhalinsk. The Sakhincentr "Business Center" is equipped with an overlay advanced communications network built by AmRussCom.

Sakhincentr offers clients the following services:
- office space;
- advanced telecommunication services;
- commercial information about the Russian Pacific region;
- representation of commercial interests;
- international congresses and seminars;
- fairs, exhibitions, auctions, and sales;
- commercial advertising and mediator services.

Initially, this network connects Sakhalin Island to the world through Brewster, Washington. Further network connections are planned for the first quarter of 1993 to Japan.

The installation consists of a 4.6 meter F1 Earth Station operating on the Intelsat 177 degree POR satellite. The facility uses General DataComm multiplexer equipment and PCSI voice compression (DCME) equipment. The system supports voice and data at this time. The voice circuits are capable of 9.6 Kbps data and Group 3 facsimile. A videoconferencing link is planned in the near future.

Copper interfaces are used between the local switch and clients located within the Sakhincentr business center. There are several types of wireline and wireless interconnection facilities being used to connect remote clients to this facility. These include modems and DSU's on existing installed copper and microwave and 900 Mhz links where copper is unavailable.

The facility is characterized by its small aggregate channel size. Thus, the PCSI DCME equipment was chosen in order to provide the economy of compression for each link as well as the flexibility to operate small aggregate carriers.

CONCLUSION

Modernization of the telephone and telecommunications system within the Russian Far East is required to provide the infrastructure necessary to develop the Russian economy. Developing the economy is important to the survival of democracy. Foreign participation in this development is occurring, and more is needed. More participation is necessary to stimulate the development and push it forward. Technical training and training in the skills of marketing and customer service are necessary in order to implement successful programs.

AmRussCom is working toward implementation of a modern Russian Far East network. This is being accomplished through the numerous projects in which we are involved. The projects include building satellite earth stations for the Russian international and domestic trunk system. The systems incorporate maintenance and operational functions that respond to client demand for more sophisticated services. AmRussCom is working with Pacific Rim carriers to develop new technologies necessary for the implementation of the modernization project.

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Utilization of Developing Country Resources for
Research and Development Related to Telecommunication Products and Systems

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1. ABSTRACT

The paper highlights the experiences gained by a research and development team in a developing country, who were heavily involved with the design and development of telecom products and systems to cater for very specialized needs of telecom service providers and telecom systems manufacturers. Specific experiences and problems discussed in the article are related to design and development, manpower problems, procurement problems and other related issues.

2. SRI LANKA, ITS TELECOM INFRASTRUCTURE AND INSTITUTIONAL REFORMS

Sri Lanka is an island nation with a population of 16.9 million concentrated into 65,607 sq km. It is relatively poor, with a per capita GNP of US$ 418 in 1990. A former British colony, Sri Lanka has been independent since 1948. Its economic policies may be periodized as traditional plantation export based policies (1948-56), import substituting industrialization policies (1956-77), and export oriented open economy policies (1977 to the present). Sri Lanka generally scores high on Physical Quality of Life (PQLI) type indexes because of relatively well developed educational and health systems. Literacy levels are high for a third world country and population growth rates are low (1.3% in 1989). Sri Lanka has a tradition of civilian led, democratic governance, with multiple political parties and more or less regular elections. Sri Lanka's telecommunication has a history as far back as to year 1858.

At the early stages of development towards 1966, 23 strowger exchanges were installed in metropolitan Colombo areas for introduction of subscriber trunk dialing. The Outer Colombo Area Development Project 1 (OCADS 1) was completed in 1973, equipping major cities outside the capital area with cross bar switches and establishing microwave and cable inter exchange links. In 1976 Sri Lanka was linked to foreign countries via INTELSAT and first international gateway was commissioned providing a limited capability for international direct dialing. In 1980 little over 60,000 direct exchange lines were in operation with total number of telephones over 80,000. Exchange capacity at this time was apprximately 93,000 lines and there were no digital exchanges. After 1977 normal growth of demand had been accelerated by the open economic policies of the government and high usage of available telephone lines contributed to difficulties in completing calls. Towards early '80s digital exchanges of the types E10 (CIT Alcatel), NEAX (Japaneese) were introduced to the telecom infrastructure and the Colombo metropolitan areas were getting updated with these new Exchanges. As at today 85% of the total telephones (approximately 150,000) are served by digital exchanges and almost island-wide subscriber trunk dialing facilities are available. With regard to transmission systems 85% are based on terrestial microwave links and PCM systems which couple four E10 exchanges, ten NEAX exchanges and five DX200 (Nokia) providing the island-wide network. The country has a telex service with over 1,500 telexes, faxes and a limited amount of data communications links. Within the past several years a cellular telephone service was established to service the Colombo metropolitan area and the suburbs.

With the open economic policies and the government placing high priority on export led growth it has realized the need for higher penetration of telephone services and data communication. In July 1991 the Department of Telecommunications was converted to a government corporation - Sri Lanka Telecom (SLT) with a view to provide better service and to increase the penetration. As prior to 1991 Sri Lanka had no telecommunication regulations as the service was provided by a government department. With the formation of telecommunciation authority a separate regulatory body was also formulated. With the formation of SLT (where entire service responsibilities of former Department of Telecommunications was handed over) license issued to SLT specified the ranges of authorized services namely telephone service, public telegraph service, telex service, data transmission, maritime mobile service, facsimile service, international television transmission, international photo telegram service, voice cast transmission, IDS (SATNET) service [low volume data transmission using very small aperture satellite terminals] and INMARSAT service. However services such as pay phones, cellular service and data transmission etc are left out of the license. Presently cellular service is provided by a private company - Celltel Lanka and for data services two private sector firms namely Datanet and Electroteks (Pvt) Limited are competing. With most of the banks establishing automatic tellers etc and lot of foreign investors investing in Sri Lankan projects, a heavy demand is generated for data communications services in the country. With the new reforms, the government is desirous of seeking participation on a joint venture basis with Sri Lanka Telecom of prospective investors / operators, local and / or foreign for accelerating the development of the telecommunication network to meet the growing demand for telephone services, which is expected to reach 500,000 / 750,000 in 1995. To reach these higher penetration levels the relatively untried strategy of Build, Operate and Transfer (BOT) is what appears to be the government's main strategy. For further details reader may refer to reference 1.

3. NEED FOR RESEARCH AND DEVELOPMENT ON TELECOM PRODUCTS AND SYSTEMS

In developing countries such as Sri Lanka the reasons for low telecom penetration may be related to factors such as need for large capital funds, inadequate technical know-how related to system management or engineering and the low capital investment on R&D etc. If the needs of developing countries are carefully analyzed one could certainly see that demand for voice channels is the primary requirement and providing this basic service need be done at an extremely low cost. Most telecom vendors price their 'state of the art' products and systems using multiplying factors with base costs than a percentage profit margin. At the procurement stages of modern telecom systems users may pay a very large sum of money for the most modern telecom engineering techniques be trialled by the multinational telecom giants using large infrastructural and expert environments.

However demands by the developing countries to increase the telecom penetration may not need those modern systems and what is necessary is that more basic designs which could be purchased or even developed at a lower cost within the developing country itself. Most electronic / telecom engineering undergraduate and graduate programmes in developing country universities are reasonably advanced enough to cater for the needs of basic design and development of telecom systems. If the costs for product / system development R&D could be lowered by utilizing these engineers from developing countries with some assistance from the relevant telecom authorities it may be a definite advantage for the telecom authorities in providing higher penetration levels.

4. RELATED PROJECTS

While telecom reforms were progressing in Sri Lanka within the past 2 - 3 years, the Arthur C. Clarke Centre (ACC) was awarded with few R&D contracts for designing and developing telecom products and systems such as Single Channel Radio Systems, Data Multiplexers, Pair Gain Systems etc and these contracts not only gave the opportunity for the R&D team to gain extremely valuable research and development experience but also challenged the team to solve very peculiar problems.

The generalized experiences and related issues discussed in this paper are quite closely related to work carried out at ACC in relation to the following major projects. Most projects detailed under the next few paragraphs are either completed or presently being completed.

4.1 10 CHANNEL PCM SYSTEMS

In Sri Lanka, telecom authorities receive a heavy critisism from the 'waiting list public' who are forced to wait from few months to few years to get a new phone connection, primarily due to the fact that old outside plants are quite congested and there are hardly any free telephone pairs from Exchange Main Distribution Frames (MDF) to subscriber premises. In combating this problem telecom authorities have started installing 1+1 carrier systems (commonly known in Sri Lanka as 'SPAY' systems) where one physical pair of wires is used with a low frequency carrier (24 KHz / 48 KHz) to achieve a pair gain of 2. However these units which were mostly imported were neither cheap nor reliable and the compalints from subscribers were quite heavy.

This 10 Channel PCM System was to propose a locally designed, tested and manufacturable system to achieve a pair gain of 5 adopting techniques used on common 32 channel PCM systems. System proposed was to achieve 10 voice channels using two physical pairs of wires, using a digital bit stream transmitted at 704 kbps over ordinary pairs of wires extending up to few kilometres from the nearest Exchange. Block diagram of the system is shown in Figure 1. For a detailed technical description reader may refer to reference 2.

Initial version was totally designed using CMOS integrated circuits with a view to keep the power consumption at a low level. First prototype was a quite complex system with about 15 individual PCB modules. In order to achieve more compact packaging the circuit modules designed with standard components families are to be converted using the Programmable Logic Devices (PLD) etc.

This project was commenced as an in-house project of the Centre with the need and demand be justified by the Sri Lanka Telecommunication Department. As there was no external funding available for the project it was carried out at a slower speed with two engineers. One primary problem faced by the team was the procurement of specialized telecom components from foreign suppliers.

4.2 SINGLE CHANNEL RADIO SYSTEMS

Single channel radio equipment is normally used to provide telephone facilities to remote subscribers where a physical pair of wires is not available or practicable. In effect this equipment replaces a pair of wires laid between the subscriber premises and the Exchange.

In 1988 Sri Lanka Telecommunication Department (SLTD) has purchased 50 single channel radio equipment from a company in USA at a cost of US$ 2,300/= each. However it was revealed later that this equipment does not confirm to the specifications as required by SLTD. Further SLTD failed to commission these equipment and sought the assistance of the Arthur C. Clarke Centre to repair these equipment. The ACC agreed to investigate and subsequently one system was brought to ACC labs for inspection. The tests were then carried out at the Centre.

Essentially each set consists of two systems namely exchange end system and subscriber end system. Both these systems incorporate a radio transceiver and a telephone interface circuit. Radio transceivers operate on duplex mode in VHF frequency band and are similar in both systems but the interface circuits functionally differ. It was found that these interface circuits were not specifically designed for the requirements in Sri Lanka. Supplier has selected few PCBs developed for some other applications and has attempted to configure the requirement utilizing circuit blocks available on these PCBs. It was observed that due to this 'adaptation' of various PCB modules used for other systems the final interfaces were not compatible with Sri Lankan Exchanges. Further in the subscriber end system, the logic that determines the subscriber status was not designed adhering to standard digital design practice and it was confirmed that this circuit would never function properly. Considering the above it was decided by the project staff of ACC that it was necessary to redesign the telephone interface circuits. Also it was observed that there was a need to redesign even the power supplies. Basic system block diagram is shown in Figure 2 and for further technical details on the project one may refer to reference 3.

Finally SLTD was informed that it is not possible to repair this equipment due to the above mentioned shortcomings and subsequently SLTD agreed to consider our proposal to redesign the equipment. This 'design modification' project was commenced with a commitment from the SLTD for approximately US$ 17,000/= for modifying 50 systems which includes the design and development costs as well as manufacturing costs of the new interfaces. A prototype system was then designed by ACC and it is now in operation between the ACC and a nearby Exchange. Presently ACC has started assembling the final interfaces with a view to deliver 50 numbers of these modified systems. In this particular attempt of redesigning the interfaces, it was a great burden on the R&D team to procure specialized telecom components from foreign suppliers. For example once when the Subscriber Line Interface Circuits (SLIC) were configured using few samples of (Motorola) chips and when the field trial / manufacturing stages commenced it was observed that the procurement of 100+ quantities of the same components from component retailers (or Motorola agents themselves) were almost an impossible task. However project managers finally succeeded procuring these from a Singapore supplier. This delayed the project by several months. Another problem worth highlighting here is that the reliability problems faced at field trials due to poor PCB quality. This problem was ultimately cleared by rearranging the components on the PCBs and avoiding close tolerances on the PCB track widths and spaces. (However the problem could have been avoided totally if it was economical for the team to order PCBs from a foreign PCB manufacturer. Most local companies who are manufacturing telecom / electronic products do not have PCB manufacturing plants with double sided through hole facilities.)

4.3 DESIGN OF A TDM SYSTEM FOR TELEX MULTIPLEXING BASED ON CCITT R101

Towards first quarter of 1991 one of the successful telecom manufacturers in Sri Lanka - Electroteks (Pvt) Limited reached the Arthur C. Clarke Centre for R&D assistance in developing a telex mux system based on CCITT specification R101/1988.

This system presently known as ETX-48 is a 46 channel maximum capacity telex multiplexer system based on the CCITT recommendation R101. According to CCITT specifications the system was to multiplex 50 - 300 baud telex channels and to ultimately transfer the multiplexed bit stream on a 2.4 kbps over voice grade telephone pairs using industry standard modems based on CCITT V.26.

The system block diagram is shown in Figure 3. Main blocks include

(a) 1 Transmitter Board
(b) 1 Receiver Board
(c) 6 Telex Channel Cards
(d) 1 Modem based on V.26 standard
(e) 1 Personal Computer (via RS232)

The system was designed using state of the art components from fast TTL / HCMOS logic families together with Programmable Logic Devices from the Generic Array Logic (GAL) families. Further receive module is based on an industry standard Microcontroller Z8800 (Super 8) from Zilog Corporation. Transmit module contains approximately 9 programmed GAL devices together with other support logic chips. Channel cards of the system contains 8 channels per module and provide total electrical isolation from the line side using opto isolator devices. The system is configured in an Euro Card system with 240 mm x 220 mm PCBs. For the purposes of local and remote programming an IBM PC AT / XT or a compatible could be used.

The transmitter board which contains fast TTL / HCMOS logic and several customized chips is occupying one board position on the Euro Card Cage. This board in one direction communicates with the Modem forwarding the multiplexed channel data and clock signals while receiving the telex characters from telex channel cards. The transmission board communicates with the receive board via the processor buses of the microprocessor subsystem on the receive board.

On the receive board the microcontroller runs at a clock rate of 10 MHz derived from a 20 MHz crystal. This board takes care of the function of receiving the multiplexed bit stream from the Modem (receive channel data), demultiplexes and writes telex characters towards the telex channel cards. Further the receive board has an RS232 connection which couples the system to an IBM PC or compatible for the remote programming and subscriber channel data changes. Receive board constantly communicates with the transmit module via the processor buses.

The Modem is a V.26 based state of the art module which is used to transmit multiplexed telex data on the voice grade line. Channel cards are 6 in total and each card carries hardware to couple 8 telexes with necessary line isolation and signal conversion and conditioning demanded by the receive and transmit modules. The power supply based on a PWM technique provides the necessary power rails for logic and telegraph circuits. For further technical details please refer to reference 4.

The design team was responsible for the design and development of the two most complex modules of the system namely the transmit module and the receive module where it was necessary to commence the basic design work from hardware concepts to final implementation of the system utilizing semicustom components mixed with standard component families. In order to save time the team decided to utilize commercially available Modems, channel cards and the other hardware already utilized by the client - Electroteks (Pvt) Limited. Design staff was faced with usual learning curve problems related to various sophisticated engineering software packages to programme semicustom chips etc.

This project is now being commissioned in another Asian country where the client of the ACC has won a competitive bid for supply, installation and commissioning of 40 numbers of ETX-48 systems. Funds needed for the project was negotiated and agreed with the client and the project staff was given the freedom to select the suitable technology. This gave the R&D team the opportunity of getting more advanced design knowhow where the project work demanded the use of several modern software packages for design and simulation of various circuit blocks. However in order to keep the overall R&D costs at a minimum, design and development tools were selected using careful planning.

5. GAINING CONFIDENCE ON DESIGNING TELECOM SYSTEMS

One key point worth noting in this article is that via carrying out design and development related to above projects (and other related projects too) it was quite possible to prove that if a suitably qualified group of developing country R&D engineers are employed and given the basic design tools and other instrumentation, the relevant telecom authorities could attempt to design and manufacture the 'less sophisticated' system components which are needed in few hundres or thousands.

Examples of such systems are

(a) Pair Gain Systems
(b) Power Equipment for Exchanges
(c) Data Multiplexers
(d) Single Channel Radio Systems

In most of the above systems the necessary number of working R&D engineers per project could vary from one to several and hence could be easily co-ordianted by design team leaders who are less experienced with the design and development of large telecom plants (such as Digital Exchanges, Datacom Systems etc).

Further with the systems with modest levels of technical complexity (where overall system needs few PCBs only) manufacturing is not a too complex task and assembly, testing and installation could be done with minimal infrastructural expenses for the manufacturers.

6. LEVEL OF INVOLVEMENT BY TELECOM AUTHORITIES

Most telecom authorities in developing countries negotiate with the manufacturers in developed countries for staff training when they procure large telecom systems. For this reason these telecom authorities have reasonably trained engineers for installation, commissioning and maintaining large and medium size telecom facilities. Even though these engineers do not get an opportunity for detailing the designs or the design methodologies used to develop these systems they get an excellent opportunity to elaborate on systems related aspects such as relevant international standards, systems configurations, reliability and long term management etc. If these engineers could collaborate with small R&D teams in institutions in developing countries where electronic / telecom / computer hardware design experienced engineers are available, design of telecom products and systems to suit the specialized needs of developing countries will not be difficult. However it is necessary to arrange suitable mechanisms for constant supervision, discussions and close relationships to be maintained between these groups at all stages of such projects.

For example such close relationships may help the telecom authorities to understand the peculiar technical problems faced by R&D team engineers which relate to slipped deadlines etc. Another example may be the demand for co-ordinated field trials before the prototype designs are approved for manufacturing.

7. DESIGNERS' PROBLEMS DURING DEVELOPMENT STAGES

Some peculiar problems faced by the designers in developing country R&D institutions may be not similar to the experiences of design teams working with large companies in developed countries. The following may be few examples.

(a) The difficulties in getting the most up to date information on electronic components or the technology updates.

(b) Communication problems with developed country component suppliers due to distances and costs involved.

(c) Difficulties in procuring small quantities of specialized telecom chips and other hardware components for prototype building.

(d) Lack of sufficient funds for procuring R&D tools with the 'state of the art' tags attached on to same.

(e) Lack of sufficient hands-on experience or senior staff to assist design teams when they face 'practical' difficulties at the product development stages.

8. MANUFACTURE OF PRODUCTS

When a particular product development is completed or field trials are successful and manufacturing stages commence, teams may face different problems such as reliability, repeatability, testing etc.

For example, when a prototype PCB is necessary at the design and development stage, quality is not an important factor. However when manufacturing commences the quality and reliability are most important factors. For example, sometimes developing country institutions and small corporations may not own proper PCB manufacturing facilities with multilayer or even double sided through hole types. Then it may be necessary to transfer the PCB layout to foreign manufacturers and the local parties may have to face deadline problems. (For a peculiar case of using e-mail for urgent manufacture of some PCBs reader may refer to reference 5.)

Sometimes when the product is nearing the prototype / field trial stages the components used may become obsolete and the system manufacturer may face the demand for further design changes and this may sometimes lead to very unplesant problems related to delivery deadlines. (For example, the new families of components needed to replace the obsolete ones may have to be reimported.)

9. MANPOWER PROBLEMS

Based on the experiences gained through these projects one could highlight that the most peculiar and difficult problems to solve are the manpower related problems. Few particular problems worth mentioning are

(a) Offering attractive remuneration packages for qualified, experienced and talented engineering personnel.

(b) Maintaining good staff morale in supporting the projects.

(c) Provision of very specialized technical trainings for staff who are actively engaged in high tech related projects.

(d) Clearing various procedure related problems in manning day to day activities.

(e) Loss of qualified and experienced engineering manpower to greener pastures within the country or abroad.

With regard to items (a) and (b) it is worth mentioning that when R&D work need be progressed in environments governed by various financial restrictions as well as procedural barriers it is extremely difficult to keep a high morale and a team spirit in the interest of ultimate project targets. For example, our experiences within the past several years show that most qualified and development oriented electronic engineers always demand higher remuneration packages (compared to the remuneration packages which could be given within procedural and institutional restrictions). One possible solution to overcome this problem is to introduce incentive schemes where project funds could be utilized to provide additional remuneration.

Another severe problem faced by the research team at ACC is that experienced and qualified technical staff are 'brain-drained' towards developed countries or oil rich middle east countries during the middle of the projects. This really creates very difficult situations for team leaders who are pressurized by the clients in relation to deadlines.

10. ACHIEVEMENTS

With the experiences gained by the design team it is clearly evident that following clear objectives can be achieved as major success factors.

(a) Reduce the cost of telecom products and systems.

(b) Guarantee the final operation and compatibility with existing systems.

Cost of a telecom product designed locally could be very much lower compared to an imported product from a developed country where development / R&D labour costs are comparatively higher. Further the large corporations and their corporate expenses are highly reflected on the products and systems they sell. This is a definite reason why a developing country should concentrate on making use of their R&D institutions with a view to utilize their limited financial resources (sometimes borrowed or received as a grant for infrastructural developments) for achieving more systems for less amount of money.

When the product is developed in the user environment or close to user environment itself the compatibility and operational reliability is always guaranteed. This is a definite plus factor for telecom authorities to consider developing a certain amount of telecom accessories and subsystems.

11. CONCLUSION

The experiences gained by the ACC team who were working closely with the telecom industry in Sri Lanka clearly showed that there is a very high potential for the use of local R&D talents as an effective measure for lowering the demand for capital funds for telecom systems as well as assisting local industrialists who are willing to manufacture and supply telecom systems and subsystems for local telecom authorities. If means and measures are identified to overcome various problems related to R&D, there is no doubt that developing countries could become self-reliant in manufacturing a substantial percentage of their telecom systems demanded.

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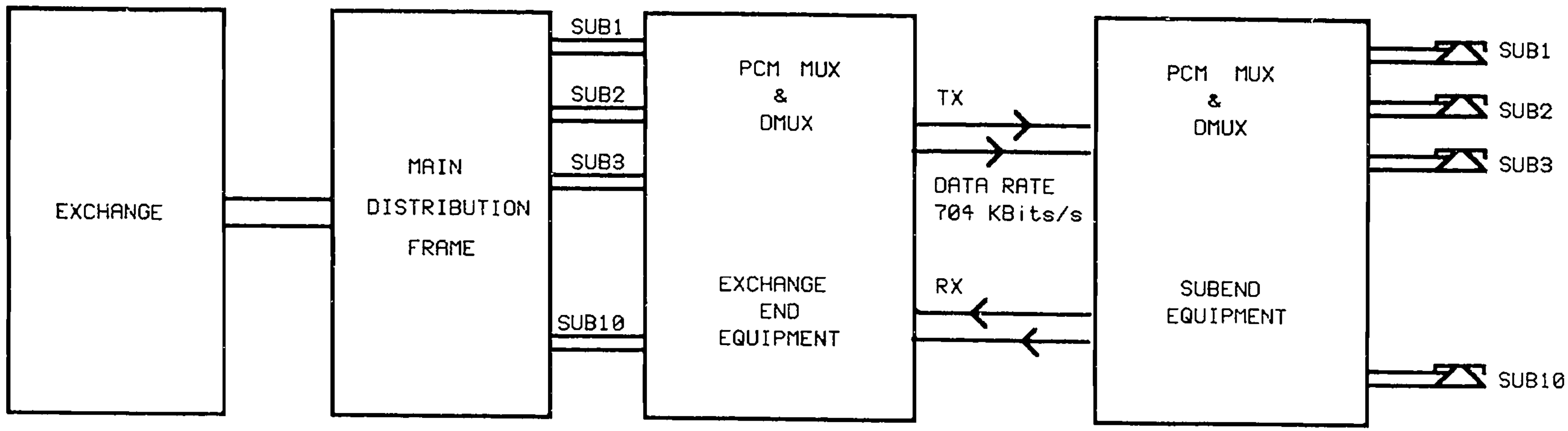

FIGURE NO.1 - BLOCK DIAGRAM OF 10 CHANNEL PCM SYSTEM

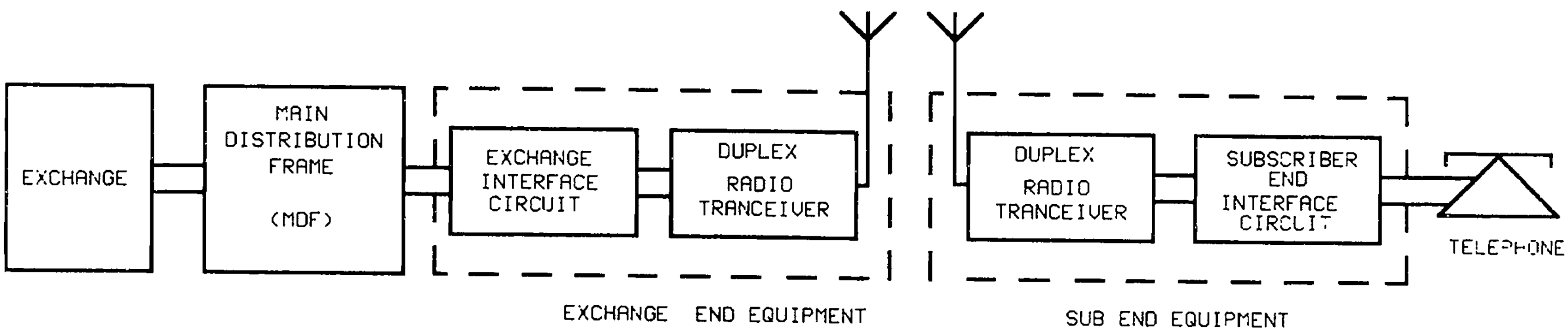

FIGURE NO.2 - BLOCK DIAGRAM OF SINGLE CHANNEL RADIO TELEPHONE EQUIPMENT

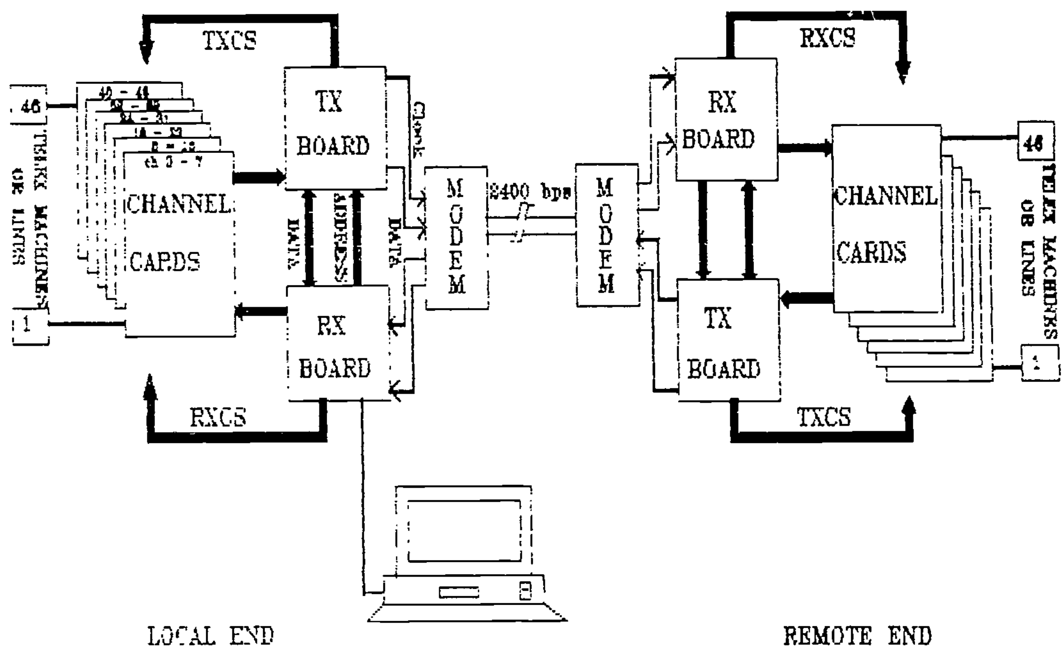

FIGURE NO.3 - BLOCK DIAGRAM OF ETX 48

The Political Economy of Deregulating Telecommunications in Hong Kong

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1. Abstract

The deregulation of telecom services in Hong Kong reached a point of ending the Hong Kong Telephone Company's monopoly in local voice communication in 1995. Nearly six years have passed since the first proposal for a second telecom network was submitted. In these six years, the alignment of different business interests and political forces affected the development of the second telecom network. After 1990, the control of the development has fallen into the hands of China. The most likely winner of the second network in Hong Kong will be one which ensures secure control of China in its operation. Minority foreign partners with telecom expertise to offer would also be included in the play. The existing telecom player will be put at a disadvantaged position if the new network is not operated in a business-like manner.

2. INTRODUCTION

Hong Kong people is an information-conscious species as evidenced by the high penetration rate of radio paging services and the rapid growth of facsimile. By December 1991, 877,000 pagers were licensed in Hong Kong; 1 out of 6.6 people was using a pager. This figure puts Hong Kong at the top of the list of radio paging penetration in the world.[1] The growth of fax lines in the past decade was also amazing. In 1984, there were only 1,024 fax lines; by March 1992, the number was increased to 146,116, with an average growth of 1,771% per year. As of September 1992, out of 100 telephone lines, 17 were fax lines. This fax density is second highest in the world, only after Japan which has 26 fax lines out of 100.[2] Today, Hong Kong has more than 3.5 million telephones in service, with 61 telephones per 100 population.[3]

The growth of mobile telephone services is also tremendous. In mid-1992, there were about 200,000 subscribers of cellular phone services, reaching the point of saturation. It represented an increase of 40% from last year. The Hong Kong government had to issue five licenses in July 1992 for digital mobile telephone services in addition to the old analog cellular services. Two licenses will use the American AMPS standard while three will use the European GSM. This is to maximize the capacity of the services.[4]

A year ago, the government already issued four licenses for CT2 (Cordless Telephone 2) services. These services have been available since the end of 1992. More people in Hong Kong are using data communication as well. In 1991, the connections to Hong Kong Telecom's switched services grew by 18% and non-switched services by 24%.[5]

3. DEREGULATING TELECOM NETWORK

In face of the surging demands for modern telecommunication facilities, the Hong Kong government, after dragging their feet for years, finally made up her mind in May 1992 to open up the local telecom market for full competition by 1995 when the exclusive franchise of Hong Kong Telephone Company, a subsidiary of Hong Kong Telecom, in voice communication expires. In September 1992, the government called for bids for the second telecommunication network which can provide non-exclusive data and fax services before June 30, 1995 and voice services after that date. The license holder can also connect to Hong Kong Telecom's international network, sharing the revenues of international calls with Hong Kong Telecom which still has monopoly in international telephone and data services until 2006.

This last provision for connecting with Hong Kong Telecom's international network and sharing the revenues is very important. It makes the construction of a second network in Hong Kong financially viable. In their first study on the telecom industry of Hong Kong, the Booz Allen and Hamilton had the following comment:

> "It is only if international competition is permitted in due course that we can conclude with confidence that network construction of a second telecommunication network is desirable"[6]

The hesitation of government in terminating the voice monopoly of the Hong Kong Telephone Company before was one factor contributing to the demise of the cable project in 1990. Without a promise of revenues from international calls, the commitment of HK$7 billion in constructing an optical fibre network merely for cable television and data services could hardly be justified.

Now a second telecom network is on the agenda. The forces at work behind the deregulation of telecommunication network is worthy of study. Because of the delay in decision, an alternative network for competition has been shelved for more than five years and the cable television project was almost abandoned for good.

4. FORCES AT PLAY

To understand the political economy of deregulating telecom network in Hong Kong, we have to identify the major players first. The players can be identified in terms of capital ownership. The construction of a second telecom network requires a huge amount of investment. Without adequate capital, no company can compete with the dominant incumbent operator - Hong Kong Telecom. The identification of capital interests in deregulation helps us to analyze the complexity in the deregulating process. The ownership of capital indicates the interests represented by the capital.

There are six major types of capital interests in Hong Kong. They are British, local-Chinese, PRC-Chinese (People's Republic of China), Taiwan, American and Japanese. Among them, the most important are the British, local-Chinese and PRC-Chinese capital.

By the end of June 1992, the total value of the companies in the Hong Kong Stock Exchange Market was HK$1,389 billion. Ten big families accounted for 53% of the total values. Among them, the Keswick (Jardine Matheson), Swire (Swire-Cathay Pacific Group) and Kardoorie (China Light-HK Hotel Group) Family were British while the rest were local-Chinese.[7]

Apart from these family holdings, the Hong Kong Telecom, Hong Kong & Shanghai Banking Corporation and Hang Seng Bank (a subsidiary of HK & Shanghai Bank) accounted for another 18% of the total market values of the stocks.[8] In other words, over 70% of the capital market and business activities were controlled by 12 groups (as Hang Seng was controlled by Hong Kong Bank). The remaining 30% values of the stocks were shared by more than 300 companies listed on the market. From this we can see that the capital in Hong Kong is highly concentrated.

4.1 British Capital

Before 1980s, the British capital was dominant in Hong Kong. In the late 70s and 80s, however, the British capital was challenged and out-shone by the emerging local Chinese. At present, the most important British corporations in Hong Kong are Hong Kong and Shanghai Banking Corporation, Hong Kong Telecom, Jardine Matheson, Swire and China Light.

The Hong Kong and Shanghai Banking Corporation has overtaken Hong Kong Telecom as the company with the highest market value in the stock market since its merger with the Midland Bank of the United Kingdom in mid-1992. Hong Kong Telecom is a subsidiary of the Cable and Wireless, Plc. of Britain. Its values in the market has declined in face of the ending of monopoly in the local market in 1995. China Light, Jardine and Swire were still on the top ten or top fifteen list in the stock market in 1992.

4.2 Local-Chinese Capital

The influence of local-Chinese capital was achieved in the 70s and 80s out of the boom of local property market. The most influential ones in the 90s are Li Ka-shing's Cheung Kong group, Sir Yue-kong Pao's Wharf group, Kwok's Sun Hung Kai Properties group and Lee's Hang Lung Properties group. By the end of June 1992, Li Ka-shing's group which included the Cheung Kong (Holdings) and Hutchison Whampoa Ltd. valued at HK$165 billion, accounting for 12% of the total market values of the stocks in Hong Kong, ranking at the top of the top ten families list.In the same period, the Wharf group ranked fourth only after Li's, Keswick's and Swire's, accounting for 5% of the total market values of all listed companies.[9]

4.3 PRC-Chinese Capital

China has invested heavily in Hong Kong particularly since 1978.[10] The most important companies with PRC-Chinese capital are the China Banking group, China Resources and China International Trust and Investment Corporation (CITIC). The last one is a major investment arm of China in Hong Kong. It is the company which bought 20% shares of the Hong Kong Telecom in 1989, becoming the second largest shareholder, only after the Cable and Wireless which owned 58.5% of Hong Kong Telecom.

It was estimated that by 1988, the total capital investment of PRC in Hong Kong already reached HK$60 billion.[11] The heavy investment of China in Hong Kong can also be seen in the value of her most important listed company in the Hong Kong Stock Exchange - CITIC Pacific. The total value of this corporation in the stock market was HK$17 billion, accounting for 1.2% of the total values of the market in June 1992. In terms of ranking, it was on the top fifteen list.[12] Many PRC companies in Hong Kong are not listed in the stock exchange market. The actual amount of PRC capital in Hong Kong is thus difficult to estimate.

4.4. Other Capital

The other sources of capital in Hong Kong include the American, Japanese, Taiwan, Southeast Asian and Australian. It was estimated that up to early 1990, the total U.S. investment in Hong Kong was about HK$48 billion, the Japanese was a little more than $48 billion and Taiwan was about $16 billion. In the years between 1986 and 1988, the Southeast Asian capital increased to HK$22.14 billion and that of Australian was $12.46 billion.[13]

Among all these capital, only the British, local-Chinese, PRC-Chinese and the U.S. were interested in telecom business in the 1980s and early 90s.

5. PARTIES INVOLVED IN SECOND NETWORK

5.1 First Stage (1986-88)

Those who were initially interested in a second telecommunication network in Hong Kong were a local company and a British company. The hiring of the Booz Allen and Hamilton (BAH) to study the telecommunication development in Hong Kong in 1987 was started with the government's invitation of expression of interest in the provision of a territory-wide cable television service. The government received substantial submissions from two companies: the Cable Television Hong Kong Ltd (CTHK) and the Hutchison CableVision Ltd. (HCV). The former was a subsidiary of Hong Kong Telecom. It proposed the use of a cable television network to be constructed by the main existing local telecommunications service provider, the Hong Kong Telephone Company (HKT). The HCV, on the other hand, proposed the construction of a cable television network independent of HKT's facilities. And this new network could subsequently be used to provide telecom services in competition to HKT. These proposals raised serious issues of telecom policy. As the BAH Report remarks,

> "The HVC proposal would bring into being a second, competing, telecommunicationsnetwork, while the CTHK proposal would result in a continuation of the existing telecommunications monopoly."[14]

The issues involved in the construction of a second telecom network prompted the government to initiate a study on the telecom development in Hong Kong by the Booz Allen & Hamilton consultancy company.

Apparently, the government by that time had no policy on the opening up of local telecommunication market for full competition. This is evidenced by the fact that the government did not limit the ownership of the new cable company by the existing network to 15% until 1988 when the BAH recommended to break the existing telecom monopoly. The Hong Kong Telecom had to disband its cable company (CTHK) after setting it up for nearly two years.

The HutchVision was the potential winner once the government made the decision to have a second network for the transmission for cable television and the CTHK withdrew from the play. The HVC had a strong backing from the British Telecom plc (BT) in the U.K. which had 40% shares of the HCV.

The British Telecom is the dominant telecom service provider in the U.K. Since 1984 it has to compete with a second network operated by the Mercury which is owned by the Cable & Wireless plc. In other words, the Cable & Wireless is the second telecom network operator in the U.K. while maintaining an unchallenged monopoly in Hong Kong. The coincidence of BT's alignment with Hutchison Whampoa Ltd. in challenging Cable & Wireless's subsidiary - Hong Kong Telecom's monopoly can be construed to be a spillover of deregulation from the U.K. to her colony - Hong Kong. Yet all these happened before the Tiananmen Massacre in 1989.

5.2 Second Stage (1988-90)

Two months after the Tiananmen Massacre, the HutchVision had to make a decision whether or not to commit more than HK$5 billion in constructing an optical fibre network which would make a profit only after 1997. Hutchison's confidence in Hong Kong by that time was apparently shaken and refused to increase further capital commitment in the last minute. And the bid of the Cable Project was won by the Hong Kong Cable Communication (HKCC) which had the Wharf group as the largest shareholder, with the U.S. West and other three local and foreign companies as minor partners. The HKCC agreed to nearly every term stipulated by the Hong Kong government.

Hence at the second stage, the British players, the Cable & Wireless and the British Telecom, were all out. Now it was the American and local-Chinese capital involved in the construction of the second telecom network.

But the HKCC in retrospect did not seem to have prepared themselves well and the project was delayed more than a year after the license was awarded in 1989. While little progress was made, the AsiaSat I was launched in mid-1990 and the Hutchison group, one-third of AsiaSat's shareholder, quickly applied for uplink and downlink licenses for satellite television.

This provoked strong opposition from the HKCC which claimed to have been promised by the government of monopoly in providing television services other than those provided by the two existing operators. Meanwhile, the shareholders of the HKCC shared different views and had serious conflicts among themselves. Finally, after the government announced the deregulation of satellite television in Hong Kong with restriction on subscription and use of Cantonese programming, the HKCC quitted the project in November 1990. At the end of this stage, the U.S. capital withdrew from the second telecom network.

Apart from internal strife and the possible threat of competition from satellite television, the government indecision in allowing the second network to compete in local voice service after 1995 was also a reason for the failure of the cable project in 1990.

At the second stage, we can see that the Hutchison company this time re-aligned with the Hong Kong Telecom in discouraging the set-up of a second telecom network and cable television, consciously or unconsciously. The AsiaSat I was owned one-third respectively by Hutchison, Cable & Wireless and CITIC. It is an alignment of British, local-Chinese and PRC-Chinese capital.

At the second stage, the attitude of PRC-Chinese capital is ambiguous. In 1990 the CITIC already became the second largest shareholder of Hong Kong Telecom which has the monopoly of local voice communication. Business-wise, the CITIC should not be willing to see competition from the second network which will cut the profits of Hong Kong Telecom. On the other hand, the Chinese authorities have strong reason to be concerned about the control of the only telecom network in Hong Kong by a British company - the Cable & Wireless.

To "nationalize" the existing network by buying out all the shares from the Cable & Wireless would be a clumsy political move since Cable & Wireless can provide valuable technological expertise and management experience to China on the one hand, the business confidence in Hong Kong would be hit badly on the other. Moreover, the Hong Kong Telecom has forged very good links with China in telecom development over the years, especially in the Guangdong Province. Strategically, the opening up of a second telecom network under PRC's control is an option to reduce the dominance of Cable & Wireless in Hong Kong's telecom activities.

During the second stage, however, the Chinese authorities did not seem to have a firm position on the set-up of a second telecom network or not. It was only reported that the CITIC had an agreement with the Hong Kong Government in maintaining the Hong Kong Telecom's monopoly before 1997.[15] But neither party has ever confirmed openly that they had such an agreement.

5.3 Third Stage (1990-92)

After the HKCC disbanded in 1990, the policy on cable television and the second telecom network dragged on. To many people's surprise, the Wharf lined up with Nynex and continued to pursue the cable television project. This time Wharf was the dominant shareholder of the new company Wharf Cable. During the period between 1990 and 1992, the government was hard pressed by the Hutchison group to relax the restrictions on the satellite television in Hong Kong. A tug of war was developed among the Television Broadcast Ltd. which is the existing dominant wireless television, the Hutchison's STAR TV and Wharf's new cable project.

Finally, in June 1992, the government opted for the issue of a subscription television license with exclusivity for the first three years. Preference was stated to be cable technology. STAR TV was allowed to charge subscription fees via the new subscription TV licensee and Cantonese programming will be allowed after the exclusivity period of the subscription television.[16]

At about the same time when the decision on subscription television was made, the decision for setting up a second network was announced. This decision on opening up the local telecom market for full competition after 1995 obviously boosted the confidence of the Wharf in using optical fibre for transmission of cable television.

Since the government did not tie the cable TV license together with that of second telecom network this time, it would be pointless for those who are interested only in telecom to bid for the cable TV license, although this may increase the weight in bidding for the second telecom network. Not many potential second telecom network operators were well prepared for cable television except the Hutchison group which had previous experience. For unknown reason, however, the Hutchison group gave up the bid for the cable television in the last minute. And there was finally only one bidder for the cable TV license - the Wharf Cable.

At the time of writing, the deadline (February 1, 1993) for the bid of the second telecom network has not come yet, the number of bidders is still unknown. From the press, we know that the following parties are interested: Wharf, Hutchison, Taiwan Pacific Cable, CITIC Pacific, British Telecom, Nynex, Rogers Cantel, OTC and Alcatel.[17] The AT&T was originally reported as interested but denied such a report in late October 1992.[18] It is often the case no one really knows who will be the bidders until the last minute.

The announcement of the bid for a second telecom network could be taken as a "go-ahead" sign given not only by the Hong Kong government, but also by the PRC. At the end of 1990 when a row developed between China and Britain over the expenditure on the plan for a new port and airport, the Chinese government made it clearly that all Hong Kong affairs and infrastructural projects crossing 1997 must consult China. In fact many people attributed the delayed decision on the second telecom network to the need of obtaining the blessing of China. After the announcement of the decision on the second telecom network, no objection was heard from China. Obviously, the decision for the cable television project and second telecom network already got the "understanding" of China.

Whether or not the latest row developed between China and the United Kingdom over the democratization of Hong Kong will change the attitude of China on the second telecom network is unknown. Up to the end of 1992, China had not made the second network an issue though it picked up the contract of a new container port as the bullet firing at the United Kingdom.

6. THE ALIGNMENT OF INTERESTS

It is still unknown who will bid for the second telecom network, from the exiting alignment of different interests in other telecom services in Hong Kong, however, we will still be able to get some ideas about the politico-economic groupings in telecom in future.

The alignment of interests can be seen most obviously in the mobile telephone services.

In the bid for digital mobile telephone services in mid-1992, four local winners were Wharf, Sun Hung Kai, CITIC Pacific and Chevalier. All of them lined up with foreign telecom operators. The Wharf lined up with the Nynex (U.S.); Sun Hung Kai with MacCaw (U.S.) and Tong Qiang (subsidiary of China Ministry of Post and Telecom in Hong Kong); CITIC Pacific with NTT (Japan) and Chevalier with OTC (Australia).

Hutchison is the most active local company in telecommunication. It has developed into a multinational corporation since the 1980s. In telecommunication, it has interests in the U.K, Australia, Korea, China in addition to Hong Kong. In Hong Kong, it lined up with Motorola in providing mobile telephone services, and with AT&T in VANS (Value-Added Network Services). In Canton, Hutchison worked with a local company to operate paging. Li Ka-shing himself is on good terms with the senior Chinese leadership.

The Wharf, a main local competitor of Hutchison in telecom as well as in other businesses, is not slow in building up its China connection. Although the alignment with PRC capital in telecom is not obvious yet, it has actively sought links with PRC capital. The most ambitious project is the containerization of Central Chinas' port of Wuhan, which will provide dynamic growth for the trade within and without China.

It should be noted that Hong Kong Telecom has intensified its cooperation with China in recent years. In 1990 it agreed to train the telecommunication workers in China for a period of three years. In November 1992, it set up its first office in Beijing. Up to 1990, the Hong Kong Telecom had transferred over 520,000 exchange lines to China[19] and a second fibre optic cable between Hong Kong and Shenzhen was constructed and put into use in early 1991.

7. IMPLICATIONS

In these 6 years of deregulation of telecom services and setting up a second network, we can see that the initial move was made by the local-Chinese capital together with the British under the trend of deregulation in the U.K. and the world. At the outset, the Hong Kong government took control of the development. But the development of events quickly turned the control away from the Hong Kong government.

The Hong Kong government lost a chance in keeping the initiatives in 1989-90. When it awarded the license for the second telecom network, it limited its service only to the non-franchised telecom services and refused to make any commitment as regards the ending of Hong Kong Telecom's monopoly in telephone and international data services. This indecision made the investment in the second telecom network highly risky, contributing partly to the withdrawal of Hutchison group in the first place and the demise of HKCC in the second. Once the time was lost, it was lost forever.

Since 1990, China has started to tighten its grips on Hong Kong, probably due to her unpleasant experience with Hong Kong in the democratic movement of 1989. After 1990 when the communists stood on their feet again after the crackdown of the students, China started to intervene all-out into Hong Kong's affairs. There was probably a shift of her Hong Kong policy after 1989.

The political situation in China and Hong Kong overtook the worldwide deregulatory trend in shaping the development of telecom in Hong Kong. Without Tiananmen Massacre in 1989, the development of events in telecom would definitely be different and less political. Hutchison group and the British Telecom would probably have got the license of cable TV and run the second telecom network. If Hutchison group and the BT had started the second telecom network before 1990, the PRC would not have had so great an influence on the second telecom network.

It was only after 1990 when China became sensitive to all infrastructural projects crossing 1997 as a result of Hong Kong government's design to spend all its reserves on a new port and airport. With a shift of policy on Hong Kong from one of "non-intervention" to "meddling in every possible way", the China factor has become most crucial in the build-up of the second network. No company can operate telecom network without the blessing of the Chinese authorities. In the coming few years, the links with China will be most crucial in telecommunication sector, be it strategic or genuine link.

The corporation which is likely to get the license of the second telecom network will be one which ensures the secure control of PRC over its operation. Once this happens, the existing telecom network, Hong Kong Telecom, will be placed at a relatively disadvantaged position in the long run. In the PRC's eyes, the values for the existence of Hong Kong Telecom's network in Hong Kong will lie mainly in its expertise and management.

To say this, it does not mean that foreign interests will be excluded from the second telecom network. If the foreign interests are only minority shareholders and able to contribute greatly to Hong Kong's and China's technological advancement, they would still be chosen. Among these foreign interests, the American are probably the most welcome partners since they could provide not only technological expertise for China, but good links with U.S. political interests. Strategic-wise, China's relationship with the U.S. is valued more than any other countries.

Whether or not Hong Kong Telecom's network can continue to operate profitably depends on the maintenance of competition in a business-like manner in Hong Kong. No one knows whether the new network under the PRC's control will operate in a business-like manner. Great uncertainty ensues in telecommunication in the forthcoming years. Probably, the Cable & Wireless and Hong Kong Telecom will put their eyes on the China market more than the Hong Kong in the years to come.

In the period of sovereignty change, all telecommunication players have to adapt to the rules set down by the new master. Economic decision has to be juxtaposed with politics. The final outcome of this decision will not be the most rational one. The policy consideration in telecommunication is never purely economic. In a transitional period of political power, this is even more so; the political considerations would override economics. It is most interesting that we will see what will really happen very soon.

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NEW "HAVE NOTS" AND THE OLD PROBLEMS?
How the East European Countries
and the Republics of the Former Soviet Union
Integrate into the World Communication Order

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ABSTRACT

The fundamental changes which have taken place in the last few years in Eastern and Central Europe as well as in the republics of the former Soviet Union have wide ranging consequences not only for the media, and in particular for the broadcasting system within these countries, but also for the world communication system and the global media marketplace in general.

On the one hand, domestically, a new broadcasting system and new broadcasting structures are developing. In the old order broadcasting was more or less centralized, state owned and under strict control of the communist party. Now, the new system becomes decentralized, independent from the state and commercialized.

On the other hand, internationally, the world communication market gets new producers and new consumers, new providers and new users. In the old world communication order there was strict barrier between the former East bloc and the rest of the world as far as the flow of information and the production, distribution and consumption of radio and television was concerned. Now the world broadcasting market becomes really global. The East, representing an area of about 150 million television and radio households, is integrating, step by step, into the global communication system. New national broadcasters are looking for international joint ventures.

A new regional fragmentation which goes beyond the old political and ideological frontiers is developing along geographical, economic, cultural and linguistic lines in Europe, Central Asia and the Pacific Rim. Not a special ideology but the footprint of a broadcasting satellite constitutes new coalitions. At the same time the global flow of information will become even more unbalanced. The majority of the new countries are new "Have-Nots" and will remain "information-poor" states. Although all the former East bloc countries have a developed national broadcasting system and the majority of the individual households are well equipped with radio and television sets, the capacities for the production of national television programs will remain limited and the majority of the new countries will become, sooner or later, dependent on the big transnational broadcasting corporations in the West.

Domestic developments

After the velvet revolutions and the radical reforms of the late 80s and the early 90s, all the new democracies are now recognizing the fundamental human right to freedom of expression as it is laid down in Article 19 of the United Nations Human Rights Declaration of 1948. Relevant paragraphs were incorporated into the new constitutions and governmental censorship over the media was declared as illegal. The Final Document of the CSCE Conference on the Human Dimension, which took place in Copenhagen in June 1990, confirmed this new consensus. The CSCE Helsinki Summit in summer 1992, showed that media questions, for more than half a century a battlefield between the East and the West, are no longer a controversial issue.

Theoretically and practically, the way is free for the development of a democratic broadcasting system. The collapse of the old system has opened indeed the door for the establishment of a "free marketplace of ideas" from Sofia to Riga as well as from Budapest to Moscow. The ideas of John Milton's classical "Aeropagitica" have "conquered" the East. But the process of change is difficult and things are looking different if reality takes you for the mountains of perspectives to the valleys of problems. The wind of change didn't change everything. There are still barriers, new and old ones.

New and Old Barriers

There is lack of historical legal tradition concerning free and independent media in a democratic society. The real meaning of the idea of a "public broadcasting service" is widely unknown and partly misunderstood. The existing broadcasting corporations (still mainly state owned) are lacking financial and technical resources, they are overstaffed (very often with the old personnel) and use outdated broadcasting technology. There are new efforts of the new governments to get back or to maintain control in particular over television. A new kind of independent and investigative journalism has to be developed in a time which is overshadowed by social and economic problems, also for the working journalists. There are no experiences with advertising and domestic as well as foreign private broadcasting. Frequency allocation procedures are not yet established. Rules for cable and satellite radio and television are very often not existing and international copyright regulation is often ignored.

The situation is different from country to country, but although all the new states are now looking for special national arrangements, the problems they are dealing with, are more or less the same. The most urgent things are the following ten tasks:

- the elaboration of a new media policy and a regulatory framework for broadcasting
- the reorganization of the old central and state owned broadcasting system
- the creation of national broadcasting authorities and broadcasting councils
- the establishment of a financial basis for public broadcasting
- the allocation of frequencies to and licensing of private broadcasters
- the regulation of cable and satellite televisions
- the adoption of rules for advertising
- the introduction of copyright legislation
- the modernization of broadcasting equipment
- the development and improvement of the telecommunication infrastructure

The individual regulatory activities on the national basis have to be seen in a wider international context. In the "information age" radio and television do not know any national frontiers. Globalization is a main tendency in international communication. But at the same time, and this is the other side of the coin, there is also a tendency towards localization and regionalization in broadcasting. The "global village" of the 21st century calls for a certain kind of international harmonization of broadcasting systems and structures, but this transnational harmonization has to take into consideration both the national economic needs and cultural identities as well as the international trends and developments.

New National Broadcasting Legislation

One fundamental precondition for an integration of the new national broadcasting systems into the world communication order is a national broadcasting legislation which is compatible with the international regulatory framework. In all the new democracies, regardless of their specific national conditions, new broadcasting laws are under discussion or already adopted by the national parliaments. International regulation like ITU Radio regulations or the European conventions on human rights (1950) and on transfrontier television (1989) are taken as general guidelines. There is a declared political will to follow "western experiences". But if it comes to the concrete details, different kinds of problems arise.

The broad variety of different models in the West creates a lot of problems for the East. Whom to follow? Some of the new democracies, in particular the Central European countries, try to introduce the **"West European dual system"**, that means to change the state-owned broadcasting system into a public broadcasting system and to open the frequency spectrum for private broadcasters. Others, like Bulgaria or some of the republics of the former Soviet Union, prefer the **"American model"**, that means to introduce a constitutional guarantee for freedom of the media (like the first amendment), to establish a more technically oriented regulatory authority (like the FCC) and to privatize the broadcasting market.

Regardless of the discussion of the different models, the development is mainly overshadowed by new internal conflicts within the countries, in particular between the new governments and the media. This conflict is deep rooted in the concrete historical experiences. The last forty (or seventy) years have produced a special political culture and a structural behavior which does not disappear after the disappearance of the old power structures.

In the old Stalinist system, the media were seen as "instruments" of the party/the government which have to give "guidance" to the people. Opposite voices did not have access to broadcasting. Now, after the revolutions, the new governments, the former opposition, has for the first time access to radio and television. Being in power, the new rulers realize very quickly that it is not so bad for an administration, in particular in an un-table situation of a transition period, to have control over television. The new governments rediscover the benefits of using television "to explain" their own policy to "the masses" and to create a public opinion which is favorable for a reelection. And they feel themselves very justified to do that. They argue, that after free elections they are now democratically legitimized to "use" the media for their own political purposes. In the past, television was "theirs", now it is "ours".

This misunderstanding of the role of the media in a democratic society has its historical explanations. In all the Eastern countries there were no experiences with a broadcasting system, independent from the government, serving (more or less) the interest of the public, criticizing the government, functioning as a "watchdog" and a "forth power" in a democratic society and following the rules of the market.

That the "peoples right to know" determines the use of the media freedoms is a new experience which has still to be made. This "missing experience" influences the process of change and can constitute another new barrier for the continuation of the reform of the broadcasting system. While changes of programs and persons took place very rapidly immediately after the revolutions, changes of structures and mechanisms did not follow soon.

To refer to a drastic example: After the changes in Latvia, new senior officials for the national broadcasting corporation were nominated and instead of Russian films, American films and series were shown on the evening program. But at the same time the new director general of LTV got the order from the new government in Riga to reserve two of the four available Betacam cameras. One to cover the daily activities of the prime minister and the other one to cover the daily activities of the president of the parliament.

Government versus Opposition

The question how far governmental influence (or control) should go in the new broadcasting system is in the center of the discussion around the broadcasting laws.

Key controversial issues are the following three questions:

- the composition of **broadcasting authorities**/councils
- the nomination procedure for the **director general** for radio and broadcasting
- the procedures for the **allocation of frequencies** to private broadcasters.

In all the three areas, generally speaking, the same basic conflict between the government and the opposition can be observed.

Firstly, the governments prefer a broadcasting council, nominated mainly by the executive to guarantee that the government has a majority in it, while the opposition wants to have and "Independent Broadcasting Authority", elected by a two third majority by the parliament to guarantee independence from the government.

Secondly, the prime minister wants to reserve the right to nominate the Director General for radio and television while the opposition wants to establish a procedure where the parliament on the basis of a two third majority or an independent broadcasting authority has the right to elect the senior broadcasting officials.

And **thirdly**, the governments want to maintain control over the frequency spectrum as much as possible while the opposition favors the establishment of another independent institution for frequency management and allocation.

Like many other governments both in the West and South, also the new governments in the former East bloc are basically not interested that their policy is criticized publicly by an independent broadcasting watchdog. Insofar they do not have to hurry to introduce a new broadcasting legislation which would undermine the governmental influence in radio, and in particular, television. This explains to a high degree why even in Hungary and Poland, where a certain democratic tradition still exists, the adoption of a new broadcasting legislation was postponed again and again since the changes started in 1989.

Private Broadcasters Have to Wait in Eastern and Central Europe

The delay in the adoption of broadcasting legislation slows down the process of demonopolization of the national broadcasting system and prevents in particular, private broadcasters to enter the market. In all the new democracies there is still a state monopoly in the field of broadcasting while a hundred of private initiatives, mainly in radio, are waiting for the allocation of a terrestrial frequency. In nearly all Eastern countries, so called "frequency moratoriums" have blocked a breakthrough so far.

In **Poland**, a frequency moratorium was in force since 1990. Several efforts to adopt a broadcasting law under the governments of Mazowiecki, Bielecki, Olszewski and Pawlak failed. Under the government of prime minister Barbara Suchocka, the "Polish Iron Lady", the broadcasting law was adopted by the Sejm the 15th of October 1992. The Senate passed the broadcasting law in late November 1992, but asked for the adoption of nearly forty amendments. Senate Amendments can be rejected by the Sejm with a two-thirds majority. After the final adoption by the Sejm and the signing by President Walesa, the bill will enter into force, probably in January 1993. The "Polish Law on Radio and Television" establishes a "National Broadcasting Council" as the highest broadcasting authority in the country. The Council will be responsible both for public and private broadcasting. The Council will have nine members, three nominated by the president, two by the Senate and four by the Sejm. The Chairman of the Council will be nominated by the president of the republic.

In **Hungary** the broadcasting bill has been under discussion already since late 1989. According to the constitution the broadcasting bill needs a two-thirds majority in the parliament. This has blocked so far its adoption because government and opposition were not able to bridge their conflicts concerning the composition of the broadcasting authority, the nomination of the senior officials of the new Hungarian public radio and television companies and the procedure for frequency allocation by a compromise. The ruling parties want to reserve a possibility for the government to maintain a certain kind of final control over radio and television, the opposition wants to give more influence to the parliament where they have a right to participate in decision-making on the basis of a two-thirds majority clause.

The split of Czechoslovakia has changed fundamentally the broadcasting situation in this country. Federal broadcasting comes to an end. A "Federal Broadcasting Law", adopted in October 1991, which created a legal possibility for the allocation of terrestrial frequencies also to private broadcasters, does no longer constitute a legal basis. Both the Czech and the Slovak republic will redraft their own broadcasting legislation, will reestablish their own national broadcasting authorities and each will have their own national public channel. There will not be an "information union" between the two countries as proposed by the Slovak prime minister Meciar. The Czech prime minister Vaclav Klaus prefers instead of this "union" a general "privatization" of the broadcasting landscape.

In **Romania**, where television played a central role in the revolution of 1989, a broadcasting law was adopted in March 1992. The "National Audio Visual Council", which was establish by law, has eleven members. Two are nominated by the president of the republic, three by the government and six by the two chambers of the parliament. Private broadcasting is possible. Besides a number of private national radio and television broadcasters, an international joint venture "Atlantic Television" has already overtaken the second national TV channel. But the law was criticized strongly by national broadcasters. The law includes some unclear formulations like the prohibition of defamation of the nation and its representatives, which can be misused again for governmental censorship.

In Bulgaria, foreign radio programs like BBC, Voice of America and Deutsche Welle as well as domestic private radio broadcasters got licenses without broadcasting legislation on the basis of decisions by the government or by the media commission of the parliament, a body which seems to be the highest broadcasting authority in the country for the time being.

Unclear Perspectives in the Republics of the Former Soviet Union

In the republics of the former Soviet Union, the most interesting development can be seen in the Russian Federation.

After the coup in August 1991, president Yeltsin, under the pressure of some private broadcasters like "Echo Moscow", the only voice in the air when the tanks were on the red square, opened the door for private broadcasting by a special "Ukas". The Ukas No. 500, adopted in September 23, 1992, established an "Interim Broadcasting Commission" which got the right to allocate frequencies on the basis of a competition to private broadcasters.

The "Russian Law on the Mass Media" from December 1991, stated that a separate "Law on Radio and Television of the Russian Federation" should be elaborated. Several drafts of the new broadcasting bill has been discussed by the parliament since January 1992, but the law is still waiting for adoption. The key part of the law is the establishment of a "Russian Broadcasting Commission" which looks very similar to the American FCC. According to the draft of the law from October 1992, the "Russian Broadcasting Commission" will be the highest broadcasting authority in the country, responsible not only for the allocation of frequencies but also for general broadcasting policy, including radio and television programs. The Commission will have eight members, four nominated by the president of the Russian Federation and four by the two chambers of the Supreme Soviet.

For the moment it is difficult to say, when the new law will be adopted and which effects the law will have in practice. The whole development can be stopped and channeled in another direction by unforeseen events within the Russian Federation. In early December, President Yeltsin recalled the Minister of Information, Mr. Poltoranin, and the Director General of the first TV channel, Mr. Yakolev. How the media policy will be determined after the Russian congress is at the moment, (6th of December) when this paper was written, an open question.

New broadcasting laws are also under discussion in the other republics of the former Soviet Union. In the Baltic countries, Latvia has already adopted a broadcasting law in May 1992. The adoption of the Estonian broadcasting law is expected for spring 1993. The situation in Lithuania is unclear after the last elections.

In the Ukraine, in Belarus and Moldova, the old soviet media law from August 1990, is still in force, but first drafts of a national broadcasting legislation are circulating in the media commissions of the national parliaments. The situation is similar in the three Caucasian republics (Georgia, Armenia and Azerbaijan) and the five Asian republics (Uzbekistan, Kirgizia, Tadzhikistan, Turkmenistan and Kazhakstan).

Ostankino - A Russian Company or an International Channel?

Regardless of the political struggle around the broadcasting laws, the broadcasting landscape is dramatically changing also without any legislation in the former Soviet Union. Two main developments determine the general picture.

Firstly, the search for a new status of the former first soviet television channel, today's "Ostankino TV", the worlds biggest television company with more than 25,000 employees and secondly, the development of national broadcasting systems in the republics of the former Soviet Union.

After the disappearance of the Soviet Union in late 1991, President Yeltsin transformed the former "Soviet Gosteradio" into a Russian company "Ostankino" which got the mandate to distribute a Russian language program to all the former members of the Soviet Union.

At the first meeting of the presidents of the members of the "Commonwealth of Independent States" (CIS) it was agreed to internationalize the status of "Ostankino". Two options were discussed: first, the conclusion of an international agreement and the establishment of an "Euro-Asian Broadcasting Company" and secondly, the transformation of Ostankino into a semi-private corporation where member-states of the CIS could become shareholders.

One year of controversial negotiations between the CIS members did not produce a final agreement. The non-members of the CIS - Estonia, Latvia, Lithuania, Georgia and Azerbaijan - indicated that they were not interested to become neither a member of an "Euro-Asian Broadcasting Union" nor a shareholder in an "Ostankino LTD". Other republics, like the Ukraine, articulated strong political reservations against Ostankino. The president of the Ukraine blamed Ostankino as a "Russian Voice" which "interferes into internal affairs of the Ukraine". Other republics like Kirgizia or Turmenistan, are ready to participate into a joint international "Ostankino" venture, but declared that they do not have the financial means to contribute to the budget.

In the meeting of the CIS presidents in October 1992, the Heads of States of eight republics decided to elaborate a treaty for a transformation of Ostankino into a private company in which "interested states" can buy a share. The Ukraine and Tadzhikistan, both CIS members, declared that they are not interested in participating in such an agreement. It is planned to sign the treaty at the meeting of the CIS presidents in late December 1992 in Minsk. Whether the Russian Federation and maybe Belarus will finally the only shareholders, has to be seen.

New National Broadcasting Companies

The discussion on the future of "Ostankino" is paralleled by the development of new national broadcasting systems in all the republics of the former Soviet Union, including the Russian Federation.

Already in the past every republic of the former Soviet Union had its own national broadcasting company. This "national company" was theoretically "independent" from Moscow and played the role of a "regional program" under the control of the local party committees. Although the studios and transmitters were not badly equipped, the quality of the service was on a low level. The most creative journalists and programs producers left the country and tried to join "Gosteleradio" in the past. this explains also, why "Ostankino" has, even after the disappearance of the Soviet Union, a privileged role. The programs produced by Ostankino are, regardless of its political orientation, more professional and represent a higher quality in both technical and program content standards.

The strongest competitor for "Ostankino" can be found now in the Russian Federation itself. A new company - the "Russian Radio and Television Company" (RTR) - has been established already in late 1990. RTR, the former second soviet channel, was seen under Gorbachev as Yeltsin's voice. RTR became soon a success story and expanded its program from six hours to 16 hours daily and has now a share of about 35 to 40 percent of the daily viewers. RTR sees itself, meanwhile, as the real first Russian television channel. RTR, which has to share at the moment the so-called educational channel (the third channel) with Ostankino, plans to overtake the whole third channel as its own responsibility and to produce its own second program.

With "Moscow TV" and "St. Petersburg TV" the Russian Federation has two other television programs. The Russian television market has become colorful. Each of the four companies - Ostankino, RTR, Moscow TV and St. Petersburg TV - declare that they are "independent" today. But the independence remains limited for the time being because all the four companies are paid by the state. There is no license fee system in the Russian Federation and the income from advertising is on a very low level.

Non-state television is only in its first stage of development. The most interesting project is an initiative, started by Eduard Sagalazhev, a Deputy Director General of Ostankino, already in 1991 and called "Independent Russian Television" (IRTV). IRTV wants to become a totally privately financed television company. The shareholders of this new company are private banks and some Russian individuals. In summer 1992, IRTV has concluded a cooperation agreement with Ted Turner and it is fighting now for the allocation of a free frequency, the sixth television channel in Moscow, which is not yet in use.

The "Interim Broadcasting Commission" has opened a competition for the sixth channel in summer 1992 on the basis of "Ukas No. 500". Sagalazhev and Turner are obviously the favorites among the six candidates. An allocation of the sixth channel to IRTV would be undoubtfully a turning point in the Russian broadcasting policy. But the question is still undecided. The present parliament denies the right of the "Interim Commission" to allocate the frequency. It argues that only the new "Russian Broadcasting Commission" will have the right for such a strategic decision.

Besides Russia, the most interesting broadcasting market is the Ukraine with more than 20 million radio and television households. In the Ukraine, the old state monopoly is still alive. The state owned "Ukrainian Radio and Television company" (URTC) has occupied the majority of the frequencies. A first commercial television channel has started in the middle of 1992 but even in this "private company" the URTC has more than fifty percent of the share. An "Ukrainian Union of Independent Television" has been established in late 1991. The Union calls for a "demonopolization", but there is no hurry in the Ukrainian parliament to elaborate a new broadcasting bill.

Also, in the other republics, broadcasting is still mainly state-owned and monopolized by the government. Private broadcasters have difficulties in mobilizing the financial and material means for the production of radio and television programs as well as to get the needed frequencies for the distribution of their programs.

Regardless of the more restrictive tendencies in frequency allocation for private broadcasters, privatization is developing. The most promising field is at the moment cable television. Local and regional networks are managed by private entrepreneurs who distribute local and regional news as well as international films, very often without any permission and by violating international copyright regulation, but with high viewing rates.

The new CTV companies are very often linked with broadcasting equipment manufacturers who are looking for privatization of their factories. Some of these companies even try to get their own private satellites. where the money of these "new companies" is coming from remains often unclear, but there is a tendency, that a new kind of "transnational" broadcasting business is developing by establishing new networks of private radio and television companies in the different republics of the former Soviet Union. There is certainly a long way to go to have an alternative private "Ostankino", but, under conditions of a successful economic reform, this could indeed be more than an only theoretical option.

How far the new state-owned or private companies, which succeed the former unique soviet broadcasting system, will look for international cooperation still remains unclear. On the one hand, there is a growing tendency for isolation. Language and cultural barriers promote such a disintegration-development. On the other hand, the former Soviet Union is a big market and the new national companies need financial and material cooperation with foreign broadcasting corporations. It is obviously too early to make any forecasts how new joint ventures will influence the international broadcasting market. But in the long run, the disappearance of the Soviet Union will certainly provoke a rearrangement of the global broadcasting market, at least in three regions: Europe, Central Asia and the Pacific Rim.

International Consequences: New Transnational Actors?

In Europe all the former OIRT members are joining the "European Broadcasting Union" January 1, 1993. The EBU will become the most powerful international broadcasting organization in the world. The broadcasting companies, united in the EBU, reach a population of more than 350 million people. One satellite like "Astra" can cover the whole region not only from the North Gap to Gibraltar, but also from the Atlantic to the Urals. The "closed East" is now more or less open and ready for an expansion of private broadcasting companies. Berlusconi, Murdoch and other transnational corporations are already knocking at Eastern broadcasting doors.

But on the other hand, the new members constitute also a new burden for the EBU. Broadcasting companies from Latvia, the Slovak Republic or Belarus even have difficulties to pay their membership fees. In some of the new laws there are restrictive rules concerning foreign participation in national broadcasting. Quota systems, both for program and capital, are incorporated into the new broadcasting bills. And it is still open, how far the growing nationalism in Europe will have also consequences for the broadcasting landscape and the development of transnational joint ventures in private radio and television.

In Central Asia, new coalitions are in the process of birth. The five Asian republics Uzbekistan, Kirgizia, Kasachstan, Tadzhikistan and Turkmenistan, still members of the CIS, and the Caucasian republic of Azerbijdshan, are strengthening their cooperation with Turkey, Iran, and Afghanistan. The six republics joined the Islamic "Organization of Economic Cooperation" (OEC) in late November 1992. The Turkish television satellite "Turksat" distributes already its programs to the Asian republics of the former Soviet Union. The new national broadcasting corporations in these countries, while still cooperating with "Ostankino" in Moscow, are looking for closer links with broadcasting companies in Teheran and Istanbul. A new broadcasting area with a population of about 200 million people is in the stage of emergence in Central Asia. Could this lead to the development of new transnational actors in this area?

At least, there will also be consequences for the Pacific Rim. At the moment, there are still unsolved political problems between Russia and South Korea and Japan. But in the future, both South Korean and Japan will see Russia (if the political problems have been settled and the Russian reforms will have led to a successful economic development) as an attractive potential market for broadcasting equipment and television programs. New transnational broadcasting actors also in the Pacific Rim?

Creating Tomorrow's Telecommunications Infrastructures:
Cultural Needs and Economic Realities

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1. ABSTRACT

Historically, telecommunications policy-making emphasizes subsidies, extensive collaboration, and temporary protection. This approach impedes the implementation of new technologies and fails to address pressing social needs, especially in developing countries. Focusing on new digital technologies and their diverse delivery systems, this political-economic study examines the tensions which exist in today's regulatory environment where new technologies and standards are used as competitive tools. Suggestions for achieving long-term cultural goals by separating infrastructure requirements from competitive objectives are presented.

2. INTRODUCTION

Many nations are experiencing unsettling political and economic changes as they move from industrial-based to information-based societies. Successful businesses in nations with advanced economies are now based on specially tailored products and services. The new barrier to entry is not volume or price, it is skill in finding the right fit between particular technologies and particular markets. According to Harvard political economist Robert Reich: "Core corporations no longer focus on products as such; their business strategies increasingly center upon specialized knowledge: (1).

Reich identifies three groups of workers who are responsible for providing most of the value to core corporations:
(1) problem solvers,
(2) problem identifiers, and
(3) strategic brokers. In order to take advantage of new discoveries and new opportunities, these three groups must be in continuous contact with one another:

> Speed and agility are so important to the high value enterprise that it cannot be weighed down with large overhead costs like office buildings, plant, equipment and payroll. It must be able to switch direction quickly, pursue options when they arise, discover new linkages between problems and solutions wherever they may be (2).

Although corporations have always searched for faster and more efficient means of transportation and communication, their need for instantaneous, worldwide information to support their new global competitive strategies is responsible for elevating telecommunications technologies and information processing to their new roles as distinct and critical commodities (3). While these economic needs are driving the development and deployment of new communications systems, cultural differences and political pressures are subtly modifying individual parts of these systems, affecting their ability to create a truly global communications network.

But these modifications, in turn, transform the very culture that brought about the changes in the first place (4). Because of this interdependence between culture and technology, choosing a particular technical standard or creating a seamless telecommunications infrastructure is, in effect, a political and economic time bomb, which seems destined to explode regardless of the direction a nation's telecommunications program and policies may take.

On the one hand, a government must ask itself if the ability to communicate freely with other nations outweighs the advantages gained by adopting incompatible systems. The incompatible systems approach not only helps preserve a nation's culture, but also gives it an economic advantage by effectively keeping incompatible foreign systems out of the domestic market (5). On the other hand, nations can no longer substantially enhance the wealth of their citizens

> ...by subsidizing, protecting, or otherwise increasing their profitability of "their" corporations; the connection between corporate profitability and the standard of living of a nation's people is growing ever more attenuated (6).

For example, in 1990 more than half of the exports and imports in the U.S. (by value) were transfers of problem-solving (research and design), problem-identifying (marketing and advertising), and brokerage (7). Therefore, rather than asking "which nation's citizens own what, governments must now ask themselves if their citizens are learning how to do what, so that they are capable of adding more value to the world economy" (8). This requires developing modern telecommunications infrastructures to support the free flow of information and the rapid dissemination of all types of data.

These opposing philosophies have created both political and economic dilemmas for corporations and governments and have thus far thwarted the development of a truly efficient global telecommunications network based on emerging digital technologies.

3. POLITICAL-ECONOMIC ASSESSMENT OF ISSUES

Today, governments use technical standards as a means of stimulating private-sector industries or of protecting a specific market from foreign domination. This approach is especially common in the case of digital technologies (e.g., B-ISDN, advanced television or HDTV, and digital radio). While the issues raised by these policies are not trivial, they have a tendency to conceal the broader issue of world market domination (or the preconceived fear held by most governments concerning their loss of world market domination within a specific industry).

This political-economic analysis focuses on one segment of the digital industry, digital radio, as a means of exploring this issue. The thesis developed within this framework suggests that a policy of deregulation and privatization carried out without considering a society's cultural norms hinders the development of national and international technical standards (9).

4. DIGITAL TECHNOLOGIES

The buzz word of the '90s is "digital." You are not "up-to-date" or "fastest" or the "best" unless you have invested in the latest digital technology. Everything from audio tape players to food processors is marketed touting "new, improved digital features"--whatever that means. But regardless of the sales hype, digital systems are rapidly replacing their analog counterparts, especially in the field of communications. New digital audio and video equipment is being developed daily, while older information transmission systems employing coaxial cable or twisted-pair copper wire are performing beyond expectations due to the development of new data compression techniques.

Meanwhile, government agencies are setting ambitious goals--mandating the commercial use of many of these new technologies by the year 2015 (10). The conflicts surrounding the roll out of "Telecom 2000" (11) or its equivalent are best exemplified by looking at the problems encountered in establishing digital radio broadcasting.

4.1 DIGITAL AUDIO BROADCASTING

Digital Audio Broadcasting (DAB) actually exists in many forms. Trying to understand what it is and how it functions can be a daunting task, because each country and each potential provider sees it in somewhat different terms.

4.1.1 PROJECT "ACORN"

Project "Acorn" is an experimental terrestrial broadcast system developed by USA Digital (12). It supposedly offers AM broadcasters a 96 dB signal-to-noise ratio, stereo and a frequency response from 20 Hz to 15 kHz. In addition, the technology can also be applied to FM broadcasting. In this case, a digitally encoded audio signal is sent within a station's RF mask providing in-band digital FM. On the receiving end, this digital signal is decoded using a chip originally developed by the military (13).

4.1.2 DIGITAL CABLE RADIO

Another form of terrestrial digital radio began with tests conducted by Jerrold Communications in 1988. Digital radio signals were transmitted over cable television systems and feedback concerning the programming was gathered from subscribers to the test. Today, approximately 35,000 households subscribe to Digital Cable Radio (DCR) (14), which is carried on more than 60 U.S. cable systems. DCR offers 19 disc jockey and commercial free CD-quality music channels as well as digital stereo simulcast feeds of HBO, Cinemax, Showtime, MTV, and VH-1 (15).

4.1.3 SATELLITE DIGITAL AUDIO SYSTEMS

Digital audio services are not limited to terrestrial delivery systems, of course. Some satellite providers are now offering Digital Audio Transmission Service (DATS) in the C- and Ku-bands. This technology employs pulse code modulation (PCM) and time division multiplexing (TDM) techniques to saturate a satellite transponder using a single carrier in order to avoid potential inter-satellite and terrestrial interference problems. Recent developments in Single Channel Per Carrier (SCPC) channels allow for a variety of data rates (128 kbps to 384 kbps), providing 10 kHz or 20 kHz audio channels (16). Presently, this system is used primarily to furnish radio stations with network and syndication feeds.

4.2 OTHER DIGITAL SYSTEM FEATURES

A number of other features will be available to the consumer using digital radio once functions and standards are agreed upon by the industry. One example is RBDS (Radio Broadcast Data Systems). Based on a technology developed in Europe, RBDS uses a 57-kHz data stream broadcast on an FM subcarrier. Once this subcarrier is decoded by the receiver, it can provide the user with such information as the station's call letters, its frequency, the type of programming broadcast by the station and any emergency situations existing in the immediate vicinity. Moreover, if users are in an unfamiliar location, they can take advantage of a program type code (PTY) broadcast on the subcarrier. By pressing a button corresponding to a particular radio program format, the user can use the receiver's search function to lock into any local stations broadcasting the listener's preferred style of programming. When used in conjunction with AM radio broadcasting, the proposed system is referred to as ID Logic B (17).

4.3 OTHER SYSTEM PROPOSALS

The above systems are just a few of the digital radio technologies available now or in the near future. In fact eleven Digital Audio Radio Services (DARS) have been submitted so far. Companies proposing systems include: Amati Communication Corporation, AT&T Bell Labs, Digital Planet, General Instruments, Kintel Technologies, Mercury Digital Communications, Massachusetts Institute of Technology (MIT), NASA/Voice of America (VOA), Strother LinCom, Thomson Consumer Electronics, and USA Digital Radio. Testing of these various systems is scheduled to begin in April of 1993, and the Electronic Industry Association (EIA) plans to select a standard by the end of 1993.

Another service which is very similar to digital radio is being planned by NBC in conjunction with IBM and NuMedia Corporation. These companies plan to provide NBC News and CNBC cablecast news on personal computers. The experiment dubbed "Desktop News" will consist of a feed of daily programming to corporate customers via satellite, although it can also be sent on coaxial and fiber optic cables.

Michael Wheeler, NBC consultant and former president of the Financial News Network (predecessor to CNBC) said that the network will have

> . . . an industry-tailored newswire [sic], using news staff and vertical publications. As technology develops this will be another alternative in which people will get information (18).

The video program is compressed and decompressed using a $1,400 computer card, called Digital Video Interactive, from Intel Corporation. It plays back at 30 frames per second. A slower version will also be available. Corporate customers can review the latest news on demand, backed up with related text from industry magazines. The typical feed would last no longer than two minutes and would be continuously updated (19).

Finally, new VSAT technologies are lowering the cost of using satellites for smaller groups of radio stations. While program distribution via satellite has been around for a number of years the high recurring monthly satellite fees have precluded their use by small users. New digital audio techniques have now lowered the cost of sending high-quality digital programming across the U.S. to about $1,200 to $2,500 per month in the Ku-band (20).

4.4 DIGITAL SYSTEMS: BLURRING THE LINES BETWEEN TYPES OF SERVICES

As the world moves from analog to digital information systems, the line between types of services begins to blur considerably. What distinguishes "AM" digital radio from "FM" digital radio? What's the difference between receiving news programming on a computer or a high-definition TV set? and What's the difference between conducting a videoconference over a fiber optic network or linking up several Wide Area Networks using B-ISDN (Broadband Integrated Services Digital Network)?

The answer, of course, is that there is really little difference among these applications--all of their information is contained in digital packets. Bandwidth and propagation (or latency) vary depending on the amount of information sent, but most of these technical problems have been solved or nearly so. The nagging question that remains, then, is Why can't these various systems be integrated into a national or international network capable of disseminating all types of information almost instantaneously? The answer to this question depends less on technology than on corporate decisions to pursue these areas of development. The following examples will show how political and economic factors are retarding the development and deployment of digital radio.

5. TELECOMMUNICATIONS POLICIES AND DIGITAL RADIO

The people responsible for shaping telecommunications policy are members of one or more of the following groups: standards organizations, lobbying organizations, the various branches of government (in the case of the United States these branches are the Judicial, Executive, and Legislative--including Congressional committees and subcommittees, regulatory agencies, and the Department of Defense), domestic and foreign manufacturers and distributors, and consumers. Because each of these groups has its own agenda, conflicts arise when trying to develop standards based on reaching a consensus among the various factions. These conflicts are especially apparent in the case of digital radio.

5.1 IN-BAND OR OUT-OF-BAND DIGITAL RADIO

The biggest issue facing proponents of digital audio broadcasting is whether or not the service should be offered within the existing FM band. This issue was addressed at the Inter-American Committee on Telecommunications (CITEL) meeting held in Mexico City in mid-August of 1992. Members were split, with the Mexican and Canadian delegations opting for an out-of-band service similar to the European Eureka 147 DAB system while the U.S. was pushing for an in-band system similar to "Project Acorn" funded by CBS, Group W and Gannett Broadcasting.

While the Mexican and Canadian representatives were strongly in favor of L-band development, they eventually agreed to form an *ad hoc* CITEL working group on DAB to address the concerns raised by Voice of America and National Association of Broadcasters (NAB) delegates, who felt that nations committed to L-band DAB should not try to "short-circuit the development of in-band [DAB] in the Western Hemisphere" (21)

Michael Tremblay, executive vice president of the Canadian Association of Broadcasters replied that "any criticism of in-band is based on scientific evidence" (22). He also said that "the USA Digital Radio Consortium has done some very good work on in-band, but that it will not provide the capability of Eureka because of the spectrum constraints" (23).

The possibility for telemetry conflicts between Canada and the U.S. is another potential problem. The L-band is used for military telemetry and testing in the United States, while Canada uses the S-band. The S-band issue also raises concerns among current users of the spectrum in the U.S. and is presently being addressed by the Federal Communications Commission (FCC).

5.2 REGULATORS AND NEW TECHNOLOGIES: FORWARD INTO THE PAST

Defining and then regulating new technologies is one of the greatest challenges facing most countries having a mature telecommunications infrastructure. In the case of the U.S., long-term planning decisions and policy-making is further hampered by a set of laws originally formulated in 1934. As a result, most policy-making becomes reactionary in the sense that rules and regulations address problems based on past experiences and situations. While this approach may make excellent legal sense, it generally stifles creative solutions to problems and opens up the entire regulatory process to aggressive (and usually) successful lobbying by powerful groups interested in maintaining the status quo.

The United States is not the only country whose telecommunications philosophy is shaped in this way, however. Although the specific political structures of policy formation differ from country to country, many of the same arguments can be heard from politicians, manufacturers, and providers wherever they are located in the world. In the 1980s "privatization" and "deregulation" were touted as the saviors of national economies and industries. While the trend continues worldwide, in the United States (where deregulation had its roots) there seems to be a shift toward re-regulating some communications industries, driven by a demand from consumers for more accountability in some services such as cable TV. This clash of philosophies can be seen in the way regulatory agencies are handling the digital audio broadcast situation.

5.2.1 DIGITAL RADIO AND THE FCC

The FCC has approved a Notice of Proposed Rulemaking (NPRM) on digital audio broadcasting, giving satellite-based technology a portion of the S-band. Under the NPRM, the FCC would reallocate the 2310-2360 MHz portion of the spectrum to satellite digital audio services while current users of the spectrum (mobile and radiolocation services) would be reaccommodated at the upper end of the S-band (2360-2390 MHz). Meanwhile, these services would be allowed to operate in their present location until January 1, 1997.

The FCC also approved a Further Notice of Inquiry (FNOI) pertaining to terrestrial DAB systems, acknowledging what it termed "widespread interest" in terrestrial DAB, especially in-band technology (24).

In discussing the NPRM, Dr. Thomas Stanley, chief of the Office of Engineering and Technology, suggested that satellite DAB might be implemented "toward the end of the 1990s," while a "truly successful" terrestrial system may not be in place until after the year 2000 (25). These statements by Stanley raised a number of questions at the FCC.

Commissioner James Quello asked Stanley about the effect of proposing S-band for U.S. DAB when both Mexico and Canada seem intent on using L-band. Stanley replied that "the U.S. will participate in coordination efforts with [those] countries," noting the possibility of "power and coverage tradeoffs" (26).

Commissioner Ervin Duggan then asked Stanley whether the action undertaken in the NPRM would be a threat to localism, and how the concept could be preserved in the face of satellite-based DAB implementation. Stanley's response was the "the issue raises a question of relative values--that is, localism versus quality" (27).

5.2.2 A EUROPEAN FCC AND EC SATELLITE REGULATION

A single European telecommunications service license is being proposed by the Commission of the European Communities. If approved, this license would permit companies to avoid licensing procedures in each country within the EC, thus cutting down on paperwork and expenses.

The proposal would also create a pan-European regulatory body which would wield a substantial amount of direct regulatory authority over telecommunications providers at the expense of national authorities (28). While the proposal does not currently apply to satellite services, it does set up a structure that officials say will be modified in the future to accommodate satellite licensing. The EC Commission argues that current satellite regulations in Europe were created decades ago and fail to deal with rapidly advancing technologies (29).

According to Gerald E. Oberst, Jr. (30):

> The intent . . . is to permit single licenses to extend into other European countries represented in the European Conference of Postal and Telecommunications Administrations (CEPT). Thus, this proposal could affect licensing conditions for a total population area of over 350 million customers. . . .
>
> To assist in the administration of the system, the Commission proposes to establish a Community Telecommunications Committee (CTC), composed of representatives of national telecom regulatory agencies from all EC countries. . . . In fact, the Commission would obtain a new and significant level of regulatory power under the current proposals (31).

The new structure does not address satellite services, because the Commission believes that satellite licensing requires consideration of frequency coordination, access to space segment and interconnection with the public networks (32).

While this proposal should simplify licensing procedures, it also will be a test of power among the various EC governments and the powerful PTTs and those agencies who control European and international telecommunications satellites.

5.3 LOBBYISTS, MANUFACTURERS AND DISTRIBUTORS

While issues concerning cross-border interference and localism versus quality are being addressed by various government agencies, technical standards, patents and copyrights are currently stalling the implementation of DAB in the United States.

For example, the RBDS standard was originally expected to be approved by the April 1992 NAB convention, but it became stalled when the NAB threatened to pull its support. The NAB's RBDS committee felt that the standard was being driven by receiver manufacturers, represented by the Electronics Industry Association (EIA), and argued that it offered no benefit to AM stations.

Even after the two groups compromised by working ID Logic B for AM into the standard, NAB Manager for Technical Regulatory Affairs, John Marino, said that there was broadcaster resistance to the FM format scanning feature. According to Marino:

> A lot of broadcasters just don't want format scanning at all. They feel that their station may actually be missed in any format scanning [by listeners] (33).

One of the problems with the scanning feature is that only 10 specific categories of programming are identified, and many stations have said that they don't want to be rigidly categorized in one format. For instance, there are several variations of the country format, but only one country format code is presently available; thus, all types of country stations would be lumped together and selected during listener scanning.

On the other hand, proponents argue that the proposed standard already has 21 PTY formal codes with two spare codes, and as formal scanning is a primary feature of the system, they believe that without it most consumers would not buy the receivers (34).

Meanwhile, the EIA is setting up a testing facility to select a DAB standard. The organization is supposed to test all systems that are received for evaluation by April of 1993 and select one of them by the end of 1993. However, the NAB and other critics of this plan argue that the committee overseeing the testing does not involve broadcasters to the same degree as others. In fact, the proposed voting bloc gives broadcasters two votes, the receiver industry four and one vote each for satellite interests, software manufacturers, broadcast equipment manufacturers, radio networks, the semiconductor industry, and the computer industry. However, the EIA said that the subcommittee will recommend a standard only by consensus, and the voting bloc only comes into play when the standard is sent to the FCC (35).

On another front, DAB is being assailed by the Recording Industry Association of America (RIAA). This organization is urging the FCC to take a cautious approach to satellite digital audio broadcasting.

Citing the FCC's acceptance of Satellite CD Radio's application to have a satellite DAB service up and running by 1996, the RIAA told the FCC that

> . . . without adequate protection, these digital audio broadcasting services could have a devastating impact on the recording industry, and ultimately on the listening public as well.
>
> For example, unless subject to certain controls, a digital radio service could transmit with CD quality an entire album of a popular artist, such as R.E.M.'s new hit album 'Automatic for the People,' on the day of its release, thereby making it available to millions of R.E.M. fans throughout the country.
>
> One can readily see how this capability could virtually wipe out the economic incentives now afforded to record creators to produce new recordings by eliminating the market for the sale of prerecorded music--the only existing means for providing compensation to the record producers and the artists whose performances are fixed on the recording (36).

The RIAA went on to recommend that the FCC "fully protect the copyright interests" of the music industry and to limit satellite radio DAB transmissions to "an individual selection from a particular album during a limited time period" (37).

In its filing at the FCC the RIAA renewed its request for performance-rights royalties for performing artists, a request that the organization has made on several occasions during the last ten years, but which has never gained much support in Congress. The concept calls for broadcasters to pay royalties to the music industry for their use of prerecorded music beyond the licensing fees they pay each year to ASCAP and BMI (38).

5.4 STANDARDS ORGANIZATIONS

Although professional societies such as the Institute of Electrical and Electronic Engineers (IEEE) and the Society of Motion Picture and Television Engineers (SMPTE) develop many of the manufacturing standards used in the U.S. telecommunications industry, the coordination of these standards is carried out by the American National Standards Institute (ANSI). While ANSI licenses manufacturers whose products conform to its standards, their guidelines are still only recommendations. In fact, they do not enjoy the same status as government regulations. Manufacturers are free to develop their own "standards" and often do. Examples of "selective standardization" include VHS and Beta videocassette machines and IBM-type and Apple personal computers.

Relying on voluntary cooperation and the marketplace to determine "standards" produces customer confusion. Consumers become wary of buying expensive products which may quickly become obsolete. Manufacturers hesitate to invest heavily in research and development, and many financial institutions and investors are unwilling to lend capital for low-return, high-risk ventures.

One example is AM-stereo radio. After choosing a standard, the FCC reversed itself and opted to let the marketplace select the standard. Now, the FCC has decided to re-open the matter and, perhaps, choose a system after all, having decided that the marketplace approach was actually hindering the implementation of the service. DAB also faces many of the same hurdles that caused AM-stereo to stumble.

Bob Finger, Vice Chairman of the AES's standards subcommittee, says that

> [The] problems in developing a standard [are that] the standards process is a "voluntary activity," and that "geographic" problems make regular communications difficult. More importantly the AES is not a compliance organization. Therefore, it is up to the manufacturers to "police themselves" (39).

As a result, the digital interface standard being proposed by the AES actually has two parts: the electrical portion and the channel status portion. But there are levels in the implementation of the interface, divided along professional and consumer lines. So the AES set up "minimum," "standard," and "enhanced" criteria for implementation (40).

5.5 FOREIGN ORGANIZATIONS

The Mexican broadcasters association, Camora Nacional de la Industria de Radio y Television (CIRT), is negotiating to join the Eureka 147 digital audio broadcasting consortium and is moving ahead with plans to begin testing and introducing digital radio to Mexico by 1998. The Mexicans are coordinating test scheduling with the Canadians, the most active proponents of the Eureka system at L-band outside of Europe. Canada has conducted tests since 1990.

This action establishes Mexico as a digital radio broadcasting leader among nations that it is connected with culturally, such as those in Central and South America, because of commitments it made to these countries to help them develop digital radio as part of the World Administrative Radio Conference (WARC) in 1992.

A key aspect of the CIRT plan is extensive lobbying of the United States. A spokesperson for the group said:

> We will insist in our lobbying efforts with NAB, that it change its current position [support of S-band for satellite and possible implementation of in-band for terrestrial] and assist them [the U.S.] in obtaining the spectrum and the assignment to the broadcasters in their country (41).

Australia is another country that many believe will soon commit itself to digital audio broadcasting. The earliest starting date for DAB in Australia seems likely to be between 1995 and 1996 for experimental broadcasts with simulcasts until 2010 and digital broadcasts by 2015 (42). (This is approximately the same time frame proposed by the U.S. Congress to have a nationwide, advanced, interactive, interoperable, broadband telecommunications infrastructure in place.) (43)

Australian officials believe that having a single transmission standard (L-band) will lower the cost of receivers by simplifying their construction, thus making them more appealing to consumers. Receiver costs were cited as being the principal reason for AM-stereo's failure in Australia as consumers were not willing to purchase a receiver to listen to a service they could already receive with analog and digital simulcasts. The same problem could occur again with DAB.

Another possible problem that may retard the growth of DAB in Australia, particularly satellite DAB, is the economy. Although there seems to be a great deal of enthusiasm for DAB among members of the Federation of Australian Radio Broadcasters (FARB), many radio stations are operating at a loss, and the nation is still in the grip of recession. Therefore, the prospect of investing heavily to keep pace with technological change is not an attractive proposition for everyone (44).

5.6 CONSUMERS

The success of any advanced digital information system: radio, television, data--whatever, eventually depends on consumer acceptance. Determining what consumers need versus what they want is critical in any venture, especially during periods of economic recession, when consumers spend less for "wants" and concentrate more on their actual "needs". An editorial in Communications Week aptly sums up this philosophy of purchasing in the case of high-data-rate services:

> Users want fast data services, but don't want them immediately. Or they want them immediately, but don't want to pay dearly for them. . . . Switched multimegabit data services are becoming available, but we don't hear a mad rush of users asking to get them. And analysts say that sales of switched data services that operate at 384 kilobits per second or above are sluggish.
>
> The pattern is not new. ISDN services are speedier than regular phone lines for PC communications and facsimile transmissions, yet ISDN has not sold well. And 45-megabit-per-second services are widely available from interexchange carriers, but they are not widely used (45).

5.7 COMPETITION

In effect, competition is a two-edged sword. It is responsible for providing consumers with a variety of new and better services. But it has also prevented their full implementation, because it has forced providers to cut their basic offerings. Faced with a stagnant economy, most users have opted for slower, but cheaper services. In addition, because many new technologies are only now being introduced at the consumer level, most purchasers are waiting to see the industry shake itself out--to see what "standards" survive and what "bugs" are in the systems.

For example, just when everyone thought ISDN was going to get off the ground with the NI-1 specifications defined by Bell Communications Research and endorsed by all the Bell companies in February 1991, ISDN users were surprised to hear that Southwestern Bell and US West do not plan to install NI-1 software (46).

On another front, HDTV seemed ready to enter the consumer market. Then, new digital systems supplanted the analog systems originally under consideration for testing in the U.S. Japan soon followed suit, and NTT has been promoting R&D for a Super HDTV (SHD) that will have a resolution of 1,125 scanning lines, approximately twice that of the current Hi-Vision system (47). In Europe a new digital HDTV system has also been proposed. The standard, known as HD-DIVINE (Digital Video Narrowband Emission), was supported by James C. McKinney, chairman of the U.S. Advanced Television Systems Committee, who chastised the European Commission for its pursuit of the enhanced TV system D-2 MAC as a stepping stone to analog HD-MAC. McKinney argued that "to withhold HDTV from the public simply to sell them first an enhanced television receiver is a matter of unconscionable greed on the part of the equipment manufacturers" (48).

6. DEVELOPING THE TELECOMMUNICATIONS INFRASTRUCTURES OF THE FUTURE: SUMMARY AND CONCLUSIONS

While this paper has concentrated on recent developments in digital audio broadcasting as a reference point for discussing emerging information delivery systems, it is obvious that many of the same problems are confronting those who wish to implement any of the new technologies: radio, ISDN, HDTV, LANs, WANs, or satellites.

Having examined such areas as governmental policy-making, lobbying groups, standards organizations, foreign competition, and economic constraints, one can begin to see certain commonalities among nations and groups that continually effect the deployment of new technologies.

6.1 PAST APPROACHES

Any country with a mature telecommunications infrastructure is hampered by the preconceived notion that existing technologies must be protected. This is true in the area of software development as well.

Furthermore, most industries and associations representing those industries lobby for unrestrained trade and competition--until they find themselves being undercut by competitors. This philosophy also carries over to the area of R&D. Many firms actively seek out public funds for research, yet decry public control of the infrastructure as overburdensome and anticompetitive.

Most regulatory agencies try to formulate rules governing new technologies based on past practices and reactive rule-making procedures. In the U.S. the FCC still categorizes technological systems by application (cable, telephone, television--broadcast or common carrier) even though most technologies, and certainly digital technologies, make these distinctions irrelevant.

Finally, a global capitalist economic system generates a number of forces which can no longer be controlled at a national level. Protective tariffs, unique "standards," and subsidization of certain businesses to protect a state's dominance no longer work in a world in which multinational corporations are linked by instantaneous communications. Recent events in Eastern Europe have shown the fallacy in this line of reasoning.

6.2 THE UTOPIAN FUTURE

Returning to the issues raised by Robert Reich in the beginning of this paper, nations wishing to remain competitive must develop better ways to develop problem-identifying, problem-solving workers and better ways of linking them together. These goals can only be achieved by selecting the right combination of technologies for a given situation.

6.2.1 AVAILABLE TECHNOLOGIES

Today, the principal forms of delivering information around the world include twisted-pair copper wires, fiber optics, terrestrial broadcasting and two-way radios (including cellular and "Sky" phones), coaxial cable and satellites. All of these technologies can handle some amount and some form of digital information.

After information is turned into a digital format, we can no longer tell whether the information is radio, TV, supercomputer data or anything else. Therefore, the ideal approach would be to allocate the various parts of the electromagnetic spectrum based on transmission efficiency, rather than on pre-existing sub-bands.

Once the spectrum is assigned using these criteria, nations could then develop an infrastructure based on community needs. For example, remote areas may need satellite coverage, whereas cities could be served by fiber. Low-data rate users could benefit from packet radio and low-cost receivers. Only by reevaluating the services provided to consumers based on actual needs, rather than on overly optimistic "wants" (as defined by overenthusiastic marketing departments) can a state or nation develop a truly workable telecommunications infrastructure.

6.3 REALITY CHECK

The utopian vision of developing a working telecommunications infrastructure is just that--utopian. In reality established services will continue to lobby for protection, and government officials will continue to regulate the industry based on preconceived and past practices. Nevertheless, certain actions can be taken now to improve the overall situation.

First, everyone must recognize that no one telecommunications infrastructure will work in all cases. Cultural considerations and needs ultimately decide what a society will or will not accept, advertising and marketing executives' beliefs to the contrary.

Second, governing bodies must realize that the shift from analog to digital information delivery systems is giving us the opportunity to view information applications from a new perspective. We can use this opportunity to break away from our rigid approaches to spectrum planning.

If we can accomplish this feat, we can then explore ways in which to integrate various digital technologies into seamless telecommunications infrastructures. Our goal is to organize the market in such a way that it will motivate the problem solvers or "symbolic analysts" (49) to discover new ways of helping society while inflicting the least amount of harm on our global environment.

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Converging Telecommunications Technologies and Business Efficiency

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1. ABSTRACT

The role of telecommunications in improving business efficiency is reviewed. Two examples: automatic call screening and audio conferencing, are explored through a typical business scenario. The impact of several new telecommunications business capabilities resulting from converging technologies is then explored. New capabilities discussed include store and forward facsimile, voice annotated facsimile, dial-up video conferencing and video mail.

2. INTRODUCTION

During the past decade, it has been widely recognized that a strong telecommunications infrastructure is essential to economic development. Major investments are currently being made in developing and expanding telecommunications throughout the Asia/Pacific region, and in many other parts of the world. This investment is a response to the need for better people to people communication - particularly in business.

The role of personal relationships is important in business everywhere, but it can be argued that this is the single most important element of conducting business in Asia. The role of telecommunications in building and maintaining these relationships has continually increased in importance over the years.

Initially, the telephone was a poor substitute for a face to face meeting. Calls were difficult to set up. Quality was often poor. And the service was expensive. The introduction of modern equipment with such capabilities as stored program control and digital communications, has drastically improved communications both within Asia and between Asia and other regions.

As these improvements have taken place, the telephone call has changed from a poor second choice for holding a meeting, to an indispensable tool for conducting business in Asia/Pacific. One indicator is the wide spread of wireless personal communications. In major Asian cities today, more than in any other part of the world, one encounters large numbers of people using portable handheld wireless terminals. The traffic jams of some Asian cities are legendary, and these tools have already become essential to maintaining contact, and building and maintaining the relationships on which Asian business depends.

The basic telephone call provides a major improvement to business efficiency by itself. It would be literally impossible to meet face to face with the number of people one talks with in a typical business day. But this is only the beginning of the business efficiencies which come from modern telecommunications systems. Many such improvements were introduced first in the advanced private telecommunication systems installed in large corporations. As these capabilities spread into the public networks, and become available more widely to all sectors of business, the effectiveness of Asian business will increase. Beyond this, new features and capabilities from converging telecommunication technologies will provide even further economic stimulus through further improvements in business efficiency and effectiveness. It is some of these new features and capabilities which are the focus of this paper.

3. BUSINESS EFFICIENCY SCENARIO

Two examples of business applications implemented first on advanced private business communications systems include automatic call screening and conference calling. As with most telecommunications improvements these applications are concerned with more efficient use of time and people.

3.1 Automatic Call Screening

Call screening allows an individual to specify how incoming calls are to be handled, based on the identity of the calling party. For example, an individual may be working against a tight deadline to prepare a bid. Only calls from departments concerned with the bid preparation are to be accepted. In addition, of course, calls from the boss will be accepted. The departments from which calls will be accepted, and the identity of the boss are entered into the system. These calls will "ring" on the individual's desk, with a special ringing pattern to identify them. All other calls will be forwarded to the individual's voice mail system. This allows the individual to concentrate on the task at hand, without interruption, except for calls which are needed to complete the immediate task.

During one of the calls, an issue is raised which requires resolution among several departments, before the final bid can be prepared. The individual immediately places a conference call to four key people in several different cities and the issue is resolved in about an hour.

3.2 Audio Conference Calling

Conference calling is also concerned with time and people. Setting up a face to face meeting among the people involved in the conference call would require both time and expense for travel. And the deadline for submitting the bid could be missed, because of scheduling conflicts. Conference calls don't eliminate scheduling conflicts, but they reduce them, because the time required is typically reduced to one to two hours, instead of the one to two days typically required for travel to and from a face to face meeting.

4. IMPACT OF CONVERGING TECHNOLOGIES

4.1 Convergence Of Voice And Fax With Store And Forward Technology

It is quite likely that some facsimile communications would also be used in the process of preparing the bid. Following the explosive growth of the last decade, it is hard to imagine conducting business in Asia/Pacific today without fax. Ease of use, reliability and low cost are a few of the reasons facsimile communication has exploded globally. The fact that any language can make use of facsimile, regardless of the writing system, has been particularly important in Asia/Pacific. Closely related is the fact that voice telephony is independent of language. Bringing voice and fax technologies together, and combining them with store and forward technology will provide a powerful extension to an already powerful communications tool.

Store and Forward Facsimile

Store and forward technology, facsimile technology and voice technology are converging, and the result will be a strong positive impact on business productivity and efficiency. This convergence will improve people to people communications. Continuing improvements in memory size together with continuing reductions in cost will make it feasible to combine digital voice annotations with digitally stored facsimile documents.The concept is shown in Figure 1.

STORE & FORWARD FACSIMILE CONCEPT

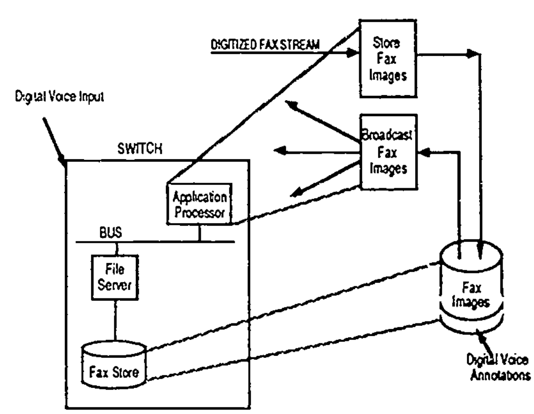


Figure 1

It could be argued that facsimile is basically a "store and forward" mechanism. The message is stored on paper, then transmitted to the receiver, where it is "stored" on another piece of paper. So there is a natural synergy with the advances of the past decade in store and forward voice mail and text messaging.

Voice Annotated Facsimile

A basic capability of message store and forward systems which will enhance facsimile is the ability to forward a stored fax message to another person, with or without annotations. The annotations may be text. But, further integration of store and forward facsimile with voice mail systems will give senders and recipients the capability to add voice instructions or comments before sending or forwarding the fax.

No matter how good the writer's writing skills, more complete comments and directions can be given with voice. The user interface can be as simple as any telephone set with a DTMF interface. Using a combination of keys, the recipient of the fax can begin recording, pause, edit, etc. - all the same capabilities typically available with a tape recorder or dictation unit.

This need not require special facsimile equipment. All modern voice communication systems send and receive digital bit streams. Bit streams which contain the carrier plus the fax information can be captured and held in memory associated with a PBX or a Central Office switch, and then transmitted to a facsimile unit or a CRT screen at a later time, under user control.

Additional Efficiencies From Store And Forward Fax

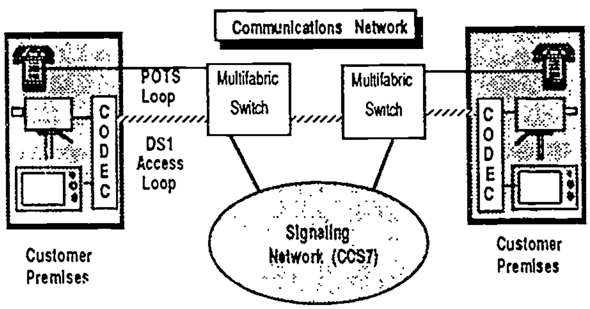
Several capabilities associated with voice mail systems today, will make store and forward facsimile more effective than standard fax. A simple example is the capability to turn on a "message waiting lamp" on the recipient's telephone set. Facsimile equipment is typically located in a special room which may not be attended. The individual expecting an urgent message by fax can waste time going back and forth between office and fax room. A message waiting lamp on the telephone set to alert the recipient that a facsimile has arrived, will eliminate this inefficiency. Yet another capability likely to be added to facsimile store and forward systems is integration with a paging system to notify a recipient of the arrival of an urgent facsimile message.

One of the most valuable features of a voice mail system today is its ubiquity. A user can access his voice mail and receive messages anywhere there is a phone. Store and forward fax has a similar capability. The user can access the facsimile messages by dialing in from any fax terminal. Fax terminals are already common in airports and fax interfaces have become common in portable personal computers. These tools become even more powerful when used in conjunction with a fax store and forward system. It is not difficult to imagine a fax pay phone in many locations in the future, when fax store and forward systems become widespread. This effectively provides the ability to route a fax to wherever the recipient is located, even if he is moving among several locations.

4.2 Evolution of Business Video Conferencing

Many different communications technologies have converged to make business video conferencing a reality. Video communication is the most recent advance available to the general user. Reasonably good quality dial-up video , using two 64 kb/s circuits, is emerging globally, using the technology shown in Figure 2.

DIALABLE WIDEBAND SERVICES



- End User Dialable (DTMF or ISDN Signalling)
- Logical Association of POTS Loop or ISDN D Channel with Video DS-1 Access Loop
- Access and Interoffice Connection Options:
  - Sub DS-1 • DS-1 • DS-1- Multiple

Figure 2

The cost is affordable to all the nations of Asia/Pacific and the impact is dramatic.

This relatively low bandwidth video does for real time communications what facsimile does for store and forward communications. The video camera allows individuals at multiple locations to communicate images, drawings, and text, in real time conferences, and to discuss what is displayed. Dial-up video conferencing, combining real time images with real time voice, is both independent of the character sets of the languages being used and works equally well for all languages.

Video conferencing has begun to be widely used for conferences involving people distributed around Asia/Pacific in the authors' organization. The vast distances in the region make video conferencing a particularly effective tool. Video conference rooms at our corporate locations in Sydney, Singapore, Hong Kong and Tokyo are in heavy use both for conferences only involving people within Asia/Pacific, as well as for meetings involving people in our European and North American locations.

Video Mail

In the relatively near future, video cameras and scanning devices will be available on the desk top, so that people will not even have to go to a specially equipped room to have a video conference meeting. As this occurs, and as the technology continues to evolve, video mail will emerge as a natural convergence of the fax mail and video technologies. This will allow a sender to send documents containing live video annotations and voice annotations. This will be the pinnacle of multi-media communications.

5. CONCLUSION

These are only a few examples of the ways in which converging technologies will greatly expand the impact of telecommunications. The capabilities discussed will be implemented as extensions to the capabilities of telecommunications switching equipment (both central office switches and PBXs). Some additional equipment will be required, such as video cameras, video codecs, and additional memory to store the digital voice and facsimile images. But, the cost will be minimized by exploiting synergies with existing telecommunications equipment capabilities. The additional equipment required may reside either in the public telephone network or on the premises of businesses.

It is these kinds of capabilities which will make Asia/Pacific business both more effective and more efficient in serving domestic needs, and in competing in the global economy of the 90's.

The Telcos Move Toward A Global Market: Economic And Cultural Implications for the Pacific Island Nations

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This study examines the changing nature of U.S. telcos from an economic and regulatory perspective and identifies problems and possibilities with their potential application in the Pacific Island Nations. The study places a significant emphasis on the transfer and application of a telco's video distribution capabilities.

Multiplicity of cultures and an array of political systems make the Pacific Island Nations (PINs) one of the most diverse regions in the world. However, the PINs do share a common challenge: the development of a communications infrastructure.

Fundamental economic, political and social problems have forced most PINs to approach the communications infrastructure challenge from a development perspective. As a result, the development of a communications infrastructure is tied to political, social, economic and educational development.

A possible communications model for PINs may be the telco. Telcos in the United States (U.S.) have the capability to distribute video, voice, and data. However, the transfer of technology is a complex process that is dependent upon needs, resources, technical skills and political and economic factors that influence the development and transfer of the technology.

U.S. telcos may provide a communications model that is useful to PINs. However, the evaluation of a telco model must take into account movement into a global market and the economic, political and regulatory factors that are driving this movement.

This study examines the changing nature of U.S. telcos from an economic and regulatory perspective and identifies problems and possibilities with their potential application in the PINs. The study places a significant emphasis on the transfer and application of a telco's video distribution capabilities.

TELCO'S IN THE UNITED STATES

The Regional Holding Companies (RHC's) continue to examine domestic opportunities while actively pursuing ventures and operations outside of the U.S.. The RHC's are pursuing international agendas by owning cable operations or pay-television services.

NYNEX has been providing cable television services to customers in the United Kingdom (U.K.) since 1991. The company plans to integrate telephone services with cable networks (1).

In 1988, Pacific Telesis and Jones Intercable Incorporated acquired a principal interest in East London Telecommunications Ltd., a cable and telephone company (2). Since that acquisition, Pacific Telesis has increased its cable holdings to fourteen franchise areas (3).

Southwestern Bell has an equity position in the Oyston Cable Communications Group. The company provides financial and marketing expertise to Oyston's cable systems in England. Day-to-day operations are handled by a management team hired by the Oyston Group. In a second venture, Southwestern Bell and Golden Channels Ltd. hold franchise areas in Israel (4).

In 1988, U.S. West acquired a ten percent interest in a French cable company, Lyonnaise Communications. Since that acquisition the company has acquired an interest in cable operations in the U.K., Hungary, Sweden and Norway. The systems in the U.K. integrate phone and video services (5). U.S. West did suffer one notable setback when it withdrew from a cable operation in Hong Kong.

Ameritech, Bell Atlantic, Time Warner and Tele-Communications Incorporated have acquired a fifty-one percent interest in Sky Network Television, a New Zealand pay-television service. The service uses three UHF channels to provide news, movies and sports programming to approximately 50,000 customers (6).

By acquiring interest in pay-television services, such as Sky Network Television, or cable systems the telcos are moving toward a global market. The primary forces pushing the telcos across the globe are the perceived hopes and promises of a global market and an unstable regulatory environment in the United States.

HOPES AND PROMISES OF A GLOBAL MARKET

The telcos are changing. They have implemented corporate diversification strategies that have resulted in the ownership of cable systems in Europe, fiber optic cable consortiums, cellular networks and interest in foreign telephone operations. In essence, the telcos are positioning themselves to be dominant communications organizations in a global market that has high speed, high quality communication systems that will provide numerous services into homes and businesses.

In relation to video, international holdings and operations provide an opportunity for telcos to conduct experiments and field tests, integrate communications services, bypass ownership barriers that exist in the U.S., gain valuable experience about cable systems and operations and prepare for future ownership and operation of systems in the U.S..

UNSTABLE REGULATORY ENVIRONMENT-LEGISLATIVE BACKGROUND (7)

Divestiture of AT&T

On November 24, 1974, the U.S. Department of Justice filed suit against AT&T for antitrust violations (8). The suit alleged that AT&T monopolized long-distance services, the market for customer premises terminal equipment, and the market for telecommunications equipment (9). The trial began January 15, 1981, with U.S. District Court Judge Harold Greene at the bench. The Justice Department's presentation of evidence began on March 4, 1981 (10). AT&T's presentation of evidence began on August 3, 1981 (11). On January 8, 1982, AT&T and the Justice Department announced a negotiated consent decree that required AT&T to divest its Bell Operating Companies (BOC's) (12). The settlement, commonly identified as "Modified Final Judgment" (MFJ), was approved by Judge Greene on August 24, 1982, after several modifications (13). In December of 1982, AT&T submitted a reorganization plan to Judge Greene, which he approved on August 5, 1983. The Supreme Court upheld the reorganization plan or December 5, 1983 (14).

The MFJ transferred ownership of the twenty-two BOC's from AT&T to seven RHC's and placed business restrictions on AT&T and the RHC's. These restrictions prohibited the RHC's from providing long distance services, manufacturing certain types of equipment, and owning information services distributed through phone systems. The MFJ did not specifically identify cable television as an information service. However, most industry observers assumed that cable television was a restricted information service (15).

In September of 1987, Judge Greene, who has the responsibility of over-seeing the MFJ, ruled that the RHC's could transmit information services. However, Judge Greene refused to lift restrictions that prohibited the RHC's from providing content or having a financial interest in the content (16). On March 7, 1988, Judge Greene issued an order that permitted the RHC's to establish telephone-computer systems that connect an information provider and user together. Also, Judge Greene allowed the RHC's to distribute a limited number of electronic messaging services, such as electronic mail and voice storage and retrieval services (17). These rulings by Judge Greene allowed the RHC's to provide the infrastructure for information services and reinforced ownership and content restrictions contained in the MFJ.

In April of 1989, AT&T submitted a request to Judge Greene for entry into electronic publishing. The request, which asked for the termination of a seven-year ban in the MFJ, was approved by the Judge and became effective on August 24, 1989 (18). The RHC's, which received no relief in this ruling, wrapped themselves in the First Amendment and moved to the U.S. Court of Appeals in Washington.

On December 6, 1989, the RHC's appeared before the court and presented a case that promoted freedom of speech over telephone lines (19). In April of 1990, the court ruled that Judge Greene had been using the wrong standard to prohibit the RHC's from providing information services, such as cable television and electronic yellow pages (20). This ruling, which asked Judge Greene to reconsider his rulings pertaining to information services, did not remove the ban. On August 17, 1990, the RHC's filed a response requesting the removal of the information services ban (21).

On July 25, 1991, Judge Greene lifted the information services restriction. However, the Judge "stayed" his decision until an appellate review was completed (22). The U.S. Court of Appeals reached a decision within a matter of months. On October 7, 1991, the Court ruled that Judge Greene did not have grounds to delay the removal of the information services restriction (23). As a result, the RHC's entered the information services business.

Telco-Cable Cross-Ownership Rules

In 1970 the Federal Communications Commission (FCC) adopted a cross-ownership rule that prohibited telephone companies from operating cable television systems. Telephone companies that were operating cable systems at the time were forced to sell the cable operations. However, there was one exception to this rule: the FCC allowed telephone companies, which were operating cable systems in rural communities that had a low density factor of homes per mile, to request a waiver of the rule (24). In 1981, the FCC adopted a general waiver of the cross-ownership rule for rural telephone-cable operations that met two requirements. First, the rural population that could gain access to the cable system had to be 2,500 or less. Second, the telephone company would have to be the only company interested in providing cable service to the community (25).

The 1970 cross-ownership rule and the 1981 waiver were codified by Congress when it passed the Cable Communications Policy Act of 1984. This legislation, which was incorporated into the Communications Act of 1934 as Title VI, codified the cross-ownership rule by prohibiting telephone companies from providing cable television service in their telephone service area and from having an ownership interest in a cable system that uses the resources of the telephone company to distribute its service. The Act states:

> (b)(1) It shall be unlawful for any common carrier subject in whole or in part to title II of this Act, to provide video programming directly to subscribers in its telephone service area, either directly or indirectly through an affiliate owned by, operated by, controlled by, or under common control with the common carrier.
> (2) It shall be unlawful for any common carrier, subject in whole or in part to title II of this Act, to provide channels of communications or pole line conduit space, or other rental arrangements, to any entity which is directly or indirectly owned by, operated by, controlled by, or under common control with such common carrier, if such facilities or arrangements are to be used for, or in connection with, the provision of video programming directly to subscribers in the telephone service area of the common carrier. (26)

The Cable Communications Policy Act of 1984 codified the 1981 waiver by providing an exemption for rural communities.

> (3) This subsection shall not apply to any common carrier to the extent such carrier provides telephone exchange service in any rural area (as defined by the Commission).
> (4) In those areas where the provision of video programming directly to subscribers through a cable system owned by, operated by, controlled by, or affiliated with the common carrier involved, or upon other showing of good cause, the Commission may, on petition for waiver, waive the applicability of paragraphs (1) and (2) of this subsection. (27)

Video Dial Tone Rules

In October of 1991, the FCC initiated an inquiry about its video dial tone proposal. Under the proposal, telcos could transport video for cable networks and other video program providers on a common carrier basis. Telcos, operating as common carriers, would have to provide services on a first come, first serve basis, while having no control or ownership over programming content (28).

As part of the inquiry, the FCC asked for comments about telco ownership restrictions. Should telcos be able to own a percentage of video programming? Should telcos providing video dial tone service be allowed to own a percentage of the programming distributed through the service?

In July of 1992, the FCC adopted video dial tone rules that were similar to the original proposal. These rules allow telcos to transmit video programming provided by cable networks or other program providers without obtaining a municipal cable franchise. In addition, telcos can own as much as a five percent equity in programming services they carry (29).

UNSTABLE REGULATORY ENVIRONMENT-CURRENT CONDITIONS

At the present time telephone companies are allowed to compete in the cable television business by distributing programming in a common carrier capacity. However, the regulatory environment for telco participation in cable is anything but stable. The RHC's, Judge Greene, Congress, the FCC, the National Association of Broadcasters, the National Cable Television Association, the National Telephone Cooperative Association, the Community Antenna Association, the United States Telephone Association, and numerous other parties are trying to have an impact on the future role of telcos. Differences between these organizations and parties can be reduced to four primary points of contention.

Common Carrier vs Information Provider

Should telcos be allowed to distribute video programming to subscribers? The distribution of video by telcos has been perceived as an inevitable step by numerous organizations and parties. For example, in December of 1988, the FCC released a report that concluded telephone companies would inevitably move into the cable television business (30). If the primary point of contention is not the entry issue then what is it?

The conditions and circumstances under which the telcos enter the cable television business has been the primary point of contention. Should telcos be allowed to own a significant percentage of a programming service they distribute to subscribers? Or should telcos distribute programming to subscribers in a common carrier/conduit capacity?

The RHC's and proponents of a system that has telephone ownership of content argue for a modern, high speed information system into homes and businesses. A fiber star-switched network would provide high definition television, home banking, home shopping, video-on-demand, interactive video for phone users and access to a variety of data bases. In essence, RHC's could integrate broadcasting, cable, computers, film exhibition and newspapers into one system (31).

According to Bell Atlantic an advanced fiber optic system could be available within fifteen years.

> Within 15 years-given a favorable regulatory climate-Bell Atlantic's deployment of digital and optical technologies, will reach homes and businesses region-wide, providing a virtually limitless number of high speed, high quality channels capable of transmitting such services as high definition television and full-motion interactive video. The potential benefits in education, work, health care-and other vital areas- are enormous. (32)

The cable industry and opponents of telephone ownership of content argue that a competitive cable/video marketplace is dependent upon telcos being assigned a common carrier status. According to their position, Congress placed a "strict" ban on telco ownership when it passed the Cable Communications Policy Act of 1984. This regulatory ban was codified because of problems and concerns that would arise if telco ownership were permitted. To allow telcos to own video services or buy existing cable systems would only open the door to problems that have been identified in the past.

Competition vs Monopoly

The second point of contention focuses on the impact that telcos will have on the cable marketplace. Will telco participation create a competitive video distribution market? Or will telco participation lead to anti-competitive practices and monopolistic behavior?

RHC's and proponents of a telco system argue for a competitive marketplace between telcos and cable operators (33). According to their position, competition between services would ultimately lead to a lower or more stable pricing scheme, a greater number of programming choices, and greater subscriber satisfaction.

The cable industry and opponents of a telco system say telcos would cross-subsidize video operations to gain control of the marketplace (34). According to their position, telcos would cross-subsidize video operations with revenue generated from telephone services. The telcos, operating from a position of power, could lower subscriber costs to a point equal to or below a cable operator's break-even point. Over a period of time the telcos would gain control of the cable industry.

Some opponents, such as Congressman Dan Schaefer, don't think telcos will be satisfied until they control the entire communications industry.

> The one thing broadcasters and cable should fear more than anything is not each other but the seven RBOC's. These are the one's sitting back with their pockets so much deeper than both of you put together that eventually...they will control basically everything, and that is what they want. They want complete control of the communications industry. (35)

Industrial Policy vs Marketplace

The third point of contention focuses on the development of a national communications infrastructure. Should telcos be allowed to compete in the cable television industry, with minimal restrictions, in return for the development of a high speed, high quality communications infrastructure? Should the development of a modern, high speed communications infrastructure be driven by marketplace factors or the political system? What problems or consequences will the country face if the development of a modern communications infrastructure is postponed for 25 to 30 years?

Proponents of a telco system argue that the U.S. is in desperate need of a modern communications infrastructure (36). According to their position, the U.S. is falling behind other countries in this area. They claim that if a national fiber optic network is not constructed the country will be hindered in its ability to compete in global markets in the future. Further, they assert that if the construction of the network is delayed too long then the U.S. could become a second class telecommunication society (37).

Proponents contend that the country's future competiveness in global markets cannot be tied to the uncertain rhythms and nuances of the market. Congress, via legislation, or the FCC, via rules and regulations, must provide incentives for telcos to construct a national fiber optic network. Entry into the cable television industry, with minimal restrictions, is believed to be an incentive that could promote infrastructure development (38).

Opponents of telco systems view any attempt, by Congress or the FCC to link telco entry into the cable industry with the development of a national infrastructure as industrial policy (39). According to their position, telco movement into the cable industry should be driven by market factors and not industrial policy. If Congress or the FCC create an industrial policy that ignores market factors, opponents argue that the end result could hurt subscribers and create billions of dollars of underutilized facilities.

Cooperation vs Competition

The fourth point of contention focuses on the relationship between telcos and the cable industry. Should telcos develop a fiber optic or coaxial system that would provide direct competition against the cable industry? Or should telcos work with the cable industry to provide homes with a modern, sophisticated communications system?

As noted earlier, telcos would like to play a major role in the communications industry of the future: a world where homes and businesses have instant access to information and entertainment. To construct this vision of the future, telcos argue for ownership rights in the areas of distribution and content production. The acquisition of such rights would require eliminating existing regulatory barriers. The key question: when will regulatory barriers be removed?

The uncertainty of the regulatory environment has resulted in calls for cooperation between telcos and cable companies (40). Raymond Smith, chairman and chief executive officer of Atlantic Bell and Richard McCormick, president and chief executive officer of U.S. West have called for an end to turf wars between telcos and cable (41). According to Smith and McCormick, joint ventures would allow the two to share costs, risks and rewards and enhance the development of a national communications network.

However, the cooperative approach may not be as beneficial to telcos as it is to cable operators. A cooperative approach reinforces the distributor role of the telco. In essence, it reduces the urgency for regulatory changes that would allow telcos to own a percentage of programming services or acquire existing cable operations.

TELCOS IN THE PACIFIC ISLAND NATIONS

The telco offers Pacific Island Nations a high speed, high quality communications system that can eliminate or reduce distance barriers and time constraints. In addition, the telco offers a communication technology that can easily be expanded and/or incorporate technological innovations.

On the other hand, the telco system would be costly and force PINs to remain dependent upon the system provider for equipment.

The key question is: how can Pacific Island Nations strategically utilize a telco system to meet developmental needs without remaining dependent upon the system provider or foreign programming services? The U.S. telco model, which is market driven, may not provide the best solution to the problem.

Telecommunications organizations, such as the RHC's and cable operators, are driven by market forces. They pursue capital by controlling markets and lobby extensively to maintain their current market control or to create conditions that will be favorable for enhanced control in the future. The constant struggle between these organizations obscures or minimizes developmental needs, such as the deployment of a fiber optic telecommunications network in the U.S..

In addition, the U.S. telco model is tied to the development and control of information and entertainment services that are perceived to be lucrative markets somewhere down the road. How well these services will address the developmental needs of the PINs is yet to be seen.

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THE CHALLENGE OF TRANSFERRING A STATE OF THE ART TELECOMMUNICATION SYSTEM MANUFACTURING TECHNOLOGY

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1. ABSTRACT

Design and manufacture of Optical Submarine Cable Transmission Systems involves very advanced technologies and a small number of competitors worldwide. It was traditionally considered that this activity would remain restricted to a small number of very advanced nations. Until recently, Japan was the sole centre involved in such an activity in the Asia-Pacific region. However, with the installation of a full submarine cable system capability by Alcatel, Australia and New-Zealand have now established themselves as a second activity centre in the Asia-Pacific region.
This paper describes how this technology transfer was planned and implemented and draws some conclusions from this experience.

2. THE INITIATIVE

The initiative of promoting the concept of a large scale technology transfer for submarine cable systems in Australia and New-Zealand came from the Overseas Telecommunications Commission (OTC) in Australia and the Telecommunications of New-Zealand (TCNZ). This initiative was based on the requirement to build a high capacity optical submarine cable loop in the South Pacific.

2.1 THE PACRIM PROGRAM

There was a need for a high capacity digital connection between Australia and New-Zealand, and from these countries to the United States and Japan. Instead of implementing a series of cables independently, it was decided to construct a complete loop connecting Australia, New-Zealand, Hawaï and Guam. This was one of the early applications of the loop concept in the field of submarine cables. Since then, this concept has experienced a large development.
This loop is described in Figure 1.

In total, the PacRim loop represent about 17,200 kilometres of cable and about 140 submerged repeaters (excluding the Transpacific 4 cable segment between Hawaï and Guam which forms part of a different program). It was considered by OTC and TCNZ that such a large program could form the basis for a technology and manufacturing transfer.

2.2 BEYOND THE CONCEPT OF NATIONAL CONTENT

There is a prior history of submarine cable manufacturing in Australia. In the framework of the ANZCAN (Australia, New-Zealand, Canada) cable system construction, repeaters were assembled in Australia and some local raw materials were incorporated in cables manufactured in the United-Kingdom. Such local activity continued in the framework of the AIS (Australia, Indonesia, Singapore) cable system construction.
This local manufacturing activity remained partial and did not involve heavy investments. It did not survive the massive changes brought forward by the development of the new optical transmission technologies.
From this experience, it was apparent that the concept of national content needed to be greatly enhanced to embrace a complete technology transfer. The major challenge was to find a manufacturer willing to implement such a technology transfer at conditions which would remain competitive.

2.3 THE TASMAN 2 TENDER

It was not practical to consider assigning the construction of the entire PacRim system to a local manufacturer before this manufacturer had proven its local capabilities. Therefore it was decided to issue a procurement Tender for the Tasman 2 cable system connecting Australia and New-Zealand as a first separate segment of the PacRim loop. This tender was to be adjudicated on technical merit, price competitiveness and extent of technology transfer. The Tender was issued in 1986 at a time when not even a handful of short haul experimental optical submarine cable systems were in operation. This very innovative and ambitious Tender attracted considerable attention in the submarine cable industry worldwide. At the time, however, it was hard to predict if the vision put forward by OTC and TCNZ would actually materialise.

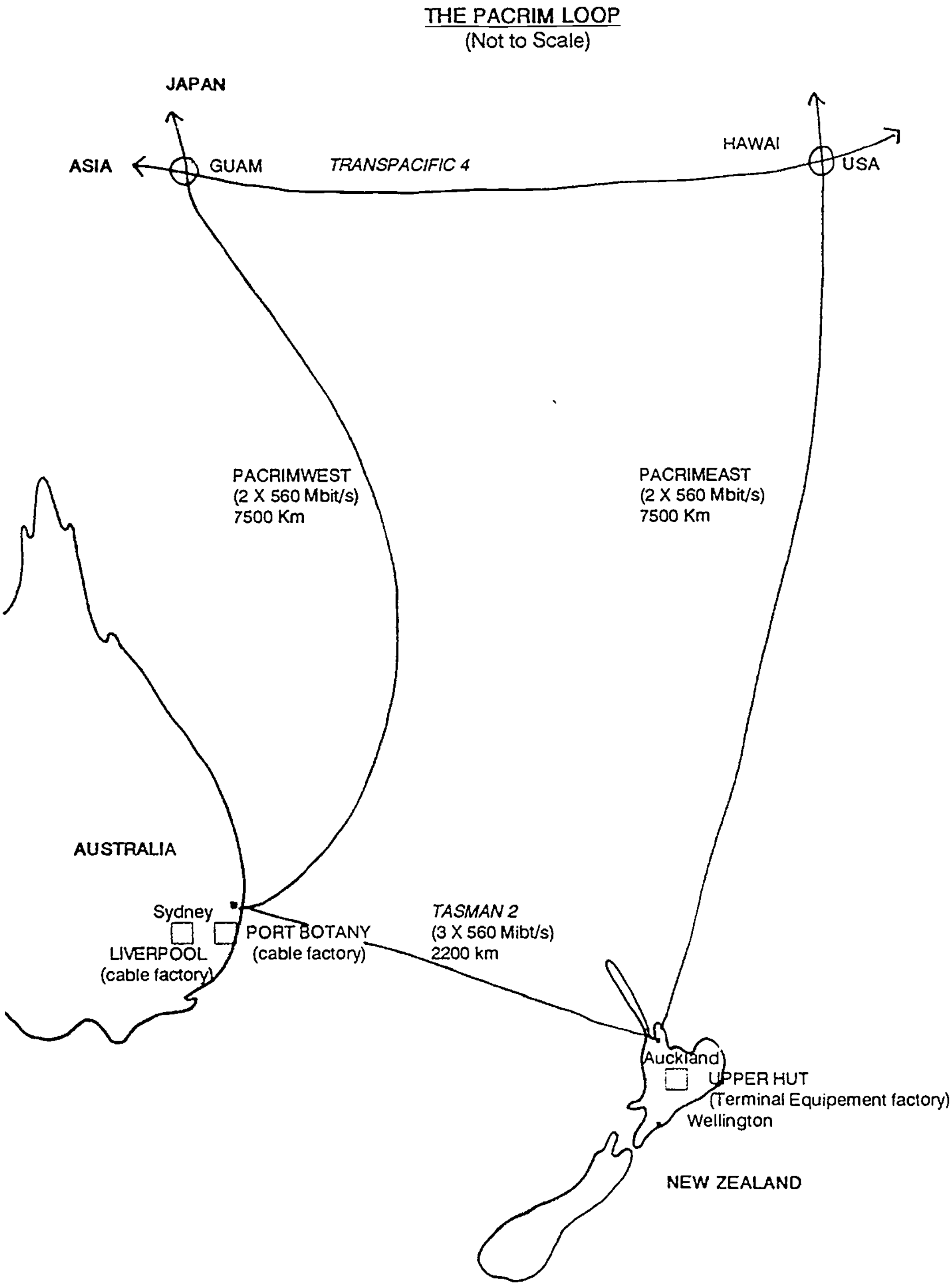
3. THE RESPONSE

Among many others, this Tender drew the attention of Alcatel. Alcatel experience in submarine cable manufacturing dated back over one hundred years but the scope of this activity had remained, for the main part, located in France and the surrounding waters (Atlantic, North Sea and the Mediterranean). Alcatel saw in the Tasman 2 Tender a strategic opportunity that could not be neglected and decided to match, as closely as possible, the ambitions of its promoters.

3.1 THE SYSTEM APPROACH

A submarine cable is not a cable : it is a System. Therefore, it was strongly felt that a technology transfer would not be solid and meaningful if it did not embrace a full system capacity. This aspect was considered fundamental for the long term success of the transfer.
Alcatel offered to manufacture cables and submerged repeaters in Australia and to manufacture land based Terminal Transmission Equipment (TTE) and Power Feeding Equipment (PFE) in New Zealand. Manufacture of the cable was to be based, as largely as practical, on locally sourced materials. Because of the very stringent reliability requirements and the high associated costs, components for repeaters and Terminal Equipment were to be sourced together with those used in the French factories.
In addition to the manufacturing facilities, the establishment of a local engineering and installation capability was also planned. This was planned, not only to increase the level of local activity but because the level of interaction between manufacturing, engineering and installation is very high. It was not considered practical to "remote control" such activities from the existing French base.

Figure 1


THE PACRIM LOOP
(Not to Scale)
JAPAN
ASIA
GUAM
TRANSPACIFIC 4
HAWAI
USA
PACRIMWEST
(2 X 560 Mbit/s)
7500 Km
PACRIMEAST
(2 X 560 Mbit/s)
7500 Km
AUSTRALIA
Sydney
LIVERPOOL
(cable factory)
PORT BOTANY
(cable factory)
TASMAN 2
(3 X 560 Mibt/s)
2200 km
Auckland
UPPER HUT
(Terminal Equipement factory)
Wellington
NEW ZEALAND

It would have been very dangerous not to establish a strong local engineering and project management group because we could have manufactured perfect cables and perfect repeaters and Terminal Equipment and discover, in the end, that they did not really fit together.

3.2 BEYOND THE "LATEST TECHNOLOGY" CONCEPT

The initial idea was to transfer the Alcatel S280 (280 Mbit/sec) technology. At a time when only a very short system based on this Alcatel technology was in the water, this could already appear as ambitious.
However, it had to be very quickly recognized that this was not ambitious enough : transferring the "latest technology" would be equivalent to transferring yesterday's technology. What was required was the transfer of tomorrow's technology. Recognizing this fact, Alcatel, OTC and TCNZ agreed to transfer the Alcatel S560 (560 Mbit/sec) technology and a new small diameter submarine cable design. It is worth noting that neither the S560 system nor the small diameter cable had been yet manufactured in France: the technologies which were offered and accepted for transfer were technologies still under development ! In the traditionally prudent and conservative submarine cable world, such an idea would not have even been conceivable a few years before. It is not an overstatement to say that this decision has contributed to shaking this traditional conservatism.

3.3 ESTABLISHEMENT OF A NEW COMPANY

The Tasman 2 System was due for commissioning on 1st November 1991. The contract for its implementation was signed in December 1987. Less than four years were available to manufacture and install a major submarine cable system on the basis of a technology which was not yet available and in factories which did not exist. To meet such a challenge it was decided to create a new company which would concentrate all its effort in the sole implementation of this task.
This company was established and called "Tasman Cable Company" which can be abbreviated to "Alcatel TCC".
The establishment of a separate company to implement this project was an effective way to create a team which would dedicate all its efforts to the timely and successful completion of Tasman 2 and to the successful implementation of the technology transfer. A deep sense of responsibility and pride was required to implement the task as well as an excellent cooperation among all parties involved (factory construction teams, cable team, repeater team, terminal equipment team, etc...)
The establishment of a company solely dedicated to the construction of submarine cable system was innovative and Alcatel TCC was the first company in the world dedicated only to submarine cable systems and having a full manufacturing capability covering cable, repeaters an terminal equipment. The company shareholders are Alcatel Australia, Alcatel Cable (bringing the cable technology), and Alcatel CIT (bringing the system technology).

4. THE IMPLEMENTATION

4.1 TRAINING AND CONSTRUCTION PHASE

As soon as the company was established, recruitment of adequate personnel started in Australia. New-Zealand, France, the United Kingdom and other countries. Very quickly, teams were established and sent for long term training (about one year) in the French factories.

In parallel, the cable factory was constructed in a record time at Port Botany in the suburbs of Sydney (Australia). The factory is located next to a deep sea harbour on virgin reclaimed land. This has permitted Alcatel TCC to plan and engineer the factory space without having to compromise with historical constraints generally related with old factories. As a consequence, the Port-Botany factory is one of the most modern cable factories in the world. Its initial manufacturing capacity was 3000 kilometres of cable per year. This has been subsequently increased to 6000 km/year. The machinery used in the factory is brand new equipment. The Terminal Equipment is manufactured in Upper Hut, next to the City of Wellington (New-Zealand) in the premises of an already existing Alcatel facility.
The Repeaters are manufactured at Liverpool in the suburbs of Sydney (Australia) in the premises of another already existing Alcatel manufacturing facility. The Repeaters are manufactured in a clean room which was the only element left from the previous repeater assembly activity in Australia. The factory has been expanded to provide office space for a technical and engineering team as well as for all Departments of a well organized company. An R&D laboratory has been established and equipped.

4.2 DIFFICULTIES ENCOUNTERED.

It is obvious that many obstacles and difficulties were encountered along the way.
A first set of predicaments were of technical nature. It included all the usual surprises and problems of a development period. The manufacturing and testing equipment for repeaters and Terminal Equipment had to be defined (and redefined) gradually as the developments were progressing. This did not proceed without unexpected modifications and variations.
Another type of technical complications was related to the selection of raw materials which is very difficult because of the manufacturing and long term reliability constraints.

A second set of difficulties was more of a cultural nature : people from various origins and nationalities had to be brought together to form a united and structured team. There are more than 30 different nationalities at Alcatel TCC. Also, two rather different cultures had to interact together : an anglo-saxon culture relying more on written instructions and procedures and a latin culture relying more on individual initiative and experience.
All these difficulties were aggravated by the pressure of time and the fundamental requirement of meeting the TASMAN 2 Ready for Service date.

4.3 ACHIEVEMENTS

The size of the challenge acted as a catalyst and unifying force among all people involved and this has permitted the success of the technology transfer. The TASMAN 2 Cable System was commissioned at the end of January 1992, with a delay not exceeding three months. It has not been commissioned later than the first 560 Mbit/s submarine cable systems commissioned elsewhere in the world. The system has been working to the date of this article without any major problem.
In December 1990, Alcatel TCC was awarded the construction of approximately 3500 kilometres of the PacRimEast System linking New-Zealand to Hawaï and the entire 7500 kilometres long PacRimWest System. The PacRimEast System has been manufactured and was being laid when this article was written. The construction of PacRimWest is on schedule to meet the October 1994 Ready for Service date.

As a result of these achievements, Alcatel decided to involve Alcatel TCC in the construction of the SEA-ME-WE 2 submarine cable system linking Singapore to France. Alcatel TCC is currently manufacturing about 2500 kilometres of cable to be laid in the Indian Ocean from Jakarta (Indonesia) and some Terminal Equipment for the Cable Stations of Jakarta and Colombo (Sri Lanka).
The factories now run at their full capacity : 7500 km/year for the cable (far more than was initially expected) and 50 Repeaters/year.

5. NEW CHALLENGES

The most stimulating outlook of a technology transfer is that it always has to be renewed.
The rapid emergence of very large capacity optically amplified system will require the transfer in the near future of a new cable design and of an entirely new type of transmission system.
The other challenge to be faced by Alcatel TCC is the expansion of its activity from an Australian base (PacRim) to an Asia-Pacific base covering the entire region.
The manufacture of SEA-ME-WE 2 is the first step in this direction but it will need to be followed by many others. We are confident that this will happen because the size of our investment and the strength of our determination will convince users in the region that we represent a real, locally based, alternative in the Asia Pacific.

6. SUMMARY

The establishment in record time of an optical submarine cable system capability in Australasia shows that even the most ambitious technology transfer is possible. As a result of this successful experience, Alcatel is conducting another technology transfer in the field of submarine cable system from Norway to Greece and is prepared to consider any other potential case.

From our experience, however, there are four prerequisites which must be met for the successful implementation and continuation of a complex technology transfer :

- a market
- a long term view (no "corner cutting")
- a very strong relationship among all parties involved, including the end user(s)
- an absolute determination of all parties.

All the rest is negotiable....

CALLER ID AND PRIVACY: NEW OPTIONS

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1. ABSTRACT

The privacy implications of Calling Number Display (CND) or Caller ID and other intelligent network-based services have been a central concern in regulatory debates. This paper argues that a generalised privacy regime, such as the one proposed by the Clinton/Gore administration would be in the long term strategic interests of telecommunications carriers.

2. INTRODUCTION

In the closing stages of the recent United States Presidential campaign, Governor Clinton and Senator Gore committed themselves to the development of a Consumer Bill of Rights should they be elected. This Bill of Rights would include consumer safety, consumer information, the protection of a competitive market place for products and services, and the right to be heard when government policy is being formulated and when administrative decisions are being made. They also committed their incoming administration to the support of consumer education (Computer Professionals for Social Responsibility, November 2, 1992).

But the most significant pledge from a telecommunications perspective, was to support a right to privacy. According to the Clinton/Gore Consumer Bill of Rights, information provided by consumers for one purpose could not be used for a separate purpose without the consumer's knowledge and consent.

The initial response of the telecommunications carriers to this proposal, is likely to be negative. Many carriers have fought, or are still fighting, long battles with regulators and privacy activists over the introduction of new services such as Calling Number Display (CND) or Caller ID as it is popularly known. In these regulatory fora, privacy concerns have been the central theme of the debate.

In this paper I will argue that appropriately framed privacy legislation, which is not restricted to telecommunications, is in the best interests of telecommunications carriers and their customers. So rather than opposing such general purpose privacy legislation, carriers should embrace it. The argument will be presented in terms of the telecommunications privacy debate underway in the United States ar ˙ ustralia.

3. THE DIMENSIONS OF THE TELECOMMUNICATIONS PRIVACY DEBATE

CND, is a telecommunications service which displays the number of the caller on a screen attached to the called party's telephone. Because the caller's number is displayed before the call has been answered, the called party has the ability to decide whether or not to answer the call from that particular number. The caller's number can be recorded or directly linked to a personal or corporate database.

Where calls are made from listed numbers CND takes on added significance. CND information linked to reverse directories can be used to rapidly identify the address and owner of the telephone service. This information can be cross-linked to other public and private data bases to create profiles of callers. CND becomes the first link in the identification chain. Clearly identification of callers can lead to harassment, but in extreme situations such identification can lead to personal risk on the part of the caller.

CND has been the focus of heated regulatory debate in the US (White, 1992). Almost all of the discussion has focussed on the privacy issues raised by this service. These privacy-related discussions concern the right of callers to make calls which do not lead to the revelation of their identity or location, and the ability of receivers of calls to re-use telephone number information which is revealed by incoming calls.

The regulatory debate about CND is important because CND is just one of a range of new services which take advantage of the new capabilities of digital telephone switches or exchanges. Transformation of the ways in which telephone calls are routed through the network means that Calling Line Identification (CLI) information which was once used for network purposes only, such as billing and routing, is now being used to create a new set of enhanced telephone services.

These Custom Local Area Switching Services (CLASS) include, automatic call return, selective call rejection, distinctive ringing, anonymous call rejection and selective call forwarding. Each of these services relies on the existence of CLI within the network. The software controlled local telephone exchange can capture, store and process the CLI of incoming calls based on the request of the called party. CND has been the most controversial

CLASS service because it reveals the telephone number of the caller to the called party. [1]

These new services are of real significance to carriers because they increase the proportion of completed calls and, in many tariff regimes, carrier revenue. At the same time, subscription fees for these services provide for revenue growth for Local Exchange Carriers (LECs). Another attraction for carriers is that tariffs for these services are less onerously regulated than the bulk of other LEC tariffs. While carriers would have invested in switch upgrades as a means of achieving greater efficiency, the present and potential revenue implications of CLASS services explain why carriers have argued their cases with such vigour.

The regulatory debate about CND has revolved around the following questions:

- Under what circumstances should a caller be able to make a call which denies the ability of the called party to see their calling number details if the called party subscribes to CND? In other words should callers be able to mask or block CND under any circumstances?

- If masking is possible, what should the default condition be? In other words, if callers do nothing more than dial a number in the ordinary manner, should their CLI be available for display, or masked from display, if the called party subscribes to CND.

- What charges should be levied against subscribers who wish to withhold their CLI on either a per-call or per-line basis?

4. REGULATORY RESPONSES IN THE UNITED STATES

The brief history of regulatory responses to these questions is turbulent and reveals rapid change. The significant changes in regulatory approach can be explained by growing consumer awareness of the social issues raised by these services. This has forced regulators and telephone companies to acknowledge that the privacy implications of enhanced telephone services must be considered when these services are introduced. Regulatory change has also been made possible by technological developments which allow for more flexible implementation of these enhanced services. For example blocking or masking was not possible with early implementations of CND. This is now a standard element of switching software.

During the first phase of CND implementation in the US. carriers and regulators assumed that the services were unproblematic for telephone users. This assumption, and a lack of interest on the part of consumer advocates, allowed the Federal Communications Commission (FCC) to authorise the delivery of CND-like information to inter-state toll free 800 numbers in the U.S. This CND information can not be masked or blocked by callers, and the existence of this facility was unknown to almost all 800 line callers. Abuse of this CND-derived information through the selling of lists containing the telephone numbers and other personal information relating to individuals who have called these numbers has led to the introduction of legislation which would severely limit what could be done with that information without the explicit consent of the caller.

Soon after, New Jersey regulators authorised the offering of unmaskable CND. That service is still being offered in that way. Other States have introduced CND with only per-line masking available to individuals and organisations who could be placed at risk by the disclosure of their telephone number.

In recent months, regulatory stances have shifted. Both New York and California have authorised the introduction of CND on the condition that all subscribers have access to either free or low cost per-call or per-line masking, and that subscribers with unlisted numbers are given per-line masking unless they choose otherwise. In other words there is unrestricted access to line masking. Excepting for silent line subscribers, subscribers who did not elect to have line masking would have per-call masking as the default for their service.

This means that in the United Stated CND regulatory regimes include:

a) No block.
b) No block with line block to "at risk" groups only.
c) Per-call block with line block to "at risk" groups.
d) Per-call block/unblock, unrestricted line block, with per-call block as the default unless requested otherwise.

Most new offerings of CND in the US now involve Option c). This entails free per-call blocking which results in less than 1% of calls being blocked (TELECOMMUNICATIONS REPORTS, November 4, 1991). One US industry view is that offering minor variations of Option c) has allowed the service to become non-controversial. As a trade newsletter comments,

> ...after two years on the market, the once controversial Caller ID service, now gets no more than routine attention from state regulators who were once concerned that the service raised far-reaching privacy issues. Per-call blocking...... has apparently defused the issue that initially threatened to stall the technology.."
> (TELEPHONE NEWS, August 10, 1992)

But the situation is probably still fluid. Some of the larger States with more active consumer advocates such as New York, California and Ohio have proposed Option d). Pacific Bell has declined to offer CND service on those terms and is seeking a rule change with the regulator. On the other hand, Nynex in New York and Cincinatti Bell in Ohio are proceeding under Option d) regimes (AIN REPORT, September 2, 1992; TELEPHONE WEEK, August 31, 1992).

As a result of carrier/regulator negotiations it is possible that variations of Option c) and d) combined with supervised customer education campaigns will emerge as the new standard in the United States. This is despite the fact that regulatory regimes which provide ready access to line masking have been opposed by some carriers on the grounds that liberal access to line masking reduces the possibility that CND will be available to callers, and, as a consequence, the commercial viability of the CND will be reduced. And in California, two of the carriers have asked the regulator to reconsider their ruling on ready access to line masking.

5. AUSTRALIAN REGULATORY PROPOSALS

Austel, the Australian telecommunications regulator has issued a Draft Report on Telecommunications Privacy which recommends that a "telecommunications specific" privacy regime be developed, and that CND be offered with free and unrestricted access to both per-line and per-call masking (Australian Telecommunications Authority, 1992). Following the schema introduced earlier, this would be described as Option c)

c) Per-call block/unblock, unrestricted line block, with line block as the default unless requested otherwise.

Before introducing the service, the carriers must conduct an approved educational campaign and conduct a ballot of all customers asking whether they wish to have per-line masking or per-line blocking as their default. For customers who do not respond to the ballot, Austel proposes that they should be given per-line masking as a default. This is in line with a proposal made by Samarajiva (1992:49). Austel's reasoning is that if telephone subscribers do not respond to the ballot, they are probably unlikely to understand the implications of revealing their number to other subscribers who subscribe to CND. Austel argues that if the CND service is as desirable as its proponents claim, subscribers will opt for per-call masking.

Austel has taken a position which allows for easy access to per-line masking and a presumption that per-line masking should prevail for those who make no choice. In the language of US regulators, they have chosen "presumptive line masking". What is the underlying rationale, and what are the social implications of the regime which Austel is proposing?

The regulatory regime which Austel has endorsed had been proposed by a number of consumer organisations and one reading of the proposed decision would see it as a victory for consumers. But the question, which must be raised is which group of telephone users is likely to benefit?

If previous telephone-related consumer behaviour is any indication, there is every reason to expect a low return rate if a ballot of Australian telephone subscribers was to be conducted. [2] This would result in the status quo prevailing. In other words, per-line masking would be the default for the bulk of subscribers. Most calls would have CND masked.

Under this regulatory regime there would be little incentive for anyone to subscribe to CND if most calls being made did not reveal CND. Of course some business and private subscribers would notify their regular telephone callers that CND was in operation, and that the revelation of their CND would result in some kind of preferential treatment for their calls. For example, airline companies might be able to process incoming reservation requests more quickly, and private subscribers might use CND as a way of screening incoming calls. And other groups of individuals or even family members could arrange to use CND as a way of alerting them to the existence of an incoming call from a member of the family or the group. Other subscribers who were "privacy aware" could either subscribe to the network-based Anonymous Call Rejection (ACR) service which notified the caller that masked calls were not accepted, or add that facility to their personal telephone.[3] But apart from pockets of use, for the bulk of calls, CND would be masked and unavailable to receivers of calls.

In essence Austel has proposed a regulatory regime which is designed to protect telephone callers. The regime is ensures that there is little likelihood of a caller's telephone number being revealed without the caller making a conscious decision. But in protecting the caller, it is important to consider the implications of that protection for the called party.

Is this predominantly "caller perspective" in the best interests of all telephone users? In its decision on CND (Caller ID as it is named in the U.S.) the New York Public Service Commission (PSC) argued that

> "...Caller ID presents not an issue of good or evil, but a clash of two goods; the privacy rights of callers (which include, for example, the right to conceal their phone numbers from telemarketers, but not the right to harass with anonymity) and the privacy rights of call recipients (which include, for example, the right to be left alone but not the right to spy on a spouse). Seen in that light, the blocking issue should be resolved in a way that offers each customer the greatest opportunity to advance his or her own interests without unduly compromising the interests of others." (State of New York, Public Service Commission, 1992:28)

But does the Austel proposal "offer each customer the greatest opportunity to advance his or her own interests without unduly compromising the interests of others"? One reading of Austel's draft decision is that it places greater emphasis on the anonymity of the caller, and a correspondingly lesser emphasis on the needs of called parties to use CND for call management purposes, and as a solution to problems raised by telephone intrusion.

It is clear that callers should have the right to mask their CND in circumstances which they choose. And it is also clear that it is in the interests of those who are called to have the identity of callers revealed under certain circumstances.

How then should the issue be resolved? There seem to be at least three generic approaches. The first would be to accept Austel's recommendation for default masking, and then promote Anonymous Call Rejection (ACR) as a way for people who are "privacy sensitive" to encourage others to unmask their CND when they are calling them. (This facility would not have to be offered by the carriers because customer premises equipment manufacturers offer this facility as a simple, inexpensive "add on" to domestic CND equipment.) Such a solution increases the power of the called party, but may not be optimal because it could confuse callers and unnecessarily congest the network.

Another solution would be to promote the default unmasking of CND by telephone callers through an extensive educational campaign. In fact the New York Public Service Commission placed great store in the value of an educational campaign as an argument against "presumptive line blocking". They state that:

> ... presumptive per-line blocking is important only if one assumes, with the Consumer Protection Board and the Department of Law, that education will be ineffective and customers wanting or needing blocking cannot be counted on to elect per-line blocking if that better suits their needs. That assumption is unwarranted, however, and we shall require an effective education program. Since the need for presumptive line-blocking has not been established and the option may well have the capacity to undermine the Caller ID offering, a fair balancing of the interests suggests that it should not be selected." (State of New York, Public Service Commission, 1992:30)

But there is a third approach which would result in benefits for both carriers and consumers. This is the promotion of a generalised privacy regime which is not specifically tied to telecommunications. It is the kind of privacy regime being promised by the incoming Clinton/Gore administration. The benefits of this approach to telecommunications carriers and users will be outlined in the next section.

6. THE BENEFITS OF A GENERALISED PRIVACY REGIME.

Reducing the possibility of a caller inadvertently revealing their telephone number is one way of protecting the rights of the caller. But limiting the ways in which that revealed telephone number can be used by the called party is another technique for protecting the caller. Put simply, a telecommunications privacy regime which limits the use or re-use of CND derived information without the explicit consent of the caller, could overcome many of the problems which can arise from the disclosure of CND.

Experience in the United States suggests that the reuse of CND (or ANI) derived information without the awareness or permission of telephone callers is the major problem which has arisen from this service. Inbound telemarketing using 800 numbers allows for the capture and reuse of CND-ANI information and the linking of that telephone number information to consumer interests, and name and address information. At some later time this information can be cross-linked to other information held in private and public data banks. So a simple response to an 800 number in search of consumer information, or for the purchase of goods or services can become the first link in a chain of transactions leading to unwanted solicitation for goods and services. [4]

So what could be the benefits of a generalised privacy regime which places consumers in control of personal information generated by their telephone transactions?

- CND is essentially a form of transaction generated information (TGI). Many other forms of TGI are being generated through activities such as the use of supermarket discount cards, mail order transactions, ordinary credit card use, and real estate transactions, to name just a few. Many of these activities are unregulated, or at most subject to self-regulatory codes. As a consequence it is in the interests of the telecommunications industry to ensure that telecommunications privacy regimes do not disadvantage that industry by placing restrictions on the use of telecommunications derived TGI while other transaction data remains unregulated. For example mailing lists created by mail order transactions remain unregulated, while a telecommunications-specific privacy regime could restrict the secondary use of information. A generalised privacy regime which covers TGI would place all TGI-based industries on an equal footing.

- As the Universal Personal Telecommunications Number (UPTN) initiatives mature, telecommunications carriers will be able to move into a range of new activities. In the past, some of these have been associated with the banking industry. With individuals having a UPTN and associated security and verification arrangements, telecommunications carriers will be able to develop services which encompass the whole chain of consumer transactions from order taking, customer verification, credit assessment and billing.[5] For these kinds of activities to occur, carriers need to be able to assure their customers that there are adequate privacy protection schemes in place. And in a potentially competitive market, carriers will also need to ensure that they are not disadvantaged by telecommunication-specific privacy regimes. Again, a generalised privacy scheme is to be desired.

- Regulation often develops as a result of a specific well publicised instance or abuse. (Take for example the regulation of video rental records and cable television subscriber records in the United States which were responses to misuse of information relating to a public figure.) This ad hoc regulation might appear to solve a specific problem, but more often than not, it does not address the wider issues. It is only a matter of time before a paradigmatic Caller ID abuse case emerges in the media. This will lead for calls for more stringent telecommunications-specific privacy regulation. Again, a generalised privacy regime would make such regulation unnecessary.

- Ruggles (forthcoming) presents a cogent case for personal data protection based on the ways in which individuals define and protect their personal boundaries. Privacy protection could become a competitive issue given increasing competition at the local exchange level. As a consequence carriers will need to assure their customers that their privacy expectations are not being violated.

- Proposals currently being considered within the European Community would restrict the transfer of personal data across international boundaries if data protection and privacy regimes were not in place. If these proposals are enacted it would severely restrict communication and trade with jurisdictions where data and privacy protection was inadequate.

7. CONCLUSIONS

Privacy protection can be seen as a strategic issue for telecommunications carriers. It has the possibility of impinging on consumer relations, the development of telecommunications transaction-based businesses, the development of strategic business opportunities, and on the ability of companies to transact business with the European Economic Community. As a consequence, the development of a generalised privacy regimes in the United States and Australia would be in the interests of telecommunications carriers.

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NOTES

1. Most of the other CLASS services process calls from pre-determined numbers in ways which have been pre-specified by the called party. These services do not reveal the number of the caller to the called party. But it should be noted that certain configurations of Automatic Call Return (ACR) also raise the same issues as CND.

2. Experience with balloting for a long distance carrier in the early stages of competitive long distance carriage in the US, and in the Australian experience when Telecom Australia's first phone monopoly was removed, resulted in no action on the majority of subscribers, and a default maintenance of the status quo.

3. Anonymous Call Rejection only allows calls which have CND attached to be received by the called party. Calls with CND masked are routed to a recorded message which advises the caller that masked calls are not accepted and that the call should be made again with CLI unmasked.

4. It should be noted that the use of 800 numbers is not restricted to the telmarketing of goods and services. Candidates in the 1992 United States Presidential campaign used 800 numbers, and ANI derived information as a means of developing lists of potential campaign contributors, and as a means of generating political support. The advertising, chanting and presentation of 800 numbers became an integral part of the campaign.

5. A variation on this proposal is made by Samarajiva (1992;52). In an argument which supports default line masking, he proposes that carriers could position themselves as an "authenticator" information.

SOFTWARE PATENTS, OWNERSHIP AND INFRINGEMENT CRIMES: NEW DEVELOPMENTS

By Stephen Glazier*

Abstract

Most advances in telecommunications are either hardware/software hybrids, or pure software inventions. Software can now be patented in the U.S. Software infringement can now be a crime, and corporate officers and directors can be personally liable for triple damages and jail sentences; however, steps can be taken with independent patent counsel to insulate from such personal liablity. Ownership of patents is slippery and can be easily lost.

Many of the new advances in telecommunications technology are software inventions, or software/hardware hybrid inventions.

In the U.S., software can be both patented and copyrighted. (See In Re Iwahashi, and Arrhythmia v.Corazonix, below.) Do both if possible.

Infringement of software copyrights in the U.S. can be a federal and state crime. (See 18 USC 2319 and §31.05(a)(4) Texas Penal Code.) Employees of infringing companies, including officers and directors, can be liable for prison sentences. (See Schalk v. Texas, Tex. Ct. Crim. App., 2 October 1991.)

Willful infringement of patents (for hardware and software) can make an infringer liable for triple damages. (35 USC 284) Officers and directors of infringer corporations can be personally liable for these triple damages, even if they did not personally infringe, and did not know of the infringement, and even if they were advised by in-house counsel that infringement did not exist. Data Products v. Reppart, (U.S. Dist. Kan., 29 November 1990, Lexis 16330) and 3M Corp. v. Johnson and Johnson, Inc. (CAFC, 30 September 1992), ____USPQ2d____.

Independent patent counsel can often act with a corporation to insulate its officers and directors from possible personal liability for payment of triple damages and jail sentences for corporate infringement. These prophylactic steps, when available, should be taken as soon as possible; but the vary with each specific case and should be discussed in confidence with independent counsel.

There is further good news regarding this personal liability for corporate civil and criminal infringement. By making infringement more dangerous, these developments make patents and copyrights more valuable for their proper owners.

It is easy to lose ownership to patents and copyrights, especially software patents. Use written contracts giving the corporation ownership of all innovations by employees, consultants and partners. (See Community v. Reid, below.) Use written confidentiality agreements with all business associates. Otherwise, ownership of your technology may end up in the hands of your employees, not your corporation.

Record written assignments to the corporation for all patents and copyrights. Record them in the Patent Office and Copyright Office. (See 18 USC 261.)

Implement a confidentiality program for all your trade secrets, or else you may lose ownership to them.

It is not clear how to create a lien on intellectual property in the U.S. Follow a dual track, using both the UCC (state law) and federal filing. (See 18 USC 261.)

Title searches for intellectual property in the U.S. cannot be reliable because of deficiencies in the statutes. Proceed with great care when reviewing the ownership of patents and copyrights in a merger situation.

There are many proposals before Congress to further change the U.S. patent laws. This is part of a general trend to make patents and copyrights more valuable and enforceable for all. U.S. patent law will become more like patent law in the rest of the world, and foreigners will be treated more equally with U.S. citizens regarding patent applications and infringement. However, these changes in U.S. law must be watched closely, because they will change the proper procedure for protecting intellectual property rights.

I. The New Rules in Software Patents

The coming advances in software/hardware hybrid patents in telecommunications can be seen in many areas. One example is the recent discovery of how high quality real time audio/visual signals can be sent over conventional copper phone wire. This allows full bandwidth video signals to be sent straight to the consumers home over existing phone wires, without re-wiring the phone grid. Also, the FCC has recently allowed the phone companies to provide this service and compete with the cable television companies. A race is now on to combine this function with other existing phone hardware and services, such as push button phones, 900 numbers, faxes, televisions, and home PC's to create new profitable businesses. These innovations will then be protected by patents for new software

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inventions that tie together conventional hardware and operate the new hybrid in new ways. (In fact, this writer is currently working on a pending patent application to provide video on demand on an automated basis, over existing telephone lines.) Similar frontiers recently opened in mobil phones, interactive communications, home shopping, airborne communications, and automated switching control.

It is well known that patents are available for devices. It is less commonly understood that processes may be patented, including computer processes (that is, software programs and algorithms). Additionally, patentable devices may include traditional equipment improved by incorporating new computer controls or micro-processor chips. Indeed, recent legal developments clarify that pure software patents and hardware/software hybrid patents are available and enforceable, and that patents (where obtainable) are superior to copyright protection for software and hardware/software combinations.

Many of these patents claim and patent, at the macro-flow chart level, software algorithms used by specific programs for specific computer applications, sometimes in association with known hardware elements.

Patent applications of this class of technology at the U.S. Patent Office have been growing at about 30% per year for the last four years.

U.S. and Foreign Patents

The U.S. patent statutes specify that a new and useful invention may receive a patent, if it is not obvious, if it has not been sold or publicly disclosed more than a year before an application is made in the United States, and if a patent application is properly drafted and prosecuted. A U.S. patent, once issued, gives the patent holder an absolute monopoly in this country to prevent others from making, using and selling the invention for a period of seventeen years. Licensees, if sold a license from the patent holder, may use the invention if they satisfy the license requirements, including payment of royalties.

Foreign patents may also be applied for in most developed countries. Note here one common misconception. Upon public use or publication, an inventor has a one year grace period to file a U.S. application before he loses his patent rights. However, this grace period does not apply to applications in foreign countries. (In addition, treaties under negotiation may abolish the U.S. grace period.) Hence, new developments should be kept confidential until a U.S. patent application is filed, or else the option of foreign patents may be lost.

The Old Law of Software Patents

For a long time it was thought to be an open legal question whether pure software inventions, and hardware/software inventions, were patentable. Until recently, patent law in the United States was unclear on this issue, but tended to be negative. Traditional legal principles state that mental processes, mathematical algorithms, and methods of doing business were not patentable. With the development of sophisticated computer software, it was thought by many that these traditional principles prevented the patenting of pure software inventions. Further inhibiting software patenting was the fact that prior to 1983, about 75% of all patents that were attempted to be enforced in the federal courts were ruled to be invalid and the courts refused to enforce them.

However, in 1983, the new Federal Circuit Court of Appeals was created with exclusive jurisdiction over patent appeals cases. This court was created to be pro-patent and began enforcing the majority of patents brought before it. The court tremendously strengthened the legal presumption that all patents issued by the U.S. Patent Office are valid. Furthermore, various legal cases have developed over the last ten years to make it clear that computer inventions, even pure software inventions, can be patentable and enforceable. These computer and software inventions only have to meet the conventional requirements for patents of being new, useful, non-obvious, and without prior use or publication.

The old legal confusion as to software patents was found in Gottschalk v. Benson, 409 U.S. 63 (1972). This case took the naive view that computer software is nothing much more than a complicated calculator and ruled that a computer process in a patent did little more than manipulate numbers. As such, the computer process would only preempt a mathematical algorithm, and therefore was not patentable. However, the case refused to rule whether or not all computer programs were unpatentable.

Things got better in Parker v. Flook, 437 U.S. 584 (1978), by a more sophisticated Court. Here, a pure mathematical formula was not allowed to be patented, where no physical activity took place in the process and where computers and computerization were not part of the claims. In rejecting these claims of a pure mathematics patent without computerization, the Court did say that new and useful computer programs may be patentable. The Court reiterated an old principle, though, that an invention that uses a mathematical algorithm can not be considered new (and hence patentable) if the only new part of the invention is the new mathematics.

Things got even better in Diamond v. Diehr, 450 U.S. 175 (1981), when the Court strictly limited

Gottschalk. This case seemed to move away from the Gottschalk holding in several respects. First, it acknowledged that computers and software have a function in various industrial processes that is unrelated to mere mathematical calculation. Specifically, this case upheld a patent for an industrial process incorporating computers and computer software even though one of the steps in the patented process recited a particular mathematical algorithm. The old anti-software problem about "thou shalt not patent mathematics" had been eroded. However, this case dealt with a computer software application incorporated within a physical process for curing rubber. The case did not comment on pure computer programming or data processing patents that did not physically alter matter, although the Court did say that the Patent Act applied to "anything under the sun that is made by man." However, with this case, the lower courts went forward with the new pro-patent direction of the law.

The New Pro-Software Patent Law

In a case in the Court of Customs and Patent Appeals (the predecessor to the Federal Circuit), In Re Pardo, 684 F.2d 912, 214 USPQ 673 (CCPA 1982), the court ruled that pure programming technique was patentable, in this case an algorithm for a computer compiler. The court stated that there is a difference between a mathematical algorithm (which is a mental process) and a computer algorithm (which is not something that can be performed by the mind). This follows earlier hints from Application of Knowlton, 481 F.2d 1357 (CCPA 1973). This case dealt with a fundamental patent for the programming techniques of relational data bases. Although this case focused on the question of what constituted an adequate description of software for patent purposes, it refused to be offended by the concept that pure software was patentable.

This trend was carried further by Paine Webber v. Merrill Lynch, 564 F. Supp. 1358 (D. Del. 1983). In this case, the court upheld a pure software patent for the Merrill Lynch CMA account, which case favorably cited the Pardo, Gottschalk, and Diehr cases. In Paine Webber, the court stated that although business methods are not patentable (and hence the CMA account is not patentable), the patent in question merely patented a computerization of a business method, not the business method itself. Therefore, the patent was upheld. This was a pure software patent to implement a business method where the method could not itself be patented. The case is a major step forward for software patentability. The court was unconcerned that as a practical matter, no mass market brokerage account, such as the CMA account, can today be offered and serviced without a computerized system. Hence, they permitted a software patent that as a practical matter, wholly preempted the business method that was not patentable. The court felt comfortable in taking this step despite the fact that in Gottschalk, the Court seemed to imply that merely computerizing a mathematical algorithm (in a way that wholly preempted the mathematical algorithm) would not be patentable.

Software Patents Without Source Code

Various court cases pursue the interpretation that disclosure of source code is usually not required in software patents. In Re Ghiron, 442 F.2d 985, (CCPA 1971) indicates that flowcharts rather than source code are satisfactory in software patents. The patent application should explain each box and arrow of the flowchart and the hardware platform required to execute the program. Ghiron states that enablement should be provided to the expert reader by the patent with only a reasonable degree of routine experimentation. It is our judgment that normal debugging usually is permitted as routine experimentation, and hence debugged source code need not be provided. Obtaining a software patent without disclosing source code may be like having your cake while eating it too. Where the bulk of software development costs may lay in coding and debugging source code, one may often earn a software patent monopoly without worrying about the possibility of giving an unscrupulous, but underfinanced, infringer his source code through the patent itself.

Knowlton dealt with a software patent that did contain a few lines of key sections of source code. However, the judges reacted rather negatively to that, pointing out that the statute requires "concise" patents and that they prefer to deal with just flowcharts and not source code.

Hirschfeld v. Banner, 462 F. Supp. 135, (DCDC 1978) made it clear that a patent claim cannot recite a program without describing the program in some manner in the patent. But there was no indication that source code was required in the patent.

1990 Patent Cases

The case law is continuing to develop on a daily basis to further elaborate important questions regarding how to best patent software. In particular, cases are developing to further support the patentability of software and clarify the level of detail of disclosure required in a software patent.

In general in a patent, the invention must be described in adequate detail to permit the expert reader to implement the software invention in its best version known at the time of the patent. Northern Telecom, Inc. v. Data Point Corporation, 908 F.2d 931, 15 USPQ2d 1321 (CAFC 1990) indicates that the amount of required detail of disclosure of the software depends on the difficulty of the software. Hence, the amount of required disclosure is a judgment call on the part of the patent attorney drafting the software patent. For this reason, the patent attorney should be knowledgeable in software and computer patent applications to make these judgments. It is our judgment that it is usually not required to disclose source code for an adequate software patent, provided that the inventive feature of the patent is adequately disclosed at the flowchart level. (However, if the software owner sees no competitive downside, it may help the patent to include the source code.)

The patentability of software was further supported by In Re Iwahashi, 888 F.2d 1370, 12 USPQ2d 1980 (Fed. Cir. 1989) . The patent in this case covered a computer program that calculated a coefficient pursuant to a mathematical formula and stored the answer in memory. This is the type of "calculator" program that might be most susceptible to attack as merely preempting a mathematical formula. However, the court saw this as no problem and upheld the patent. The court reasoned that a mathematical formula was not preempted, and instead a device was patented. This was because the claims included the sole physical element of computer memory and the step of storing the results of the calculation in memory. Obviously, this requirement for a mathematical software patent is no barrier to even the most mathematical program; the sophisticated patent lawyer must simply include in the patent application this step of storing the answer in memory. This surely is done by any program in any case, and would not represent a practical limitation on the invention. Since this case almost eliminates, as a practical matter, any subject matter barrier to mathematical software patents (if very carefully drafted), the easier case of the non-mathematical software patent remains even more secure.

In a contemporaneous case by the same court, In Re Grams, 888 F.2d 835, 12 USPQ2d 1824 (Fed. Cir. 1989), the bounds of a computerized mathematical algorithm patent are set. In this case, the court denied a patent where a mathematical algorithm was merely computerized. The only physical step in this patent was collecting data generally to feed the algorithm, and no special or detailed data collection steps were claimed. Hence Grams tells us that data collection and calculation is not quite enough, but Iwahashi tells us that calculation and recording the answer in memory is enough, for the merely mathematical program.

1992 Patent Case

Arrhythmia Research Technology, Inc. v. Corazonix Corp., 22 USPQ 2d 1033 (CAFC, March 12, 1992), carefully tracks the evolution of software patent law from Gottschalk forward. In Arrhythmia, the court reviewed an issued patent for a software algorithm for analyzing electro-cardiographic signals to predict heart attacks. The court held that this is patentable subject matter, overturning a lower court decision to the contrary. The court felt that this was in the mainstream of the trend of the cases on point, and the concurring opinion expressly noted the limitation on the anti-software orientation of Gottschalk.

1990 Copyright and Software Cases

Two cases developed in 1990 indicating the importance of proper contractual provisions dealing with copyright law for software products.

Gershwind v. Garrick, 16 USPQ2d 1707 (D.C., SDNY, 1990), held that a consultant hired to produce certain computer graphic animation for a producer, in the absence of contractual provisions to the contrary, was the owner or joint owner of the resulting computer product. As such the owner/consultant could proceed to use the product without permission or payment to his client, in the absence of provisions in his consulting agreement to the contrary. Further, Community for Creative Non-Violence v. Reid, 109 S.Ct. 2166 (1988) indicated that such contract provisions must be very carefully drafted in order to be effective (that is, only a written assignment of all rights may be effective, if otherwise enforceable).

Copyright protection and patent protection can be simultaneously obtained for a software invention. However, in most ways, patent protection when available, is superior to copyright protection for software. Copyright originates as a program is written and belongs to the writer, and lasts for the life of the author plus 50 years. Registration is not required for copyright, but is beneficial. Copyright protects only against copying of the protected source code, screen display, and command sequence, but not against reverse engineering of the product. Novelty is not needed for copyright. However, patents protect against reverse engineering regardless of what source code is used, and hence can be much broader. Note, though, that patent rights arise only upon application and grant by the Patent Office, after review of points such as novelty, prior art, obviousness and adequate disclosure.

This emphasizes the need to specify explicitly the ownership of any computer software that may be generated through a consultant, employment or supply agreement. This is true even where the employer provided detailed specifications for the computer product, as was the case in Gershwind.

In Lasercomb America, Inc. v. Reynolds, 911 F.2d 970 (CA 4, 1990) it was held that a programmer's copyright to his program was invalidated due to prohibited anti-competitive clauses in a subsequent license agreement for the software that constituted copyright misuse. An analogous danger would lie in a license agreement with prohibited anti-competitive clauses regarding a software or software/hardware patent. This emphasizes the need to properly draft a license regarding patents or copyrights in the software or computer area since one possible penalty for prohibited provisions would be a punitive destruction of the entire patent or copyright property. This loss of rights would not run merely to the licensees, but would also return all the subject rights to the public domain for the use of all.

Lotus and the Failure of Software Copyright

Note that a software patent, once issued, protects against "reverse engineering"by a competitor who develops independently written source code. This is protection that a mere copyright of software will not provide. As discussed below, mere copyright does little other than protect against copying of the literal source code.

The recent case Lotus Development Corp. v. Paperback Software Publishing, 15 USPQ2d (D.C. Mass 1990), indicates the prevailing inadequacy of mere copyright protected software without patent protection. In this case, Lotus had no patent protection for its spreadsheet Program. (Indeed, none of the original spreadsheet companies obtained such a patent, to their great detriment.) Lotus sued Paperback software for infringement of copyright only. The very sympathetic court cut new ground in extending the copyright of software in a patent-like direction. It found that Paperback software's V.P. planner had copied the structure, sequence and organization of the Lotus menu command system, including the choice of command terms, the structure and order of those terms, the presentation on the screen, and certain long prompts. The court found that this was a copyrightable non-literal element of the computer program, and that Paperback had committed nonliteral copyright infringement of Lotus 1-2-3. Although Paperback did not copy the actual source code of Lotus, Paperback had reverse engineered Lotus 1-2-3's function to the user with independently developed source code. After this case, however, anyone presumably remains free to develop and sell spreadsheet programs as long as they use different command structures and presentations on the screen. Hence, Lotus 1-2-3, rather than having a 17 year patent monopoly on the entire spreadsheet market with a basic patent on the concept of the computerized spreadsheet, instead merely has a copyright on the command structure and appearance of 1-2-3. Presumably, if Paperback merely changed the command structure by the use of synonyms (for example, replacing "delete" with "erase" or "replace") then they would be free to continue selling a spreadsheet program.

Legal Uncertainty, Defensive Patenting and Infringement Searches

Software patent law and business practice is developing rapidly. It must be watched for further developments regarding unclear issues. For example, the U.S. Supreme Court has yet to rule on a Pardo type case and clearly state that a computer algorithm is distinct from a mathematical algorithm and is patentable. Furthermore, the law remains unclear on how to create valid liens and security interests in patents, and this issue could be decided at any time.

One upshot of enforceable software patents is that the major players in the computer industry are rushing to obtain software patents on their current (and past) work. These patents are then used to inhibit competitors, or as sources of royalty income, or to exchange for other patent rights.

This rush to patent takes place in a regulatory environment in which the majority of patent applications that are filed are being granted in some form by the Patent Office. As a result, in some computer fields a profusion of overlapping and redundant patents may have been incorrectly granted to different conflicting parties. The result of this may be that in some of these fields, until the situation is sorted out, software patents may be of less interest for offensive purposes, but useful for defensive purposes for any company wanting to be active in the software or software/hardware market. That is, in an area where overlapping patents are being incorrectly issued, it is of some use to maintain a product in the marketplace to have at least a narrow patent covering the product.

This situation puts additional importance on the need to do a patent infringement search prior to bringing a software product to market, to assess the risk of infringing on an existing patent of a competitor. (Such a patent infringement search should be accompanied when possible by an opinion of counsel regarding non-infringement, to reduce the possibilities of a judgment for triple damages for knowing infringement.)

The bottom line conclusions from these developments are several: Increasingly a portfolio of software and software/ hardware patent assets will become an important part of the assets of technology companies and can be made a profit center through an active licensing program. Furthermore, where substantial sums of money have been spent to develop software or hardware with software, an additional cost in the order of $10,000.00 to obtain a patent may add excellent marginal returns by reducing competition, by increasing revenues from licensing, and by providing chips to trade for other patent rights. A well drafted patent by a patent attorney knowledgeable in software and computer patent applications can be a profitable cash flowing asset and effective protection for lucrative software and hardware products.

II. Who Really Owns "Your" Software: New Developments

Even though a company may have conceptualized its software, written the specifications for it, and paid the programmers to write it and debug it, that company may not own "its" software. The software may be the property of the programmers. This is most likely the case if independent consultants were used to write the source code and no written contract with them was used.

Or to put it another way, if a programmer or software consulting company has written a lot of software for clients without written contracts, then that consulting company may be the owner of a large library of software assets (which it may have thought belonged to its various clients) and which may be protectable by copyright and patent laws.

Ownership of software written by employees or consultants can be controlled by properly drafted contracts. However, if contracts were omitted or drafted using old language (and not reflecting recent changes in the federal statutes), then the resulting ownership of the software may not be as intended by the parties that paid for the development of the source code.

The legal concepts behind this situation can be summarized simply enough, but are not generally understood. Potential legal rights in software can simultaneously include copyrights and patents. Copyrights are automatically created in any written work at the time of creation, and can be registered if desired. A patent to an invention may be issued to the first inventor, but only if properly applied for and pursued by the inventor. After recent legal developments, patents can now be obtained for software programs that are new, useful, and not obvious. A patent gives the owners a 17 year monopoly to the patented software concept or application. This monopoly includes the right to prohibit programs by others that do basically the same thing but with re-written, reverse-engineered source code.

Copyrights: The Leading Case

The original owner of copyrights in software is the programmer/author. The programmer/author must be an individual or group of people; corporations cannot be authors (although they can obtain eventual ownership). The programmer/author by contract can transfer and agree to transfer all copyrights by assignment or exclusive license.

Some older contracts use language that deems the work of a consultant/programmer to be a "work for hire". The concept is that a "work for hire", from the time of creation, is not the property of the author, but instead is the property of the employer of the author. However, recent changes in federal law (see the 1989 U.S. Supreme Court case, Community for Creative Non-Violence v. Reid 109 S. Ct. 2166, herein called Reid) clarified that "works for hire" may arise only in employer/employee situations. The "work for hire", except for a few exceptions specified in the statute, cannot arise in the consultant/independent contractor situation. That is, where a consultant writes software for a client, the consultant initially owns the copyright to the software, not the client. The consultant will continue to own the software unless he licenses or assigns it in writing to someone else (who may or may not be the client).

Reid correctly interpreted the Copyright Act of 1976 as amended. Copyrights are originally owned by the author, 17 U.S.C. 201(a), but in the case of a "work for hire", the employer is considered the author, unless ownership is otherwise determined by contract, 17 U.S.C. 201(b). However, the statute defines "work for hire", as a "work prepared by an employee..." and no contract may alter that definition, 17 U.S.C. 101. The statute, however, does not define "employee". The court in Reid defined "employee", setting out a 12 factor test.

In the Reid 12 factor test, no one factor or combination of factors is necessarily determinative. The 12 factors are (1) the skill required for the job, (2) the source of the tools used, (3) the location of the work in question, (4) the duration of the relationship between the parties on the project, (5) did the paying party have the right to assign other work to the paid party, (6) how much discretion did the paid party have over when and how long to work, (7) when and how was the price paid, (8) could the paid party hire and pay assistants, (9) was the work part of the regular work of the paying party, (10) was the paying party in business, (11) what employee benefits were provided, and (12) what was the tax treatment of the paid party.

Many, but perhaps not all, consultants would not be an employee, and hence would own their work under this test, unless their contracts said otherwise.

The New Software Ownership Cases

Reid clarified the copyright statute, but it actually dealt with the copyright for a statue, not software. Recently, two federal cases have applied the Reid test to software, one for a consultant, and one for an employee.

In MacLean v. Mercer, 18 USPQ2d 1807 (December 1991), the Third U.S. Circuit Court of Appeals, correctly applied the Reid 12 factor test to a consultant who wrote software. The court decided that the consultant owned the software copyright, not the client. The software program was not a "work for hire", and the consultant was not an employee, because the consultant controlled the "manner and means" of how he wrote the software. There was no contract that assigned the copyright to the client. The court went on to comment that only the copyright owner may license to copy, distribute, or display the work, 17 U.S.C. 106. Furthermore, an effective exclusive license from the owner of the copyright can be made only in writing, 17 U.S.C. 101, 204(a).

In Aymes v. Brenelli, November 12, 1991, (Copyright Law Decisions, CCH ¶26,828), the U.S. District Court for the Southern District of New York correctly applied the Reid test. It found that an employee programmer did not own the program that he wrote because he was an employee, it was therefore a work for hire. There was no contract that assigned the copyright to the employee.

Since the statute defines "work for hire", a consulting contract that deems software to be a "work for hire" owned by the client is probably not effective, and ownership of the program would remain with the consultant despite the contract. Where such an unenforceable contract clause is used, the consulting client may have only a non-exclusive license to use the software, and the consultant/creator would be free to sell, license, or use the software with other parties. To avoid this problem, the consultant's client should be careful to draft the consulting contract to assign and agree to assign all copyrights to the client, without using the work for hire concept.

Patents: A Similar Problem

A similar situation arises with patent rights in software. The original ownership of a software invention is with the inventor. In any particular case, the software inventor may be the programmer, the employer, the consultant client, or others, depending on the facts. A written agreement can determine ownership in any manner agreed to, by using language of assignment or license. In the absence of a written agreement, an invention within the scope of employment of the inventor may equitably belong to the employer, and pursuant to case law, the employee would have an obligation to assign the invention to the employer. An invention outside the scope of employment would belong to the employee, but if the employee used assets of the employer to help develop the invention, then the employer may have a limited non-exclusive right to use the invention without royalty (often called "shop rights"). There are probably no shop rights for the invention of a consultant or vendor, although there may be an implied oral license of some scope of the client.

The bottom line is that in the absence of a written agreement, assignment or license, the employer or consulting client may have at best a nonexclusive license to use the patent (if the employer or client can prevail on the necessary questions of fact), but the inventor would retain all other rights to make, use, sell or license the invention to other parties.

The Solution: Prior Contract

Therefore, whenever an employee and consultant develops software for a company, that company should in advance seek a written agreement which among other things specifies where ownership of all the rights, including copyrights and patents, will finally rest. This can usually be done by an assignment or agreement to assign all intellectual property rights.

Note, however, that many software development contracts that handle eventual ownership deal only with the copyrights. This is a major oversight since it is now clear that software inventions have the possibility of simultaneous parallel protection by both copyright and patents. Therefore, a software development contract that merely assigns copyrights in a program, but does not mention patents, would leave the consulting client in the strange position of owning the copyrights to the source code, but not the patent rights to the software invention. In this case, the client-copyright-owner of the source code could not use the source code without infringing someone else's patent. In a practical situation, this is as useful as buying half a pair of shoes, and leaves the copyright owner hopping around on one foot with little in the way of useful (or exclusive) ownership rights.

A similar "ownership surprise" can arise where software is written by an employee, instead of a consultant, although there are some distinctions. The "work for hire" language will work to convey copyright in a contract with a true employee and a written assignment will convey patent rights of an employee. But the basic rule holds that without a proper written contract, the employee may own an important interest in the software that he writes, to the surprise and chagrin of his employer.

An Approach for All Technologies

The situation described here for software patents applies generally to all inventions and patents (including mechanical devices, processes, and drugs) and is not limited only to software.

The conclusion from this state of the law is that whenever proprietary software (or any new technology) may be developed, well written modern contractual provisions should be used to clarify the ultimate ownership of all the rights in the eventual software. Otherwise the parties may be surprised, pleasantly or otherwise, regarding the identity of the actual owner of the proprietary programs. Indeed, this step should be part of a larger program to identify, develop, protect and exploit intangible intellectual property assets of all kinds.

Managing the Privacy Implications of New Technology

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1. ABSTRACT

A recent national privacy survey undertaken by a consortium of Canadian companies, associations and government departments reveals that invasion of privacy ranks with environmental, educational and employment issues as a major concern for Canadians. In this paper, Brian Milton outlines the results of this survey and describes the initiatives of Canada's major telecommunications companies in addressing this growing problem. He then illustrates how the privacy issue is simply one link in a chain of events and perceptions that require a fundamental shift in the way the telecommunications industry has managed the social implications of its technologies.

2. INTRODUCTION

In business today, social factors have become inseparable from the more traditional benefits of price, value and convenience. As a result, showing leadership in telecommunications now requires a new level of sophistication and sensitivity to a more complex set of customer needs and requirements.

The partner companies in the Stentor Alliance, the new consortium of Canada's major telecommunications companies, have long been cognizant of their social responsibilities. The practice of subsidizing local rates with long distance revenues, for example, has allowed Canada to achieve the second highest penetration rate of telephones in the world (after Sweden) despite our country's formidable geography. However, a new class of social issues has arisen where the concern is focused not so much on pricing or access but rather on the purely social or cultural implications of new technologies and new services.

In Canada, automated dialing devices and telemarketing scams have increased customer annoyance with telemarketers, raising perceptions of privacy invasion and inviting the attention of governments. The introduction of 976 services in Canada has caused considerable controversy as well, raising a cluster of social questions from the morality of carrying "pornography" over telephone lines to the problem of irresponsible or uninformed household members generating huge, unexpected telephone bills.

Call Management Services, particularly Call Display, have probably provided the most challenging and vocal expression of service-related social issues to date. Cellular and mobile radio services which pose the risk of eavesdropping have also generated publicity. In the future, Personal Communications Services, among other innovations, will undoubtedly carry potential privacy and confidentiality implications.

As these examples make clear, by far the most persistent and widespread concern throughout these newer social issues has to do with privacy and the perceived threats to individual autonomy posed by new telecommunications technologies. Indeed, a Consumer Affairs report released by Price Waterhouse argues that privacy issues associated with Caller ID, debit cards, telemarketing and the sale of lists, smart cards, E-mail, Voice-mail and interactive communications technology will dominate Canada's consumer agenda during the 1990s.

There are two equally important aspects to the privacy issue. One is ensuring an individual's protection from unwarranted intrusions -- what could be called the "leave me alone" variety. The second is ensuring an individual's ability to control the flow of information from and about him or herself -- or the "none of your business" type. These areas have not been problematical for the telecommunications industry in the past.

But, the future promises a wide array of new, profitable services capable of generating vast amounts of information about an individual or an organization. For example, Call Management Services and new telemarketing technologies, which are currently perceived by some groups as privacy invasive, are both high growth and high profit areas.

In forming the Stentor Alliance, the major telephone companies in Canada recognized that they needed a clear focus to effectively manage these new and emerging issues. As a result, Stentor Telecom Policy was established and directed to centrally manage these and other issues on behalf of its shareholder companies across Canada.

Stentor Telecom Policy believes the Canadian telecommunications industry must take proactive measures to effectively manage the privacy issue, otherwise our ability to offer new services may be hurt. Our overall goal -- to develop a policy framework that would promote the rapid deployment of new technology while safeguarding customer privacy -- would reduce the regulatory, legal and public image costs of launching new services. This represents an important advantage to our shareholder companies as they strive to meet the needs of their customers in an increasingly competitive and challenging market.

3. CANADIAN PRIVACY SURVEY RESULTS

To assess and respond to the concerns of Canadians regarding privacy, Stentor, the Canadian Bankers Association, American Express, Equifax Canada, together with the federal government's Department of Communications, Privacy Commission, Consumer and Corporate Affairs Canada and Statistics Canada sponsored the Canadian Privacy Survey.

Conducted between October 28 and November 5, 1992 by Ekos Research Associates Inc., the sample consisted of over 3,000 Canadians, weighted to 1991 Census figures on sex, language, area code and education. The 90-item survey polled respondents on their concerns in general and specifically regarding privacy relative to the impact of information and telecommunications technology on their personal and working lives.

The results indicated that privacy concerns are remarkably high with only three per cent of the respondents "not at all" concerned and 52 per cent extremely concerned. Indeed, invasion of privacy ranks with environmental, educational and employment issues as a major concern of Canadians.

Overall, 92 per cent are at least moderately concerned across all major socio-demographic segments. Concern is highest amongst the poorly educated (high school education or less 59 per cent extremely concerned compared to 47 per cent some post-secondary and 44 per cent graduates of post secondary institutions) and women (56 per cent versus 46 per cent of men).

Moreover, the survey revealed a broad sense of eroding privacy paralleled by a trend towards less trust in government and big business. There's an "Orwellian" fear of being watched or controlled without an individual's knowledge. Aspects of invasion of privacy which involved lack of control, consent or awareness were among the most troublesome to the majority of respondents.

On the other hand, disturbances such as unwanted telephone calls and visitors at the door (which are announced and can be curtailed) are viewed as much less important. People clearly distinguish between the two types of privacy problems. The "leave me alone" type is considered a nuisance more than anything else while the "none of your business" type is viewed much more seriously.

It should come as no surprise that the growing concerns regarding privacy are fueled by the proliferation of new technologies and services. The survey indicated a general acknowledgment that new technologies -- particularly computers -- pose an increasing threat to privacy.

Clearly, with the growing complexity and sophistication of technology, Canadians are worried about their privacy. However, a rational disentanglement of level of threats is also apparent from the survey results. For example, there is little concern about being monitored by utilities, moderate concern with cable monitoring and serious concern regarding the linking and/or sharing of personal data. Interestingly, concern is also reduced when two conditions apply: one, the implications for privacy are explicit and transparent and two, clear benefits are perceived in the service.

In summary, general concern regarding privacy is always higher than specific or concrete concerns; the relatively powerless are significantly more concerned than more mainstream groups; control of personal information is much more problematic than traditional privacy intrusions; and concern is highest where the author, purpose and consequences of privacy invasion are unknown.

Americans appear to share the concerns of Canadians in this area. A 1991 survey conducted by Louis Harris and Associates found that 71 per cent of U.S. consumers believe that "consumers have lost all control over how personal information about them is circulated and used by companies" and are concerned about loss of their personal privacy.

4. BENEFITS AND DRAWBACKS OF FORMALIZING A PRIVACY POLICY

Stentor Telecom Policy is spearheading its shareholder companies' efforts to address these privacy concerns through a formalized privacy policy whose framework includes a Model Code of Fair Information Practices as well as a more telecommunications-specific set of privacy principles and guidelines for marketing and public affairs.

Without a formal, coordinated policy, we risked delaying or limiting the introduction of new services. Individual shareholder companies could have also developed different, or even conflicting, policies. Most importantly, without a national coordinated policy, the Stentor shareholder would have certainly lost their ability to effectively manage the privacy issue. That control would have passed to regulators, legislators or the courts.

On the other hand, with this overall coordinated policy concerning privacy, the shareholders of Stentor will perhaps enhance their corporate reputation. At the same time, Stentor has the opportunity to influence the public debate about privacy and contribute our expertise to help shape the laws and regulations that will affect how we offer new services.

Equally essential, with a formal privacy policy, the Stentor shareholders can reassure their customers about current and future service offerings. It also provides the guidelines that will inevitably ease new product development and service introduction.

With time, the shareholders of Stentor may be viewed as leaders in the shaping of a national agenda on information policy. And that prestige could be used to leverage other policy initiatives.

Of course, there are risks to this approach. Short-term profits and expenditures will be affected. There is also the potential for embarrassment if the policy is not upheld. Nevertheless, by educating employees and other interested parties and by working with regulators and legislators to ensure they understand our initiatives, these risks can be minimized.

5. MODEL CODE OF FAIR INFORMATION PRACTICES

The first thrust in Stentor's privacy policy framework was the development of a privacy code, modeled on the OECD Guidelines on the Protection of Privacy and Transborder Flows of Personal Data. The Model Code of Fair Information Practices created by Stentor Telecom Policy Inc. is a comprehensive and formal statement of principles and guidelines for the protection of personal information throughout the policies and operations of each shareholder company of Stentor Telecom Policy. It is currently being adapted by each company to meet their individual needs.

The Model Code deals specifically with the collection, storage, protection, use, disclosure, individual verification and correction of personal information. Essentially, it ensures the responsible handling of personal information provided to the Stentor companies by their customers and employees. It also reflects the many existing company policies and regulations already in place throughout our companies.

The Code formally ensures that Stentor companies will use personal information only for lawful, clearly understood purposes relevant to the conduct of business and not for any other reasons without the individual's consent. As a result, companies will not divulge anything other than the name, address and listed telephone number of a customer (except to authorized and clearly identified third parties) and anything other than an employee's or pensioner's name, position and duration of employment. In addition, disclosures will be bound by formal contracts stipulating how the information can be used.

The Code also entrenches the right of customers and employees to examine and, if appropriate, challenge personal information about them in the member company's master files. It emphatically requires that all employees with access to personal information protect its confidentiality.

Ultimately, responsibility for ensuring compliance with the provisions of this Code rests with the senior management of each company.

Each Stentor company will formally review and update their individual Codes at least every five years to guarantee that Code provisions remain current and meet the evolving needs of the company, its employees and customers.

6. PRIVACY PRINCIPLES IN NEW SERVICE DEVELOPMENT

As a supplement to the Privacy Code, a more detailed telecommunications-specific set of privacy principles was developed to serve as the basis for ensuring privacy protection in the development and provisioning of new services in our industry.

To establish the credibility of these principles and provide guidance to key employee groups, they were further incorporated into a module of the new "Integrated Product Management Plan (IPMP)", a comprehensive series of management procedures and practices guiding the development of new products and services. In effect, product and service managers are now required to undertake social impact assessments much as they currently do economic evaluations. This is similar to the situation in New York and in Canada's province of Manitoba. But, unlike these jurisdictions, we undertake these assessments on a voluntary basis.

The purpose of this assessment is to identify at an early stage the extent to which a proposed product or service may affect the privacy and/or personal security of customers - not only users and end-users, but non-users as well. The assessment addresses expected change(s) in the level of privacy for customers and identifies options and measures that would allow customers to re-establish their personal expectations of privacy and the effort and expense of making that possible.

It also evaluates the type and extent of information that should be provided to customers to enable them to make informed decisions regarding the use of the proposed product or service. It further determines whether advance consultations with customers should be undertaken to clarify any vague implications and identify additional options.

In assessing any expected changes in privacy during the product development cycle, both facets of the issue are considered -- freedom from intrusion and control over information on and about oneself. In this case, freedom from intrusion refers to uninvited sales calls, electronic monitoring and any invasion of what would commonly be considered as a person's intimate, personal or private life.

Control over information is defined in terms of commonly accepted rules that include: minimizing the information collected; collecting it directly from the person involved, restricting its use to an openly stated purpose; keeping the information secure and not providing it to a third party without the customer's consent; and allowed the customer access to the data and the opportunity to verify its accuracy.

7. FUTURE CHALLENGES

James Katz, a Bellcore authority on the social implications of telecommunications, anticipates that social issues like privacy will continue to migrate from the periphery of the business to centre-stage. Telecommunications has become a highly visible and important component of personal and business life. Network changes and the frequent introduction of new (and different) services are therefore more visible and generate greater public scrutiny.

However, while such changes to the network have a uniform impact on subscribers, the needs of subscribers are becoming increasingly diverse, and at times exclusive. Nevertheless, newer services are usually mass marketed rather than custom marketed and, as a result, can be viewed as intrusive of threatening by sometimes significant minorities of subscribers.

For example, groups such as the disabled, the elderly, and women's groups are asserting themselves in the marketplace and regulatory arena by equating threats to their consumer rights with an assault on their human rights. In seeking to influence the agenda, these groups often seek the help of the media, local politicians and the courts to politicize the issue and pressure regulators.

Balancing these diverse and often conflicting needs with the equally pressing demands of a more competitive and fast changing market is perhaps the most difficult aspect of managing the social implications of new technologies. What is more important - the benefits of a new service to a vast majority of customers or the potential drawbacks to a small, albeit important, group?

Perhaps even more important is the way the telecommunications industry tends to manage these issues in the first place. Instead of examining the issue from a variety of perspectives and then deciding what is best for this group and that group, wouldn't it make more sense to have special interest and consumer groups involved from the beginning. Wouldn't it be easier -- at least in the longer term -- to have concerned groups help make the decisions, instead of arbitrarily making decisions for them. The real challenge, then, becomes to move from an "them-us" mentality to the more constructive "we" approach to issues management.

Another growing challenge for the telecommunications industry stems from a growing lag between technology and policy. The Economist, in its 1991 survey of telecommunications, highlighted the problem as follows:

"For most people, telephones have been taken for granted for too long for them to be associated with other jolting applications of modern science...the danger in this is that a telecom industry driven by bold entrepreneurs with increasingly potent technology could race far ahead of societies that have only just woken up to the fact that big companies are in it for the money. So regulators, politicians and lawyers need to get off to a good start on some of the complex issues involved."

Bellcore's Katz agrees, observing that, ..."all the good solutions require technology and policy to proceed hand in hand. To do one without reference to the other is not a very sound way to go about creating new services that will satisfy market and social needs."

The most pressing danger associated with a continuation of this technology/policy lag is that the regulator will be forced into adopting a cautious and overly restrictive attitude to new service deployment.

In other words, unless the industry demonstrates sensitivity to the social impacts of new technology, legislators and regulators, in their own political self-interest, may adopt strategies that are not necessarily conducive to a rational development of telecommunications policy. In any event, regulators will likely respond more readily to public voices of complaint than industry voices for the benefits of new technology.

To close the growing gap between technology and policy, Stentor Telecom Policy believes the best approach is pro-active company measures, self-regulation and broader consultation. Failing this, new regulation or, more likely, protracted and longer regulatory investigation will likely become the norm.

8. CONCLUSION

Clearly, social issues are moving to the forefront as telecommunications become more indispensable and as technology becomes more socially intrusive. Privacy, however, is only the first wave of this movement. The number of issues is multiplying, their individual complexity is growing, and so is the complexity and dynamics of the interrelationships among those issues.

In other words, privacy cannot be viewed in isolation. As the national privacy survey conducted in Canada revealed, there's a growing anxiety bordering on fear that goes far beyond a loss of privacy. A substantial number of people feel disenfranchised. They do not quite know what the problem is or how to handle it. But, it exists nevertheless and they want something done to give them back a sense of control over their lives.

There are two ways to dissipate this type of fear. One is to provide the assurance that there are no hidden agendas and the other is to clearly demonstrate that something will provide a clear benefit. To succeed in the increasingly competitive and global market for telecommunications services, companies must get their customers more intimately involved in assessing the social impacts of new technologies. Indeed, customers should become what Alvin Toffler called "prosumers" in the product development process.

This new emphasis will not be tidy or simple and it will not always provide trouble-free services or perfect solutions. But it is clear that it is becoming a necessary part of doing business in the Information Age.

In its September 1991 review of "Computers, Networks and Public Policy", the Scientific American summarized the future challenges this way:

"The road to the global village is a bumpy one. As computing and communications technologies fuse, they create ways to express ideas, generate knowledge and share information. The new technologies also redefine time and place in a manner than can confound the traditional legal concepts of property, ownership, originality privacy and intellectual freedom. Government must address such issues, and it must also build a framework of policy that enables the economic and intellectual opportunities of the emerging technologies to be realized."

The telecommunications industry must also address such issues and participate fully in molding the framework that will cushion the ride into the future. First, though, both government and business must remember that the best policy frameworks and solutions result when the right processes and people are involved in the first place.

THE PERSONAL DATA PROTECTION REGIME EMERGING IN KOREA

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1. Abstract

The collection and use of personal information by the public and private bureaucracies have been considered a threat to privacy in most Western industrialized countries and recently in the less developed countries as well. Studies on regulatory ways to protect personal information have focused on the cases in the highly industrialized Western democratic countries despite the fact that the possible invasion of privacy and surveillance is no less serious in other countries including those in Asia. This study examines how the particular political, economic and cultural circumstances of Korea are reflected in the Korean data protection policy which has been formulated since 1991, and at the same time, may influence the effectiveness of the implementation of the policy.

2. Introduction

The protection of personal information has long been the subject of controversial debate in most Western democracies, but little agreement or solution has been reached due to the constantly changing technological and social environment. Privacy is also a difficult concept to define since it deals with subjective matters whose meaning vary from country to country and from time to time. Samuel D. Warren and Louis D. Brandeis are often acknowledged to have proposed the definition of the "right to be let alone" in their seminal law review article, "The Right to Privacy," published in 1890. In 1967, Professor Alan F. Westin of Columbia University defines in his book, Privacy and Freedom, that "Privacy is the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others." His definition applies the notion of "privacy" to the issue of collection and use of personal information, and hence, shifts the focus of the issue of privacy from giving individuals a "right to privacy" to granting rights specifically related to personal information (13).

Personal information consists of those facts, communications, or opinions which relate to the individual and which would be reasonable to expect a person to regard as intimate or sensitive and thus to want to withhold or restrict her collection, use, or circulation (15). Governments, bureaucracies, and organizations collect and store personal information in order to reduce uncertainty and risk in making decisions. Although public and private bureaucracies have been collecting and maintaining information on individuals for centuries, the development of computer technology and telecommunications has dramatically changed the nature and the capacity of information handling. New information technology which allows computerized data processing provides the potential for organizations to more easily collect, store, manipulate and communicate great amounts of data about individuals (1). In addition, there also has been a qualitative increase in the sensitivity and personal nature of the information contained in records (13).

This increased ability for governments and businesses to collect and use information is considered a threat to privacy in that more aspects of an individual's life are known to more people and more organizations and that the individual loses control over personal information (11, 13). Decreases in individual privacy are paralleled by increases in bureaucratic knowledge and control. Several observers identify a significant problem in the magnified potential power of modern bureaucratic organizations in relation to individuals (1, 5, 13). The computerized collection and use of personal information by bureaucracies in turn has increased public concern for protection of personal information (6, 10). The concern has been that individuals can no longer adequately protect their own privacy without the assistance of regulation and regulatory authorities, especially with respect to the information-handling activities of the bureaucracies (1). The issue of privacy or data protection has risen to the political agenda of most liberal democracies and some other countries (1) and many among them have instituted some kind of data protection regime. The existence and the nature of personal data protection policy could generate great social, political, and cultural influences on the ways in which informational privacy is protected in the society.

Various actors in a society including the public bureaucrats, private bureaucrats, and individuals try to influence the outcome of data protection policy due to different interests regarding the collection and use of personal information. Since all bureaucracies regard information as critical to their internal dynamics and to their relationship with other organizations and individuals, bureaucracies tend to resist the efforts of outside bodies to enact laws of data protection and try to ensure a weak enforcement framework (1). On the other hand, individuals generally want data protection regulation so that personal information is not used against their own interests. The issue of personal data protection becomes more complicated in that the right to privacy is bound to come into conflict with other rights such as the right of the public to know, and legal rights of freedom of expression and freedom of the press. Also, the right to privacy often seems to conflict with efficient practices of government. The conflict gives rise to considerable practical difficulty in drawing the legal boundary between these rights. Establishing a data protection regime is thus inherently a process of balancing various competing rights or values and of balancing interests of various actors. Different types of data protection policy are the results of decision making, which reflects value judgements and power relationships among the actors in each country. The examination of similarities and differences in data protection policies in different countries will contribute to enhancing our understanding of important factors that influence the implementation of data protection policy.

In countries that have not developed democratic governments and industrialized societies, the acquisition of information technology including computers have often been used as a useful tool for repression of political and social activity. It has been argued that many governments in Latin America, Asia, and Africa have supplied computer systems for the purpose of repression and surveillance of their populations (9). Moreover, the privacy of the individual is not considered a high priority by most Asian governments or their citizens (9). In this situation, establishing data protection policies in these countries would have significant impacts on the issue of privacy in terms of the ways in which personal information is allowed to be gathered and used. Despite this importance of the data protection policy in less developed countries, previous studies exclusively focused on highly industrialized, liberal Western democracies, thus failing to fully consider some important factors that might influence the formation of data protection policy such as external pressures and cultural factors.

Examining the ways in which the data protection policy is implemented in those countries with less economic development and/or a different cultural background from Western democracies would provide an insight not only on the theoretical knowledge of the data protection policy process but also on the possible type of data protection policies in other countries in which the policy has not yet fully emerged. In Korea, as an example of a relatively less developed country, the concern for the use of personal information has recently arisen, and a data protection policy has been formulated by the government. Since Korea has begun to use new information technology to manage information on its citizens and is in a quite different cultural and economic circumstances from the Western industrialized countries, the emerging Korean data protection policy would provide a valuable site for a case study.

This study starts with identifying several different types of data protection policy. The cases of four countries of the United States, Britain, Sweden, and West Germany -- which have been examined in previous studies -- will be compared in order to examine how nations with different structural, historical, and cultural features have responded to the problem posed by personal information. I will explain the similarities and differences in each country's data protection legislation as influenced by technological factors, internationalization, political structures, economic situation, and cultural influences. These factors provide an analytical framework for examining the data protection regulation and policy in Korea.

2. Characteristics of Personal Data Protection Policy

2.1 Principles of Personal Data Protection

Previous studies agree that the principles of data protection policy are similar among countries (1,3,13). For example, Bennett, in his comparative study on the data protection regimes of four Western democracies, finds that data protection or privacy statutes all embody a common set of "fair information principles": the right of the data subject to see, copy and correct personal records; the right to know and control how and to whom that information may be transmitted; limitations on collection to "relevant and necessary" information; the registration with some central authority of all manual and/or automatic personal record-keeping systems; and procedures for challenging and correcting abuses. However, many of these principles are subject to a variety of exemptions in the implementation of the policy (1). The implementation of data protection varies in terms of many aspects: what aspect of personal information problem the policy is designed to correct primarily, what type of agency (if any) is established to lead the protection, what are the characteristics of the agency in terms of its responsibilities and enforcing power, and what is the scope of regulation (1, 3, 10).

2.2 Objective of Legislation

Regan suggested that approaches to personal information handling can be categorized as the "civil liberties approach" and the "information control approach." These two approaches differ in their definition of the problem and their impact on the bureaucracy collecting and using personal information. The civil liberties approach views the major problem resulting from bureaucratic personal information practices as the weakening of the individual in dealings with a bureaucracy collecting and using such information. The solution then is to give individuals new rights or to extend existing legal actions so that individuals can protect their interests in personal information. However, since this approach relies on the individual as initiator of any action to protect her interests, it requires that the individual be aware of her rights, understand the potential threats posed by bureaucratic collection and use of such information, and be willing to invest the time and money to protect her interests. In addition, this approach only provides remedies once misuses have occurred.

The information control approach views the problems arising from the collection and use of personal information as the result of the information policies of bureaucracies, thus the solution is sought in terms of regulating bureaucratic collection and use of such information. The principle means of providing for such regulation is the establishment of an independent non-operating agency specifically concerned with the task of monitoring information systems and preventing its abuse. Between these two approaches, the information control approach is regarded as more effective in addressing the effects of personal informational collection and use on individuals than the civil liberties approach.

2.3 Data Protection Agency of Implementation

As discussed above, the existence of an independent, separate agency for personal data protection is essential to make the data protection regulation work in practice. Without a specialized mediating structure between individuals and record-keeping organizations, data protection legislation depends entirely upon the data subject's participation. According to Bennett, this approach is called the "subject control model," as distinguished from the "institutional control model" which requires separate control mechanism. Subject participation takes two forms under personal data protection policy. The first is control through the specified rights of access and correction. However, as discussed in the civil liberties approach, this entails complicated processes: that people must know about the existence of databanks, their purposes and contents; that individuals should have the right to be informed on demand of the information registered about them; etc (1). The second form of the subject control model is the enforcement of data protection rights through the courts. To the extent to which the citizens are not prone to the participation either directly to the record-keeping organizations or indirectly through the courts, however, this control model can be ineffective.

On the contrary, the institutional control model requires the establishment of an institution which can both regulate the record keeper and assist data subjects in the pursuit of their rights. The nature of an institution can be divided into three types: licensing agency, registration agency, and data commissioner. With a licensing agency all operators must register their information systems, and without the permission of the agency no personal data may be processed. Registration differs from licensing in that control agency would have no authority to block the establishment of an information system. A Data Commissioner acts as an agent of the legislature to intermediate a citizen and a record-keeper. With no power of enforcement and regulation, a Data Commissioner relies on complaints from citizens (1). The regulatory power depending on the nature of an agency is important, but the power is also subject to the actual working in practice in the relationship with other forces in a society.

2.4 Scope of Regulation

Data protection policy also varies in terms of the scope of legislation. Whether the same principles and regulation are applied to both the public and the private sectors or only one of these is an important question. It often reflects the relationship between the government and private sector, and the extent of the independence of the policy making entity from other public or private bureaucracies. Also, whether the regulation covers both computer record systems and manual files or computer files exclusively could make substantial differences in the way that data protection policy is exercised. Although the problem is created by the automated record-keeping systems, manual record-keeping systems can pose just as much of a threat. If the regulation only covers computer record systems, many data subjects remain unprotected and users can evade data protection simply by transferring personal data into manual records.

Various aspects of implementation of data protection legislation could influence the effectiveness of the data protection policy. Some implementation methods seem to have the potential to be more effective than others, although the effectiveness of any data protection policy cannot be automatically determined by formal classification of implementation strategies.

3. Four Examples of Personal Data Protection Regime

The experiences of the United States, Britain, West Germany, and Sweden provide a background for an analytical framework which will allow us to study the Korean case. As noted earlier, the principle of data protection legislation has been found to be similar in each of these countries, thus it is not discussed in detail in this section. Table 1 shows a summary of the comparison of the implementation formats in the four countries. Since I conducted secondary data analysis using other scholars' analyses and reports on the policy in these countries, some of these forms may have been modified. However, I believe this table provides some insight into the ways in which privacy policy is implemented.

3.1 United States

The United States takes a civil liberties approach which focuses on giving individuals rights of access, correction, and knowledge (13). The Privacy Acts of 1974 and 1980 and other privacy acts are primarily designed to regulate the government: to prohibit federal agencies from disclosing records of individuals; to prevent government access to individual financial records except for certain purposes; or to limit government officials or employees from searching for or seizing any work product materials used for public communication (11). But no separate agency was established to implement the data protection policy. Without an institutional control mechanism, the only means of enforcing informational privacy are through judicial enforcement and oversight by Congress and the Office of Management and Budget, which has been criticized for its laxity in data protection. The United States is the only country that restricts its data protection laws primarily to government bodies. Only the Privacy Protection Study Commission as a specialized, ad hoc Commission investigates and makes recommendations for the protection of personal information in the private sector on a voluntary approach, rather than a legislative or regulatory approach. With few exceptions, private organizations that collect and use personal information are only subject to voluntary internal codes for data protection. No distinction is made between regulation on computerized and manual records.

3.2 Britain

Britain has passed the most recent comprehensive data protection legislation among the four countries. Since concerns about privacy and computers were aired in 1960's, the British policy process was characterized by procrastination and controversy (1). Constitutional law does not state positive protection for privacy. Common law had developed no independent protections for privacy, nor were there other common law principles that could be extended easily to the protection of personal information. In addition, the judiciary is not active in settling disputes on personal information protection. Due to the Council of Europe Convention on international data flow, however, Britain received much pressure to develop a formal data protection policy. Without data protection Britain was in danger of being excluded from lucrative European markets. The Act relied on the requirement that all users of data systems which process automatically information relating to identifiable individuals be registered (1). The Data Protection Registrar is an independent body with the powers to draft and enforce codes of practices of public and private information systems and to require registration of all public and selective private information. But with a small staff, the bulk of the Registrar's responsibilities is related to establishing and updating the Register and compliance with data protection principles is largely voluntary. British policy gave up direct control in both sectors, but it was able to maintain some indirect control over a special committee in the private sector while its ability to exert any indirect control in the public sector was virtually non-existent. The Act does not cover manual files, but only protects computerized information.

3.3 West Germany

West Germany has introduced comprehensive data protection legislation focusing more on regulating the flow of personal information than on providing individual rights (3). The Federal Data Protection Act became law for the public and private sectors in 1977. The law created an independent Data Protection Commissioner who, by advising the federal government and individual ministers, is supposed to ensure that the Data Protection Act is implemented. The Data Protection Commissioners only have supervisory authority, compared with Britain and Sweden where a data protection agency has authority for registration and licensing respectively. Both public and private sectors are subject to the personal information protection, but regulated differently. Private sector information systems are the responsibility of the traditional regulatory agency for the sector concerned. Therefore, the West German data protection policy seems to regulate the public sector more strictly than the private sector. It covers both manual and computerized systems.

3.4 Sweden

The Swedish Data Inspection Board, an independent agency, pays special attention to the nature and quantity of the personal data being collected, how and from whom the data are being acquired, and the attitudes of the data subjects. The Data Inspection Board has strong regulatory authority and power in this area and has the authority to license all computerized public or private systems and to enforce compliance with its regulations. It is unlawful to start or maintain a data base of personal information in machine-readable form without applying for and obtaining a license from the Data Inspection Board, unless the Cabinet or legislature creates it. The Swedish data protection policy does not make distinction between the public and private sector, although many exceptions are given for governmental use of personal information. The scope of the Data Act is restricted to file, lists, or other notes kept in automated and identifiable form. Manual files are not regulated. Despite the strong licensing approach of data protection in Sweden, various issues remain unresolved. Sweden is an example of a country that exhibits differences in the data protection approach appearing on the Data Protection Act and actual practices. I will discuss this later in relation to cultural factors influencing data protection implementation.

4. Explanatory Factors of Personal Data Protection Policy

I have discussed various approaches to implementing data protection policy in the United States, Britain, Germany, and Sweden. The similarities and differences in the personal data protection regulation in these countries can be explained by the different political structural, economic, cultural, technological, and international factors in each country. It should be noted that since the studies of personal data protection policy have focused on highly industrialized Western democratic countries, the studies tend to emphasize more on political and structural factors in explaining different data protection policies, and either to de-emphasize the differences in economic and cultural factors among the countries, or to conclude that these factors are not critical in shaping the personal data protection policy. It should be emphasized that depending on the developmental stage of which a country establishes a data protection policy, the same kind of factors seem to influence the data protection policy in different days. In addition, any attempt to explain data protection policy in relation to these features of countries will be more successful when applied to the policy formation process than to the policy outcome itself since a different combination of other factors comes into play at that stage in each country.

4.1 Technological factor

In the previous literature it has been argued that technology not only generates policy problems initially, but also causes the convergence of data protection principles among countries (1). The argument is that societies at the same level of technological development will face the same problems and policy makers have a strong incentive to formulate laws with sufficient latitude to embrace future eventualities. It is certain that the data protection problem is one created by technology. But since the same kind of technology might be used differently in a country with different cultural background and economic development, the question is not so much about technology itself but the application of technology. The argument that the technology influences the convergence of data protection principles might apply only to the Western liberal democracies which share similar levels of economic development and similar cultural backgrounds. Therefore, if the characteristics of technology influence the convergence of data protection policy at all, it does so more by giving policy makers incentives to learn from other countries than by the nature of the technology itself.

4.2 Internationalization

Previous studies have suggested that the international policy community plays a significant role in guiding convergence in the data protection principles among countries (1). But international factors influence the policy making process in a different way depending upon the extent to which the policy is made by autonomous choice of policy makers, and upon the temporal stage in which data protection policy is legislated. Countries that legislated earlier tend to have made relatively more autonomous decisions than those made by countries adopting policies in later years. Some scholars supporting a harmonization theory argue that international organizations, especially the Organization for Economic Cooperation and Development (OECD) and the Council of Europe, played an important role in suggesting data protection principle guidelines and taking authoritative actions. According to these scholars, the similarity of principles largely reflects the guidelines suggested by OECD: collection limitation; data quality; purpose specialization; use limitation; security safeguards; openness; individual participation; and accountability (12). The Council of Europe's convention allows data protection authorities to refuse the transborder flow of data to countries that do not have adequate data protection. Therefore the Convention may have had a direct impact on these countries that legislated late. Certainly the way Britain, the one country among the four that most recently established personal data protection legislation, adopted data protection policy supports this argument.

But international pressure does not explain how countries that legislated earlier developed similar data protection principles. In the case of Sweden and West Germany, which legislated personal data practice relatively early, active cooperation of policy makers seem to have played a critical role in developing similar principles. There is an alternative argument which suggests that policy convergence has been caused more by autonomous choice than external constrain [..]. The argument is that policy makers not only had these motivations to learn, but also had opportunities for continual learning about different views and experiences through intense participation in international bodies. What is less clear, however, is the effect of international harmonization and cooperation efforts on those countries that do not show any motivation to cooperate. For example, the United States, which was not party to the discussion in the Council of Europe, had developed a similar model in its Privacy Act of 1974. There is no clear evidence or good reason to believe that United States policy makers felt pressures for conformity or were motivated to learn from its peers. Neither technological difficulty, ubiquity of the problem, nor international pressure or harmonization completely explains the similarity of data protection principles found in these four countries which had different level of international participation and different histories of developing data protection regimes. Another alternative explanation is in the nature of the value or right that the data protection legislation tries to protect. Since the value of privacy is a basic human right, no country would argue against the legitimacy of the fair information principles. Therefore, many of these principles would be subject to a variety of exceptions at the level of implementation, depending on the country and type of organization concerned. The variance in data protection policies would thus lie in specific applications of these principles.

4.3 Political structures

Political structures are the most frequently discussed factors in the literature on personal data protection policy. Regan has tried to explain the difference in policy choices for data protection between the United States and Britain as a function of the nature of liberal democracies. Her measure of liberalism involves four prominent features of democracy; limited government, separation of power between the executive and legislature, protection for individual rights, and the role of the judiciary. Regan argues that all these elements of liberalism make liberal democracies choose the civil liberties approach rather than the more effective information control approach. According to her, European continental countries with more integrated governments adopt the information control approach, while the United States and Britain, which she identifies as more liberal democracies adopt the civil liberties approach or are unable to choose an appropriate approach. Between the two liberal democracies, the United States which is the more liberal has a less effective data protection policy than Britain because she has not chosen an independent non-operating agency with regulatory power, which is the primary technique of information control.

However, Regan does not distinguish between the structural elements and philosophical or cultural elements in her measures of the liberalism. Thus even if her hypothesis is supported by her analysis, it is not clear whether philosophies or institutions are the main influence on the policy choice. Given that philosophies are not always necessarily translated into institutional forms, this approach of liberalism has a limitation in explaining policy formation of other countries.

Bennett suggests a somewhat conflicting argument with Regan. He points out administrative structures, which he defines as the level of structural integration of national bureaucracies, as the most influential factor in explaining different implementations of a data protection policy. He argues that since all bureaucracies will prefer non-regulation or weaker regulation imposed on themselves, the more integrated the national bureaucracies, the higher would be their resistance to data protection policy, and as a result, the weaker the implementation of the data protection policy. This argument seems to contradict Regan's view that the more fragmented national bureaucracy, the weaker the implementation methods. This apparent dilemma is solved when we consider policy actors more carefully and define the legislative body in each country. In Britain, the development of policy takes place in the Cabinet, which has a fusion of powers. Parliament is not a law-making body in the same way as the Congress in the United States. Therefore, the major policy-making entity in Britain is the public bureaucracy while the American policy-making body is the Congress, within which power is limited due to the separation of powers between the executive and legislature. Therefore, differences in the authority of the policy making body in the two countries may have resulted in different policy contents.

Political structures are also closely linked to the scope of regulation. Regan argues that the more liberal a democracy, the greater the legislative regulation over the public bureaucracy than over private bureaucracies. According to her, because of the fragmented bureaucratic power in the United States, control and authority over legislation in the public sector was possible, while control and authority over that in the private sector was delegated to an ad hoc advisory Commission. In contrast, Britain gave up direct control in both sectors, but was able to maintain some indirect control over a special committee in the private sector while indirect control in the public sector was virtually non-existent. It is suggested that what influences the form of data protection policy is the relationship between policy actors reflecting or resulting from these structures rather than the institutional structures themselves.

4.4 Economic factor

Economic factors involve various different aspects of a country's economic situation. Here I discuss two broad aspects; the level of economic development of a country and economic structure in terms of the role of government in the marketplace. With regard to economic development, Bennett argues that economic constraint has been found to play a limited role in the choice of principles to be legislated as well as in the implementation of data protection policy. According to him, economic constraint is relatively less important because data protection is not an "expensive" policy which requires the distribution or redistribution of vast sums of public money. However, it is possible that this economic constraint was not found to generate differences in implementation because all the countries that have been studied were industrialized, relatively wealthy countries. The role of economic constraint might be more significant in less wealthy countries. The importance of examining the data protection policy formation in developing countries is suggested here again.

Probably as related to the political structural factor, the extent to which the government could intervene in the functions of the marketplace would influence regulation of the private sector. For example, West Germany, Britain, and Sweden, more integrated governments or paternalistic states that control the economic sector to a relatively large extent, regulate the private sector and the public sector under the same Data Protection Act or even regulate the private sector more strictly than the public sector. In contrast, the United States has the tradition of a "free" marketplace, and does not expect the government to intervene in markets absent a compelling reason. This tradition not only provides a rationale for not regulating the private sector, but also has contributed to the great power of private sector industries in the policy arena. Thus, the power of the private sector combined with the fragmented nature of the bureaucratic power led the U.S. data protection policy to have no enforcement duties with regard to the private sector. Since it is certain that private industries would prefer weaker enforcement on themselves and try to influence the policy decision, policy variation in the private sector depends upon the relationships between the private sector and other policy actors and upon the private sector's ability to subsidize information needed for data protection legislation in a way that favors the actors' interests (4). This argument not only supports the proposition that examining the policy formation process in terms of the relations among various actors is important, but also suggests that inequalities in the information environment could have a critical influence on the implementation of the policy.

4.5 Cultural factor

A country's culture consists of a great many elements. Among them, here I choose to discuss the political culture and "value culture" in relation to data protection policy implementation. Political culture can be defined as the configuration of cognitive, effective, and evaluative orientations toward politics (1). Although it is difficult to conceptualize and measure political culture or to present clear arguments about what processes or policies might be explained by different political cultures, some arguments have been made about the possible influence of two elements of the political culture: citizen participation and fear of the government. Regarding citizen participation, Bennett hypothesized that countries categorized as having a more "participant" civic culture might place a heavier emphasis on citizen action in the implementation scheme. He expected that the relatively more participant culture of the United States and Sweden helps explain why citizen action and initiatives are stressed more in those countries than in Britain and West Germany. But there is no clear evidence beyond a simple association that this participant orientation is the reason why subject control methods emphasizing individual actions were chosen. Also, the ways in which "participatory culture" is defined and measured are often vague. For example, it does not seem obvious to categorize the United States as a participatory country when only a fourth of Americans vote in federal elections. Therefore, it may be expected that if the degree of citizen participation has any influence, it is on the effective enforcement of the policy in terms of the citizens' willingness to use the methods available to protect their own information.

Personal data protection deals directly with central questions about citizens' orientation toward government. Cultural beliefs about trust in government can be linked to the differences in the implementation of data protection policies. In West Germany, historical experiences with Nazi, Communists, and repressive governments are believed to have inspired a need for checks on the state (3). In the United States, fear of an overpowerful government is deeply engraved in the American political consciousness and is reflected in the fragmented and decentralized distribution of authority in government. In contrast, Swedes tend to trust their government and to regard it as a benign force since their government has not engaged in any great breach of public trust or confidence (3). It is clearly suggested that countries with a history of fear of the government tend to regulate the public bureaucracy more, and to protect personal information broadly in manual as well as in computerized systems. The data protection policy in the United States and West Germany regulates information practices by the public bureaucracies only, while in Sweden both the public and private bureaucracies are regulated and in Britain no direct control over the public bureaucracies has been legislated. Also, the United States and West Germany protect both manual and computerized information systems while the other two countries' data protection policies apply only to computerized information. The trust in government is related to the scope of regulation.

The United States' and West Germany' very different political structures in terms of the integration of government raise an interesting question. How could the United States with its fragmented bureaucratic power and West Germany with its integrated bureaucracy have established such similar controls through greater regulation of the public bureaucracy and more comprehensive regulation of manual and computerized files? It posits a question of whether the structural constraint that generates a certain relationship between policy actors or the cultural belief that relates to the citizen's orientation toward government is the important factor influencing the implementation of the policy.

The role of the "value culture" in the policy process has not received much attention in the literature despite its relationship to the core issue of data protection. As I discussed earlier, the value of individual privacy often conflicts with the value of the free flow of information and/or the value of efficiency. What I mean by the value culture is how these often conflicting values have been balanced in a society, and on what values a country has placed a priority in a given situation. The United States and Sweden are considered to be countries whose culture traditionally has valued the right of the public to know. In the United States, the fact that the right to know and the value of a free flow of information is said to be guaranteed by the First Amendment may have influenced the policy outcome through the private sector's efforts to use this competing value as a tool to resist the data protection regulation. Then why does Sweden have such a strong data protection policy characterized by an independent agency with licensing authority on both the public and the private sectors? In this case, the cultural difference regarding the value of the right to know influences the actual practices of policy implementation rather than the formal policy. An example illustrated by Flaherty on the case of Sweden shows how its data protection approach which is supposed to be effective has not been able to work effectively in actual practice, because the data protection policy conflicts with the Swedish culture that values the free flow of information;

> The Principles of accessible government information prevails over the principle of personal privacy; the Data Act is subordinate to the constitutional right of access to information. . . The faith in government combined with an acceptance of the primacy of collective interests creates a serious dilemma for the DIB, since it means that citizens are not a particularly loyal constituency for data protection when it appears to conflict with specific surveillance initiatives of the Social Democratic Government. . . . The balance between openness and privacy protection is out of control. . . The integration of these competing imperatives are not as well developed. . . (3, p. 98-99)

The value of privacy could also conflict with the value of efficiency. It is expected that in developing countries priorities might be given to the value of economic efficiency over the value of personal privacy, since the primary goal of the whole society of those countries would be to make themselves more economically advanced countries. In that situation, privacy might be considered more of a luxury than a necessity, and might be reflected in the weaker implementation of an existing data protection policy.

4.6 Public Concern

It is widely recognized that public concern stimulated by technology largely influences the need for regulation on personal information practices. Since public awareness is increased by the collection and publication of individual horror stories about how people can be denied rights and privileges (1), the critical incident that generates public, media, or legal concern might not always be the same across countries. Therefore, the nature of a critical incident would influence the type of data protection in the initial status, because this incident would contribute to framing the issue of "privacy" or "data protection" to a large extent. Some policy actors strategically try to frame the issue. For example, private organizations in the United States, with their information superiority and organized power, succeeded in obtaining weaker regulations by making arguments about the unique differences in their information needs, insufficient evidence of abuses of personal information, high costs of the data protection regulation, and policy options (13). The private sector also tries to frame the issue of data protection policy -- of which the original main concern was to protect individual control over personal information by limiting the collection and use of the information -- in terms of values of "efficiency" and "free flow of information." Examining the public discourse in the legal documents and media presentations would provide us with information about what kind of arguments are provided by which interests, and how these arguments influence policy implementations.

5. Analytical Framework

Previous studies of the data protection regime, by exclusively focusing on highly industrialized, liberal Western democracies, have failed to consider some important features that might influence the formation of data protection policy such as various economic and cultural factors. I argue for the importance of examining the ways that the personal data protection policy is implemented in those countries with less economic development and different cultural background from Western democracies. The literature reviewed above provides an analytical framework to examine the Korean data protection legislation which is yet emerging. Employing what has been known and suggested to the data protection policy formation process in Korea would not only suggest a criteria to evaluate the policy but also provide an insight on the validity of the theory and propositions.

The analytical framework provides some expectations based on the structural and cultural situation of Korea. Korea has achieved economic development to the point where she started to use advanced computer technology for management in both the public and private bureaucracies. However, she is neither a developing country nor a highly industrialized country as the Western countries of which data protection policy has been examined by previous studies. In an economically developing situation, the primary goal of policy in general is economic advancement, and in the process, efficiency of government and private enterprises is highly emphasized. How the primacy given to the efficiency may function as an obstacle to regulate personal data processing in bureaucracies will be examined.

The political structure of Korea can be characterized as an extremely powerful central bureaucracy, with the apparently independent, but practically government-controlled legislature and the police. The formation of a data protection policy would be led by the government, not by the legislature. Therefore, the public bureaucracy would have a strong policy-making power to legislate the data protection policy, but on the other hand, the regulation on the public bureaucracy itself would face strong resistance. How the public bureaucracy's policy-making power and the resistance to the policy by itself generate a controversial situation and how this contradiction influences the policy making will be examined.

Korea certainly has a different value culture from Western countries. Fear of government has been high at least in modern history; a series of government abuses of human rights to maintain its power and status have been publicized and communicated among citizens. But fear of government is no stronger than the fear of North Korea. Actually the existence of North Korea has provided the legitimacy for intensive surveillance on the citizen due to the government's fear of the citizens' ideological alignment to communism. Therefore, I suspect that the regulation on the public bureaucracy would not be firmly exercised. Also, the meaning and the value of general "privacy" in Korea is different from those in Western countries. Although it is difficult to measure how much the individual right to privacy is valued compared with other values, there are many examples where an individual's privacy is sacrificed for some other values. For instance, many high schools publicly post students' grades as a strategy to provide students an incentive to improve their grades. Some schools even assign seats in the class according to students' grades. This is very unlikely to happen in Western countries. Also, as a country whose primary goal is still economic advancement, economic efficiency often receives priorities over privacy. The value of "free flow of information" or "freedom of expression" is also very likely to be valued more than that of individual privacy, because in the long history of oppression of the mass media and the freedom of expression, the value of free flow of information may be considered "the most important value" yet to be achieved in Korea. How these priorities given to the other values are reflected in the legislated data protection policy and in policy makers' sense of the issue is worthy of examination.

In order to examine Korean personal data protection regulation, the legal documents on the personal data protection policy of Korea are analyzed. Since data protection legislation has been relatively underdeveloped in Korea, two government officials responsible for data protection policy -- one from the Ministry of Government Administration and the other from the Ministry of Communication -- were interviewed to understand their sense of the importance of the issue, the reasons, and the actors. About an hour of open interview with each government official was conducted. Their names and specific positions are not revealed per their request.

6. Korean Personal Data Protection Policy

While the Korean constitution clearly indicates the right to privacy as a fundamental right of human beings, no specified attempt was made to construct an integrated law on privacy. Individual laws in other general areas such as the Libel Law and the Law on the National Governmental Officials, can be applied for the protection of privacy, but they are not targeted directly to privacy protection, nor can they cope with issues arising from the collection and use of personal information in the modern information society. Thus no institutional methods to control or manage uses of personal information were sought until the proposal of the Bill on Protection of Personal Information in Public Institutions and Others in 1991.

6.1 The Bill on Protection of Personal Information in Public Institutions and Others

The Bill was initiated as a part of the Project on Computerization of Administrative Data Network. The government announced the enactment of the Bill in May, 1991 but has not yet enacted it (December, 1992), while the Act on Expansion of Dissemination and Promotion of Utilization of Information System, which is also a part of the Project was enacted on June 30, 1992. The purpose of the Bill was identified as "to facilitate the accomplishment of public enterprises and (emphasis added) to protect people's rights and interests by deciding matters necessary for computer processing of personal information in public institutions and others." This statement shows that the efficient accomplishment of public enterprises and people's privacy are not viewed as conflicting. While in other Western countries personal data protection became acknowledged as necessary because of the abuses and misuses of the personal information by the government and private bureaucracies, in Korea personal data protection was planned and promoted by the public bureaucracy as a way to facilitate the accomplishment of its own enterprises through computerization of the network.

The Bill combines both the information control approach and the subject control approach in its principle. It deals with the collection and processing of personal information by national administrative institutions, local self-governing administrative institutions, and other institutions that the president decides to be closely related to the accomplishment of public enterprises. The public institutions that plan to construct and use personal information files must notify the Minister of Government Administration. Then the Minister of Government Administration must publicly announce about the notified files more than once a year. However, this obligation to public announcement and official publication could be exempted by the president when it is admitted that the appropriate accomplishment of public institutions can be hindered by this obligation. In addition, advance notification itself is "not meant for control of information, but only a way to give confirmation (according to the official from the Ministry of Communication)." The Bill also allows individuals to see and ask for correction of information about themselves. However, the reasons for exemption are numerous, usually related to the efficiency of the public enterprises such as tax imposition and collection, inspection and investigation of other laws, medical examinations and treatments, etc.

6.2 Public Concern

The Korean government has for years gathered vast amounts of personal information on Koreans, but has been collecting even more personal information since the Project on Computerization started in 1983. The resident registration data collected in the computerized governmental network consist of 78 items including education, blood type, marital status, divorce history, and welfare eligibility for the Livelihood Protection Law as well as basic demographics such as place of birth, permanent domicile, sex, age, occupation, and family members. Moreover, each district's regional medical insurance associations record financial status and monthly income in addition to demographics in order to calculate insurance rates. There have been many examples suggesting unauthorized uses and misuses of personal information in Korea. Recently the mass media have begun to report on the use of personal information, especially since the election campaign in 1987 when many political candidates began to systematically use information about voters.

Dong-A Ilbo, one of the largest daily newspapers in Korea, published an article in which many experts suspected that personal data in the governmental network and in computers of medical insurance associations can circulate without any control or restraint (2). It was reported that the data gathered in these computers were released to Direct Mail firms and to some district party chapters to be used for election strategy planning. According to the article, the largest Direct Mail firm in Korea has retained information on 15 million people by obtaining information from the computerized governmental network, alumni rosters, lists of credit card members, birth reports in hospitals, apartment tenants' cards, etc. It was also reported that these data were released to members of the National Assembly, the City Assemblies, and of District Assemblies who ask for these data under the pretext of inspection. Hangyeorae Newspaper also reported that political candidates, especially majority party candidates who are closely related to the government, manage detailed personal information on voters including their financial status, marital status, information related to military service, birthdays and school year of their children, etc (7). The exact origin of these data is not known and the government strongly denies the accusation of releasing personal information to the outside. However, experts cited anonymously in the article suspected that the information collected in the computerized governmental network must have been released to the majority party based upon the fact that there could be no other sources maintaining such detailed information on a large number of people except for the government, and upon the attestation of some Direct Mail firms that they obtained some information from the majority party.

It is not clear whether the public concern stimulated by more collection and use of personal information actually "made the data protection policy existence." The government officials insist that the Bill was being prepared as a part of the Project on Computerization. But the Project started in 1983, and it was not until 1991 and 1992 that the government began to formulate and propose the Bill. It can be concluded that the public concern reflected in the media coverage at least accelerated the time of the proposal of the Bill earlier than it might have been without public concern.

6.3 Political Structure (policy-making entity)

Because the Bill was initiated as a part of the government project, the main policy-making entities have been the ones that lead the project: the Ministry of Government Administration and the Ministry of Communication. To be effective, the Bill must be enacted by the legislature. But as noted earlier, the Korean legislature has been considered bureaucratic-dependent in many aspects. A government official from the Ministry of Communication mentioned that usually agreements are easy to reach. The centralized policy-making power of the public bureaucracy enables it to formulate the policy without facing external pressures or objections. However, the regulation on the public bureaucracy itself faces strong resistance from the public institutions themselves.

For instance, the Ministry of Government Administration posited at first that the Bill should apply to financial institutions as well as other public institutions. In contrast, the Ministry of Finance, other related public institutions, and financial institutions insisted that given the special characteristics of financial information financial institutions should be excluded from being subject to the Bill (8). The different positions are clearly reflected in the forum on the Bill that the government held on the April 30, 1992. In this forum, the Ministry of Finance proposed that financial institutions be excluded from the application of the Bill and the Agency of National Taxation asked that matters related to tax imposition and collection be excluded from the obligation of advance reporting to the Minister of Government Administration and official publication (14).

The concerns of these policy actors were reflected exactly in the modified Bill (June 1992). How did the public bureaucracy with such a centralized policy-making power accept suggestions from the other policy actors completely? It has to do with the similarity of policy principles and interests of the policy making body and other public institutions. Both of whom resist any inhibitions on increasing efficiency of their enterprises; even the policy-making bureaucracy has proposed the data protection policy as a part of the project to facilitate administrative efficiency. Their shared interests and perspectives are reflected in the remark of the official in the Ministry of Communication: "They do recognize the need for data protection law, but they ask us to make a law which would not interrupt their enterprises. It is not an objection but rather a process of negotiation. We also would try our best to make this Bill in the way they want."

Thus it does not seem very likely that the policy making bureaucracy would have changed its original position had the arguments of other actors contradicted its own policy principles. In other words, exemptions of activities of financial institutions and tax imposition and collection were possible because granting exemptions fits the idea of emphasizing efficiency - the primary goal of the Project of Computerization, of which the data protection policy is a part. Also, the reason that the Bill has not yet been enacted is not as much due to the difficulty faced by the government as due to the emphasis given to the efficiency by the government itself.

6.4 Economic Factor

Korea is a country whose primary goal is still economic advancement. In this situation, economic efficiency receives priorities over privacy. The very fact that the data protection policy is promoted as a part of the Project of Computerization of Administrative Data Network reflects the importance of economic and technological development in Korea. Despite the powerful government and the tradition of government intervention in the marketplace, regulating information flow in the private sector while trying to emphasize economic efficiency is difficult. This difficulty is reflected in the Bill's rejection at regulation on the private sector. The official in the Ministry of Communication considers this natural, because "it is too difficult to control the private sector and other countries also do not regulate information used in the private sector." In addition, the Bill grants many exceptions if applying the data protection law assumes a possibility to interfere with efficiency. Under this circumstance, it is difficult to expect the Bill to be enacted in the near future or to be effectively enforced in a practical sense even if the Bill is passed.

6.5 Cultural Factor

Fear of the government that has existed in Korea may have contributed to regulating the public bureaucracy without similar regulation on the private sector. However, information activities related to "national security" are easily excluded from the application of the data protection law. This suggests that fear of the North Korea may be still higher than that of the government at least as understood by the government, thus it can be used as a rationale for granting exceptions. Although Korea does not have a high degree of citizen participation as in the Western liberal societies, the Bill consists of subject control methods as well as information control methods. However, given the presumably less participatory culture, it is not likely that Koreans are willing to initiate action to protect their own information rights either through the government or the courts. Therefore, although the extent of citizen participation was not reflected in the formal content of the policy, it certainly would have an influence on the effectiveness of the policy enforcement.

In the discussion of economic factors, it was found that the stage of economic development of Korea contributes to the emphasis on efficiency in the policy making process and the content. This emphasis given to efficiency over privacy seems to be prevalent among both policy makers and the citizens who may have conflicting interests through the data protection policy. By allowing any possibility of disturbing efficient performance of organizational activities to be used as a rationale to create exceptions from the law, the Bill does not provide the protection of personal information as it could have otherwise.

Many policy actors other than policy makers also seem to give the priority to economic efficiency over privacy. In the forum on the Bill, representatives of financial institutions, the Ministry of Finance, and the Agency of National Taxation shared the rationale of efficiency for exclusion of financial institutions. But arguments of other attendants of the forum, newspaper editors, are more striking: "Since the personal information protection policy and the information access policy conflict with each other, information protection policy should be made in such a way to encourage mutual symmetry. We should not hurry too much for information protection policy but should rather draw opinions more widely from private institutions and modify the policy accordingly."; and "Given that the personal information protection policy is in its infancy, we should be careful since it could posit many problems if we make a strong protection policy to the degree of those in developed countries. . . We should strive for harmony in order not to interfere with the whole economic flow or with a transition to the credit society" (14).

It seems that for these policy actors as well as for policy makers, making Korea an "information society" is perceived as the ultimate goal. The computerization of the network which maintain and process vast amount of personal information is the goal to be achieved without any question as soon as possible, while personal data protection is perceived as some kind of luxury to be very cautiously considered before any enactment of a related policy. This is why the Act on Expansion of Dissemination and Promotion of Utilization of Information System, which facilitates the computerized use of personal information, has been enacted, but the Bill on Protection of Personal Information, which can inhibit the use of personal information, has not.

No systematic study has examined whether this kind of value culture de-emphasizing privacy is still prevalent among citizens as well, but their interests, positions and arguments do not seem to be represented very well in the policy making process, as shown in the Forum on the Bill in 1992. If this value culture is still prevalent in the society, and privacy protection is not a familiar concept for Koreans, it is likely that people are not ready to participate in the process by requesting to read and correct their information or are ignorant of the procedure itself. The civil liberties approach which gives individuals rights to monitor information activities voluntarily and protect their own privacy may not work as well as intended. The relative emphasis on the value of efficiency seems to influence both the policy formation and enforcement by influencing the perceptions and behaviors of policy makers, other policy actors, and citizens.

7. Discussion and Conclusion

The Korean personal data protection policy has been debated since 1991 as a part of the Project on Computerization of Administrative Data Network. The Bill combines the information control approach and the civil liberties approach. However, no separate agency of implementation was established. The Bill grants numerous exceptions from the obligation of reporting to the Ministry of Government Administration about information files or of official publication when it is regarded to have a possibility of interrupting the efficient performance of enterprises. The exceptions are also given from the obligation to show and correct information when requested. The Korean government could not formulate an effective data protection policy and was unable to enact the proposed Bill despite its strong policy-making power. This contradicts the proposition that the more centralized and stronger the policy making body is, the stronger data protection policy can be legislated. The reason for this involves both the fact that the policy is initiated as a part of the project on computerization of government information and the value culture shared by policy makers and actors. The efficiency goal of the Project in which the Bill was formulated and the culture emphasizing efficiency over privacy are reflected in the proposed data protection policy. Consequently, the policy ironically emphasizes efficiency over privacy, the very value it was designed to protect.

Since this case study is based upon an exploratory analysis of the Bill on Protection of Personal Information which is still in the process of formulation, the generalization of the result and suggestions made from the result may be limited. Future study on data protection policies in other developing countries with different economic stage and cultural elements would contribute to enhancing our understanding of the ways in which data protection policy is implemented and can be enforced as designed. Within its limitations, the Korean case provides particular suggestions for less developed countries in Asia that may begin to develop a data protection policy. The economic situation and the particular value culture in Korea turn out to be the critical factors influencing the policy making process and content, in contrast to the arguments of other studies on developed countries that economic constraints play a limited role in the implementation of personal data protection policy. It is suggested that copying or adopting other developed countries' law or implementation methods without considering the country's particular characteristics does not automatically lead to the adoption of similar kinds of data protection policies as developed countries. Rather, a data protection policy formulated and implemented in this way can provide the public and private bureaucracies with the legitimacy to encourage the collection and use of greater amounts of personal information instead. Unfortunately, this comes at the expense of individuals' privacy and the protection of personal information – the original main concerns of such policies.

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Table 1: Implementation of Data Protection Policy in Five Countries

	Approach	Agency of Implementation	Characteristics of Agency	Scope of Regulation
United States	Individual rights. (Privacy Act of 1974, 1980)	No separate agency. Individual suits and oversight by Congress and OMB.	X	Public only. No distinction between computerized and manual files.
Britain	Information control. (Data Protection Act)	Data Protection Registrar.	Registration. Inspection. Ombudsman. (No enforcing power)	No direct control on public / Indirect control on private. Computerized only.
West Germany	Comprehensive Information Control with Detailed Law. (Data Protection Act)	Federal Data Protection Commissioner.	Supervision. Inspection. Ombudsman. (Use of power varies depending on political climate)	Public. (Private by traditional agency) Manual and Computerized.
Sweden	Information Control. (Data Act)	Data Inspection Board.	Licensing. Registration. Supervision. Inspection. Ombudsman. (Independent)	No distinction between public and private. Computerized only.
Korea	Information Control. (Bill of Data Protection)	No Separate Agency. (Ministry of Government Administration)	X	Public only. Computerized only.

Building Successful Distance Learning Networks

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ABSTRACT

Education improvement in the United States is one of the most important challenges of the 1990s. Our industry has the means as well as the responsibility to share in the improvement effort. One vital component in the equation is Distance Learning, the ability to compress time and space between teachers and students through the judicious application of technology. This capability maximizes the best use of scarce, high quality educational resources and brings equity to students.

INTRODUCTION

Researchers have discovered that learning is a transformational process in which new knowledge is built on previous knowledge and experiences. By contrast, in part because of the classroom's isolation from the rest of the world, today's education is more transmissional in nature, with knowledge fed "one-way" from teacher to student. Even though today's transmission media bring a variety of classes into schools and homes, this communication is still primarily one-way as well. Here then is an excellent opportunity for interactive distance learning technology to erase the barrier of bricks and mortar as well as enhance the transformational process.

Today the issue of isolation is as complicated as our ever-changing society. Although it sometimes is easy to think of rural America as idyllic and complete, some rural students are among our most disadvantaged and isolated. Many rural areas are experiencing education crises that rival those of the inner cities. Declining rural population decreases funding, which leads to fewer classes. Students may not be able to take the special or advanced classes they need, and schools may be forced to close. Distance learning helps to make more classes available to students and, with the availability of required classes, some communities can keep their schools open.

Even in crowded urban schools, some students may experience isolation. While educators spend resources on the majority of students, the needs of exceptional students may be ignored. And, although equity is a hot national issue, the reality is that many inner city schools still lack the resources of schools in wealthier districts. Distance learning is helping to solve these problems by providing college prep and advanced classes from other high schools, community colleges, or universities, while freeing teachers to spend time with students who need more personal attention.

So how does a Distance Learning network get started? The principle requirement is the belief and commitment of all the stakeholders involved, from educators, students and parents, to equipment and service providers and government officials. The coalition must guide the process, set goals and priorities, pursue funding, and keep things moving. The reasons for building the network must be absolutely clear to every stakeholder, and all of those stakeholders should be identified and involved at a very early stage. "What are we trying to accomplish?" must be satisfactorily answered, and the goal must remain uppermost through the entire program. This goal should not be stated in terms of technology, for the technology must always be driven by educational needs rather than the other way around.

COMMUNITY INVOLVEMENT IS KEY

Northern Telecom, in association with various carriers, vendors, and educational organizations, has had the good fortune to be involved in the installation of several leading networks. In Mississippi, the Mississippi FiberNet 2000 project saw South Central Bell, Northern Telecom, and several other vendors install the first switched digital broadband education network. In North Carolina, the Vision Carolina network was installed in association with Southern Bell and Videoconferencing Systems, Inc. (VSI) and showed the power of true turnkey partnerships. These networks have given Northern some insight into the building of distance learning networks, and one of the most powerful lessons to be learned is quite simple: without a partnership the project will not succeed.

This need for a committed partnership among all the stakeholders cannot be overemphasized. A few of the constituents that must be involved are these:

- A carrier, such as a phone company or alternative carrier
- Equipment vendors, such as Northern Telecom
- Educators and administrators in the involved districts
- Parents and students
- Teachers' union
- Educational TV authorities
- Local businesses
- Regional universities and colleges
- State PUC officials
- State, local and federal legislators

It is obviously impossible to satisfy every one of these stakeholders in all respects but, at the very least, each of them must be consulted and involved at the earliest stages. Issues of territory and institutional sovereignty will sink a distance learning project faster than any technological hiccup imaginable.

The close involvement of all affected parties will also pay benefits in terms of financial cooperation. If, for example, a network is planned by a school district, the network will likely be underutilized during the evening. A local community college which is turning away students for lack of space would be delighted to hook up to the network and pay "rent" for each evening student it could accommodate using the network. Since the junior college would get tuition from those students, both the college and the school district would profit. And multiple related applications will be only a step away:

1. Medical training/consultation
2. In-service training for teachers
3. Teacher preparation before class
4. Observation of student teachers
5. Remote arraignment
6. Continuing education
7. Organization meetings after school

Each of the "consuming" stakeholders is also vitally interested in a one-stop shopping approach to network installation. Despite increased technological sophistication on the part of educators, they generally have no desire to be their own systems integrator. Northern's success in this field is in no small measure due to the "turnkey" alliances made with the carriers in the networks installed so far.

The definitions of "Distance Learning" are as varied as the number of people asked to describe it. The range of possibilities varies from correspondence courses taken via the mail all the way up to live, interactive classrooms with full motion video, full spectrum audio, and integrated data connectivity. In between are an array of one-way and interactive voice and video techniques that vary in terms of their quality and objectives.

A requirement for high video quality is based on the fact that for day-in, day-out classroom activity extremely high grade pictures are a necessity. For occasional meetings or limited mentoring applications, lower quality video can easily be tolerated. But experienced ITV (Interactive Television) teachers express the need for picture quality good enough to see facial expressions and the nuances of body language. They want to see the "glimmer of understanding" (or gleam of mischief) in the student's eye. This is only achievable on higher bandwidth systems capable of faithfully reproducing the video signal. From the student's perspective, good quality image and sound are taken for granted as a simple extension of the home TV environment.

A digital fiber optic network is built on industry-standard transport and switching technology and takes advantage of defined interfaces. The network can thus convert an analog NTSC (National Television Systems Committee) video signal into a digital bit stream, transmit the data over the network, and then reconstruct the signal back into the original analog signal; or at least close to the original. This process is done in a device called a CODEC, an acronym for COder/DECoder. All CODECs compress the signal to some degree in this transformation to a digital format. However, the lower the bit rate of transmission, the more difficult is the task of faithfully transmitting and reproducing the original signal. The more the compression, the more computer processing is required to accurately predict reconstruction of the original video image. This tends to drive up the cost of CODECs as the transmission rate goes down.

CODEC technology has been advancing rapidly and some of the algorithms for DS1 transmission are subjectively acceptable for certain applications. However, the images still suffer the phenomenon of "artifacts", a jerky motion caused by lack of image data, and cannot achieve full luminance and clarity available on NTSC television. Often these DS1 pictures are degraded even further when voice traffic, transmitted over the same bandwidth, steals image data for its own use. In addition, DS1 compressed video does not hold up well on very large television screens, which have been identified as a necessity by educators to achieve the desired sense of presence in the classroom. This is not to demean lower bandwidth compression techniques. The sophistication of those algorithms is not to be denied, and there is a host of applications where compressed video is valid, not the least of which is videoconferencing. Dialable Wideband Services, desktop video, multimedia applications, and other services represent a huge market for video.

Why digital fiber instead of analog? One of the advantages of digital fiber is the high picture quality. Even over long distances, digital fiber networks produce clear, crisp video images. Another advantage of digital fiber is that the piece of equipment that transmits the signal over the fiber also acts as a multiplexor. This means that the digital video signal can be combined with other digital signals--permitting entry to the multi-media world--and transmitted over the same fiber.

The most compelling argument for switched digital broadband networks is evolution of communications itself. The networks of the 90s will be based on SONET (Synchronous Optical NETwork) technology, which is a revolutionary way of transmitting information. The SONET environment will easily support digital video services as they emerge. Digital video represents the next major wave in imaging services which will allow users to choose the picture quality they wish. This "scalability" will require the network to deliver bandwidth-on-demand so users can, for instance, watch CNN at NTSC quality and then watch a movie at HDTV quality and format. Only the flexibility of a SONET architecture will support this type of on-demand delivery, and only *digital* video will be scalable.

SWITCHED NETWORKING

In small, point-to-point networks each school is connected to every other school by a separate fiber. As the networks grow, the number of fibers and the quantity of equipment become expensive and unwieldy. In a switched network though each school is connected to a centrally-located switch. Rather than have a strand of fiber that goes directly from one location to another, this special type of switch can switch the video signal much like a normal telephone company central office switch. The versatility added by the switch makes the network even more usable by allowing simultaneous classes to multiple schools.

As shown in **Figure 1**, each link has a port on the video switch so that any classroom can be connected to any other classroom or broadcast to multiple classrooms. This any-to-any classroom connectivity capability is an extremely powerful and flexible feature of the system. The switch is under control of a computer which directs connections (time, day, origination point, etc.) for each class session. The switch control computer is in communication with a computer in each classroom so that teachers or facilitators can control certain aspects of the class session. The switch controller also keeps a log on system performance and alarm conditions. An additional feature, called "quad-split" or continuous presence, allows up to four classrooms to participate in open interaction without manual intervention to control the audio and video.

Data connectivity and ancillary voice communication are supported through an interface called the Data Comm Sync unit. With up to four DS1s which are embedded in the same DS3 as the video and audio, data can be separated from the video by the DSC unit at the central switch site for further routing or switching. Teachers or students can access external data bases such as electronic mail, library resources, etc. This platform is ideal for supporting computer based student response systems.

Because the classroom (a typical example is shown in **Figure 2**) is the point where education meets technology, the classroom's layout and design are critical. It is here that the "turnkey" effort of the system provider must be most evident, beginning with a site survey. Every classroom will be different in terms of size, floor plan, lighting and acoustic quality, and the team must design the best layout for each room. For example, cameras should be placed close to monitors to improve eye contact. Because a natural reaction is to look directly at the monitor displaying the distant person in the conversation, placing the camera next to the monitor relieves the near end person from having to consciously think about looking directly at the camera. Lighting, acoustics, and audio systems must come under the same scrutiny.

Choosing the proper video equipment is another important aspect of good interactive performance. Although cost is major concern, the cheapest bid is not always the right choice for the video classroom setup. This is particularly true for interactive distance learning applications where picture quality is important. The equipment in the classroom should be matched to the system and application. For instance, in the Vision Carolina system three-chip CCD cameras were chosen for picking up student and teacher images because of their high resolution qualities. Since the fiber network (and DV-45 CODEC) can easily reproduce the full motion, full bandwidth signal, the three-chip design was properly matched to the system. Fast action motor drives are required for the pan, tilt, zoom, and focus functions of the student and teacher cameras so that delays are minimized in focusing on specific students.

Selecting the television monitors for classroom viewing is also an economic and subjective exercise. In general, the larger the screen the better, but this brings in the economic consideration. In most new systems, it is recommended that two twenty-seven inch monitors be placed at the front of the classrooms for student viewing and one thirty-five inch monitor be placed at the back for teacher viewing.

Classroom equipment is controlled from a small keyboard that interfaces to the video and audio electronics. A facilitator can operate camera controls, image selection, graphics camera selection, and audio controls. Camera position can be preselected, allowing one-button aiming when moving the camera from one student to another. The computer-based, classroom video controller and its interaction with the broadband switch provide teachers with the versatility that makes Northern Telecom's distance learning networks so unique. Classrooms can operate in one of several modes [Lecture, Speak, Listen, Interactive, or Continuous Presence (Quad Split)], and the teacher or classroom facilitator uses a Macintosh equipped with a touch screen to control video access to other classrooms. The keyboard control system and the classroom controller are both designed to let the teacher manage the network without a costly control room setup.

And to complete the turnkey service, network builders should be prepared to provide training, service, curriculum adaptation assistance, and go well beyond the classical definition of "systems integration" in terms of user support.

While all of this sounds long and laborious, the long-term benefits to all parties are undeniable. A community coalition for education yields a community network that local and regional businesses will want to access. And many such networks, interconnected across the country, will enhance our competitiveness at a time when it's truly needed.

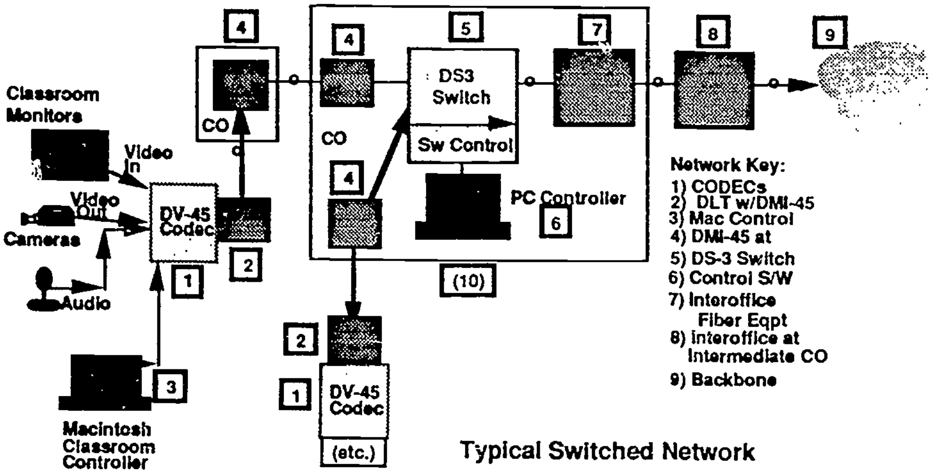
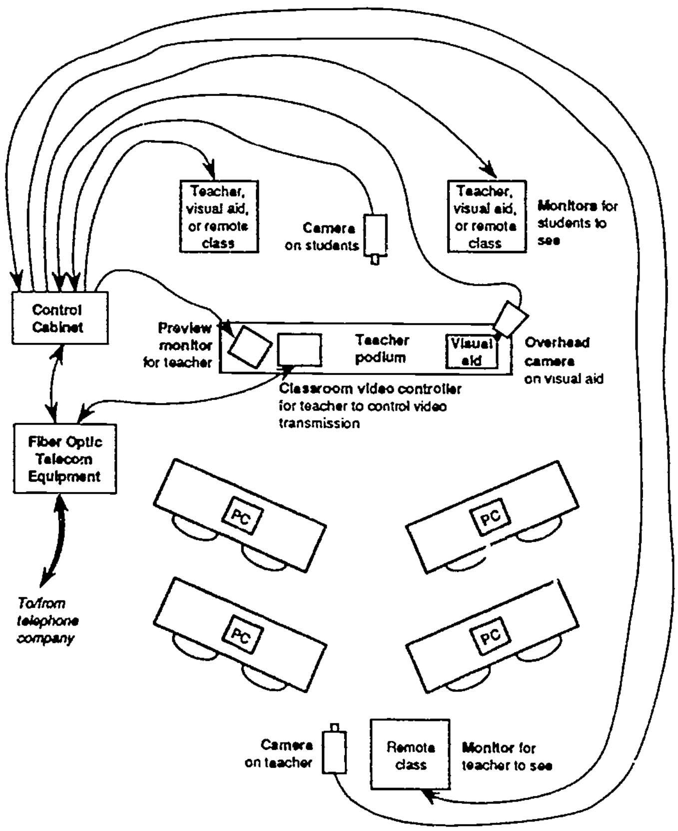


Figure 1.



Note: Microphones and speakers are not shown, but are located strategically throughout the room.

Figure 2

CREATING AN ISDN DISTANCE EDUCATION NETWORK

Betty Mitchell, Open Learning Agency
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1. ABSTRACT

The Open Learning Agency (OLA) of British Columbia, Canada, in cooperation with B.C. Tel, MPR Teltech and the Vancouver School Board, conducted a major project in 1991/92 to test the ability of Basic Rate ISDN for distance education applications. This paper reports on the results of the ISDN Distance Education Network Project and discusses network configuration, peripheral equipment set-up, instructor preparation and instructional applications.

2. OVERVIEW

During 1991/92, the Open Learning Agency (OLA) tested the use of B.C. Tel's new ISDN (Integrated Services Digital Network) service to link four adult learning centres in the Vancouver School Board (VSB). With extra telephone line capacity made possible by ISDN and new voice, data and image conferencing workstations created by B.C.'s MPR Teltech, students dialed into classes across town.

ISDN and multi-media workstations enabled school board centres to increase course offerings and share expertise. Courses traditionally not offered at centres due to low enrollment were offered to individual or small groups of students via the ISDN workstation. Students working on independent study material also used the workstation to "work through" their problem with a subject specialist at another centre.

OLA, along with Simon Fraser University, used this project to evaluate how ISDN communication services could ultimately benefit distance education students in both urban and remote areas.

3. THE PARTNERSHIP MODEL

The ISDN Distance Education Trial was based on a collaborative model which included the Vancouver School Board, Open Learning Agency, MPR Teltech, B.C. Tel, Simon Fraser University and funders: Communications Canada, and the British Columbia Ministry of Advanced Education, Training and Technology. Each organization assumed particular roles and responsibilities yet each also participated in cross-organizational planning and implementation teams.

From the outset of the project it became apparent that the trial was less about testing the ISDN service and the multi-media workstations and more about determining, integrating, and evaluating the instructional capabilities they provided. This meant that all those connected with the project: stakeholders, teachers, learning centre coordinators, and students must also be engaged in project design, development and implementation.

The team approach provided 'forums' for educator/technologist interaction, resulting in an appreciation of the different knowledge and skills of participants and a technology and network that over time evolved to better meet instructional needs. At the centre of the process was the "Champion" whose role was to manage the project and to look beyond the specific project findings to its impact on distance education course delivery in B.C. (See Figure 1).

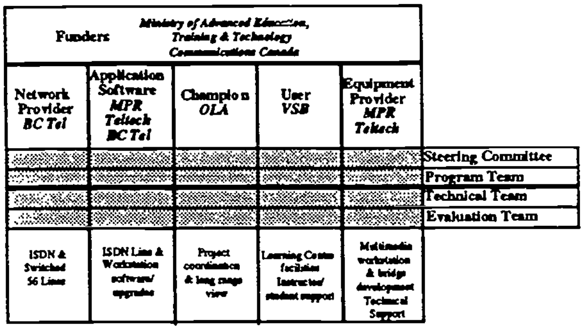


Figure 1. The Collaborative Model

By collaborating to identify instructional needs and match these needs with system and technology capabilities, project participants were able to make informed decisions regarding the impact of systems on instruction and were able to input needed changes into the network and technology configuration. The positive relationship that developed among the partners was the 'cornerstone' of the project.

4. INSTRUCTIONAL APPLICATION

The Program Team decided on applications to test three instructional methodologies: one-on-one tutorials, small group seminars, and an extended classroom (large group). The program schedule included Math tutorials in Fall 1991 followed by the introduction of small group Math seminars and History lectures in Spring 1992.

Instructional sessions took place starting in late October 1991 through to summer 1992. Starting in

October 1991 independent study students in Math were able to use the workstations to "work through" problems with content experts at other centres. In January 1992 these help sessions continued with the addition of formal Math and History courses. Twice weekly Grade 11 Math tutorials linked sites for small group interaction while a History grade 12 lecture style course tested the large group extended "classroom" capabilities of ISDN and multi-media technology. (Note: Due to problems with the graphics tablet interface for the Math sessions, the class was changed to a face-to-face format mid-semester.)

Teachers in the selected subject areas were contracted to deliver the courses, and were trained on DOS, Windows, and graphic creation software to assist them with materials development. Training also took place in August and September 1991 on the mechanics of using the workstation and input devices such as the scanner, camera and laser disc. Following these "hands-on" sessions instructors participated in a series of instructional design workshops on multi-media course development. Course-related activities involving teachers and students included tutorials, problem solving sessions, presentations and interactive small and large group participation.

Fall 1991	• Site-to-site Senior Math tutorials.
Spring 1991/ Summer 1992	• Site-to-site Math tutorials. Math group seminars (to March 1992). • History lectures (extended classroom format).

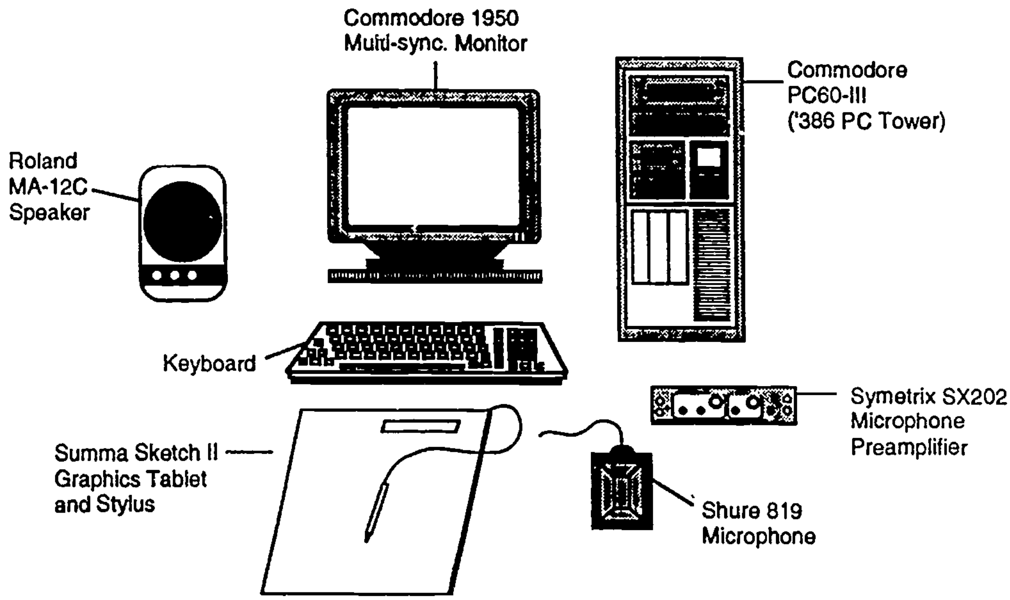
5. THE APPLICATIONS SYSTEM

The workstations consisted of IBM-compatible 386 PCs running Windows 3.0. The components of the basic workstation are illustrated in Figure 2. At the instructors' site, the basic configuration was augmented by an Epson color scanner and VCR for image input and recording. A larger 26" RCA monitor was also used in some sites. PC cards were developed by MPR Teltech, a member of the B.C. Tel group. The cards provide JPEG-compatible image compression, high quality 7khz audio, and ISDN audio and data communications.

MPR Teltech also developed the application software. Three major features are provided: image conferencing, file transfer and high quality audio.

The image conferencing facility enables two or more workstations to share high resolution image information. Images may be captured from connected scanners, VCR's, video camera and laser disc players. All participants in an image conference are able to discuss a common image displayed on their terminals. A full set of drawing tools are provided; as one person annotates, the image is updated simultaneously on the other terminals.

High speed file transfers can be simply performed between workstations. Images can be pre-shipped to minimize wait times for large image files during a class. An image not pre-shipped is automatically transferred when referred to during a conference.



Note: PC 60-III is equipped with MPR Teltech's MI-100, MI-200, MI-300, MI-302, MI-700 cards and MI-800 software

Figure 2. Multi-media Distance Learning Workstation

There are two types of audio calls available: standard and high quality. Standard audio calls allow users to participate in calls with other ISDN and non-ISDN telephones as well as to the other distance learning workstations. High quality audio calls use studio quality microphones, high performance speakers, and a digital acoustic echo canceller to provide a hands free 7khz audio connection among workstations. The high quality audio significantly improved the effectiveness of the audio component in course delivery.

The communications interface was provided by cards and software developed by MPR Teltech. The MI-300 ISDN Audio Data Communication card is a terminal adapter card which supports both audio and data interfaces to both ISDN Basic Rate lines and switched 56kbps data lines. These cards were also utilized in the multi-point bridge, another PC which provides the voice and data bridging over ISDN lines.

6. THE COMMUNICATIONS NETWORK

The ISDN Distance Education Network comprises four Adult Learning Centres in the Vancouver, B.C. area, plus a communications bridge which links them. (See Figure 3). ISDN Basic Rate was chosen because it supports audio and image conferencing, and because it will be available at a more affordable price than the emerging broadband technologies.

Early in the project it became apparent that one cannot just "sell ISDN". Instead, ISDN is just one component in a "package of capabilities" which comprise the distance education application. Several technologies and several functional groups had to be brought together to make the project viable.

An early taste of reality faced the project when it became apparent that one of the learning centres was out of reach of B.C. Tel's ISDN switch. Since the instructors taught from that learning centre, it was necessary to incorporate it into the network. The solution was to use switched 56kbps data lines extended beyond their normal reach through the use of intelligent channel banks.

This "special assembly" introduced the project to new challenges, but ones which are representative of the networks of the nineties:

- Additional application development was required to support switched 56kpbs data lines as well as ISDN lines.
- It was necessary to ensure that the network supported the interworking of ISDN and switched 56kpbs data lines.
- The special assembly demanded special testing techniques in the event of trouble on the lines.

7. OUTCOMES

The final project report "The ISDN Distance Learning Trial" prepared by D. Black and L. Harasim, 1992, reported on a number of key findings for project participants:

A. **B.C. Telephone** learned more about the educational market for ISDN and were able to resolve technical and operational problems.

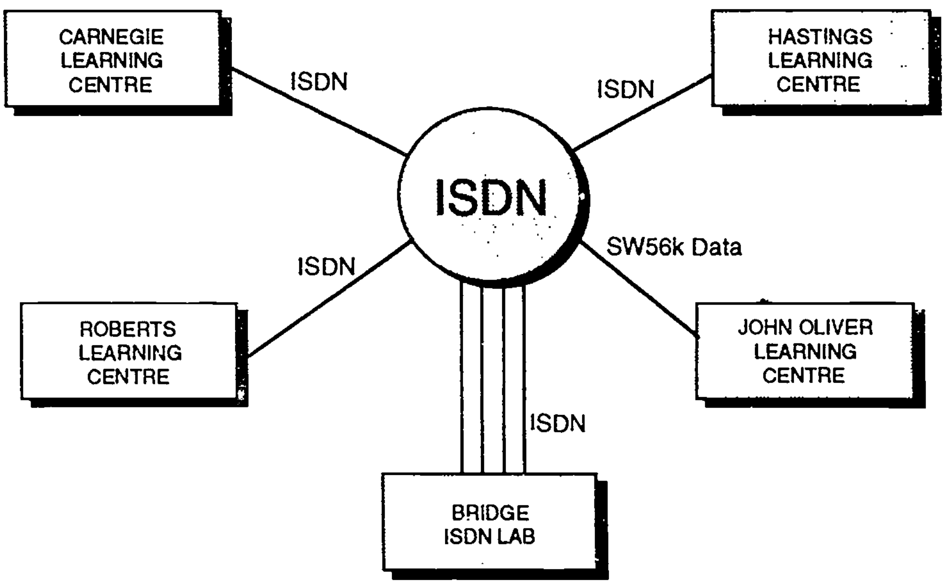


Figure 3. Adult Learning Centre Network

- "ISDN has potential in this marketplace. From a B.C. Tel perspective we have a better feel for what kinds of benefits and problems relate to the marketplace, and the importance of geographic availability."

- "Definitely it helped us sort out technical and operational issues and problems in our provisioning and maintenance of the service, another of our objectives."

- "It also confirmed the inter-operability of Switch 56 and ISDN, an important finding given that Switch 56 will be a necessary component in the ISDN network for some time, at least for distance education applications."

Switch 56 is a technical alternative, and in the short term it is a necessary component in B.C. and Canada in applications such as this. Right now Switch 56 is more broadly available but that will change with time. Switch 56 is more expensive to provide and buy, and it isn't as versatile as ISDN capable lines.

B. The major findings of the trial for **MPR Teltech** are:

- High quality audio is required. Standard audio connections do not offer an adequate level of sound quality for a multiple site conference.

- The 26 inch TV monitors should be used for conferences with more than three or four participants at a site.

- A 200 megabyte hard drive, at the very least, is required for this application; an erasable optical drive, capable of storing 600 megabytes on a single optical disk is preferable.

- The graphics tablet is not acceptable for the teaching of mathematics online.

- The trial "served to drive home the point that a customer needs a systems integrator to look after all aspects of a system such as the four workstations and conference bridge ... A customer needs to refer any and all troubles to a single point of contact. This role was assumed by MPR during this trial but the amount and type of support had probably been underestimated by MPR." (MPR, *Observations on the Multimedia Distance Learning Workstation*, August, 1992)

C. The educational partners, **OLA** and **VSB**, received valuable feedback from students and instructors.

Students were asked to rate aspects of the course: the stability and effectiveness of the learning centre network; the degree of student interaction and class participation; and other course related issues, on a scale of 1 to 5 (where 1 is terrible and 5 is great), and to compare the online course to face-to-face courses they had taken.

Due to changes mid-semester in the Math class format, student information was collected from the "Western Civilization" class only.

The course completers gave the ISDN network and the multimedia workstations a positive evaluation. As can be seen in Panel 1 of Figure 4, the audio quality was the aspect of the system most likely to be rated negatively, while the video quality was rated as satisfactory or better by all respondents. The negative evaluation of the audio quality reflects the fact that the high quality audio system was not installed until the last online class.

	1 terrible	2	3	4	5 great
1. ISDN Network					
a) technical performance	1	4	6	4	1
b) audio quality		4	6	6	
c) video quality			4	7	5
d) ease of use		1	4	9	2
e) set-up of workstation	2		2	9	3
f) ISDN classes	1	1	8	4	1
2. Interaction & Participation					
a) student interaction		1	4	9	1
b) student participation		2	4	7	3
c) individual participation			5	3	8
d) access to teacher			3	4	9
3. Other					
a) lectures		1	4	7	4
b) teacher			1	4	11
c) visuals		1	6	2	7
d) course content	1		4	5	6
e) work load		1	4	6	4
f) assignments		1	4	7	4
g) group work	1	4	1	7	3
h) field trips			5	3	8
i) student presentations		1	4	3	8
j) textbook	6	1	7	1	1

Figure 4. Student Evaluation of the Western Civilization Course

Most of the completers felt that the degree of student interaction and participation was satisfactory. As can be seen in Panel 2 of Figure 4, most rated the amount of student interaction and participation as satisfactory, and all said that their opportunity for personal participation in the ISDN classes was satisfactory or better.

The amount of interaction and participation in the ISDN classes compared favourably with face-to-face classes taken by the students. As can be seen in Figure 5, almost all of the respondents said that the amount of interaction between students, the amount of student participation, and the opportunity for personal participation was the same as or better than in face-to-face courses they had taken.

Overall, the student evaluation of the ISDN classes was favourable, as can be seen in Figures 5 and 6. Almost all of the students interviewed said that the ISDN course was the same as or better than other courses they had taken, that they would recommend the course to others, and that they would take another ISDN course.

	Worse	Same	Better
a) student interaction	3	5	8
b) student participation	2	11	3
c) student participation	2	8	6
d) access to teacher	3	7	6
e) lectures	3	9	4
f) assignments	3	9	4
g) group work	3	6	7
h) student presentations		6	10
i) student enjoyment of the course	2	1	13
j) course as a whole	2	10	4

Figure 5. Student Evaluation of the Western Civilization Course Compared with Other Courses

	No	Maybe	Yes
a) would recommend the ISDN class to others	2	1	13
b) would take another ISDN course		3	13

Figure 6. Student Evaluation of the Western Civilization Course (Recommend to Others and Take Again)

Teachers who used the system reported that:

- Class preparation time increased.

  "To set up a slide from scratch can take 20 - 30 minutes. With practice it became 15 minutes."

  "Scanning images took about 30 minutes to process and save. With practice this was reduced to 15 - 20 minutes."

  "Copyright was a real issue and meant that much of the pictures, diagrams and text needed to be reproduced by hand."

In all, the Western Civilization teacher found the online classes the same or better than instructing face-to-face.

	Western Civilization
a) amount of student participation	same
b) quality of student participation	same
c) amount of student interaction	same
d) quality of student interaction	same
e) amount of teacher-student interaction	better
f) quality of teacher-student interaction	better
g) level of student interest	same
h) degree of student involvement	same
i) quality of student work	same
j) pace of instruction	worse
k) amount of teacher preparation time	worse
l) student enjoyment of the course	better
m) overall	same

Figure 7. Teacher Evaluation of Online Course Compared to Other Courses

8. THE FUTURE

In Phase 2 (September 1992 - January 1993) the Western Civilization and Math courses will be repeated. As stated in the final project report, MPR Teltech and the project team are now making a number of changes to the multimedia workstations for Phase 2 of the project:

- a light pen will replace the graphics tablet as the primary input device for the instructor. A 31 inch multi-sync monitor will be added to the instructor's workstation. (see Figure 8)

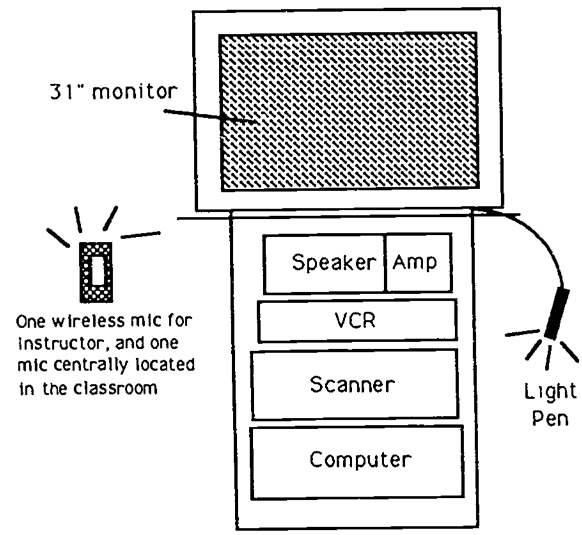


Figure 8. Phase 2 Instructor Workstation

- the image conferencing application will be revised to maximize use of the screen area on the monitor; multiple, scrollable "whiteboards" will also be available.
- a wireless microphone will be used by the instructors. One microphone will be used to pick up audio from students at the instruction site; this should make it easier for remote students to hear on-site students, and should facilitate greater student interaction between sites.
- The workstations at the remote sites will be installed on top of a round table and a light pen will be used as the primary input device. This new configuration should allow a group of five students to interact comfortably with the workstation. (see Figure 9).

As we look further into the future, this project has demonstrated that the capabilities of ISDN combined with the capabilities of multi-media technology will provide new valuable tools for distance educators. Research must continue to explore instructional design issues around combinations of media, student groupings, and types of interaction.

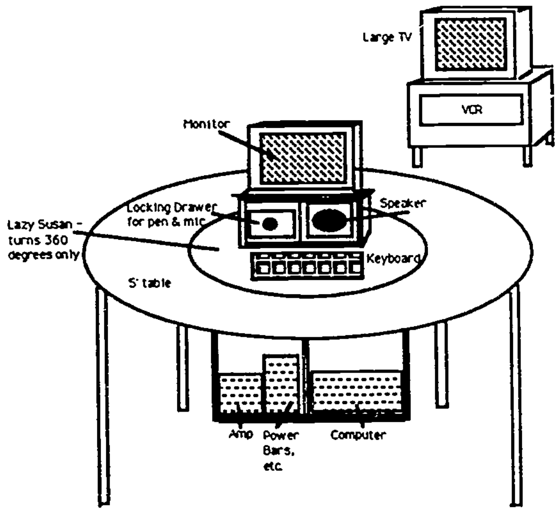


Figure 9. Phase 2 ISDN Remote Site Workstation Set-Up

9. CONCLUSION

In the 1990's, we are moving into a new era of communications. The convergence of telecommunications with information technology has enabled applications barely dreamed of as little as five years ago. These technologies offer powerful new capabilities in support of applications such as distance education.

Yet, this new world also brings new complexity. With intelligence in both the network and the personal computer, and with these technologies being adopted in new fields, a successful undertaking demands a new way of thinking and working together. Parnerships are mandatory. Sharing of knowledge and experience is critical. The application becomes part of the network, and vice versa. Network providers, equipment vendors and application developers must work together in support of the user of the application.

The ISDN Distance Education project, a collaboration of several British Columbia companies and educational institutions, is an example of this new reality.

MULTI-CULTURAL ISSUES IN THE DELIVERY OF DISTANCE EDUCATION

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ABSTRACT

By any measure, teaching at a distance is challenging. These challenges increase exponentially when instruction is delivered to a multi-cultural audience. To increase instructional effectiveness, distance educators must gain an understanding of the unique problems and opportunities facing the multi-cultural learner. Towards this end, this paper explores a number of strategies that can increase distant faculty effectiveness in a multi-cultural setting.

Without exception, effective distance education programs begin with careful planning and an understanding of course requirements and student needs and multi-cultural characteristics. Appropriate technology can only be selected once these elements are understood in detail.

There is nothing magical about effective distance education programs. They don't just happen, they are planned with an attention to detail often exceeding that required in traditional face-to-face teaching.

Before faculty and course developers can adequately meet the diverse needs of multi-cultural learners, they need to thoroughly understand what makes distance-delivered instruction different from face-to-face teaching.

DISTANCE IS DIFFERENT

Whether they realize it or not, effective classroom teachers rely on a number of visual and unobtrusive cues and clues from their students. A quick glance, for example, reveals who is attentively taking notes, pondering a difficult concept, or enthusiastically preparing to make a comment. The student who is frustrated, confused, tired, or bored is equally evident. The attentive teacher consciously and subconsciously receives and analyzes these visual cues. As a result, the delivery of information, and often the course content itself, is adapted to meet the unique characteristics and needs of the class during any particular lesson (1).

The student coming to class with organized class notes, a well-used text, and obvious enthusiasm reveals something quite different from the withdrawn student arriving without class materials or a receptive attitude. Again, alert face-to-face teachers factor these unobtrusive cues into their class planning and delivery.

A traditional classroom setting offers the teacher and students many opportunities for interaction outside of class. Maybe they talk between classes, meet on a class assignment over lunch, or have mutual interests. Just living in the same community provides a common frame of reference that leads to understanding and familiarity.

Finally, face-to-face interaction takes place without any technological linkage. Communication is free flowing and spontaneous, without the need to manipulate switches, ignore static, look into a camera, or rely on a piece of technical equipment linking teacher and students for purposes of communication and feedback.

In contrast, distance teachers have few, if any, visual cues. Even the visual cues that do exist are filtered through technological devices such as video monitors. The effortless flow of a stimulating teacher-class conversation can feel contrived when spontaneity is altered by technical requirements and distance.

Without the use of a real-time visual medium such as television, the teacher receives no visual information from the distar ' sites. The teacher never really knows if, for example, students are asleep, talking among themselves, or even in the room. Separation by distance can also affect the general rapport of the class. Living in different communities, geographic regions, or even states deprives the teacher and students of a common community link.

Until the faculty member becomes familiar with the delivery technologies being used, there is vague discomfort that the instructional message is not coming across as intended, or that the technology is reducing the effectiveness of the course for teacher and students alike.

Distance education is challenging under any circumstance. When combined with the challenges of multi-cultural teaching and learning, however, it can be an especially daunting task. Still, much of what we know about distant teaching in general can be applied, with some modification, to the multi-cultural classroom. When this is done with sensitivity and compassion the end result can be effective and rewarding.

Over the past several years, research exploring effective distance teaching strategies as well as student attitudes towards the use of distance delivery methods in a multi-cultural settings has resulted in some fairly consistent findings. These findings are worth considering when planning and implementing distance education programs for the multi-cultural learner.

Select Contextually Relevant Examples

Instruction is presented through the use of content examples. These content examples must be relevant to the intended audience. This is often difficult for teachers who have little background and experience with the multi-cultural learners they'll be teaching.

Instructors tend to teach using the same examples that were used when they received their content area training. For distance learning to be effective, however, instructors must discover examples that are relevant to their multi-cultural distant learners. A related strategy is to encourage students to find or develop culturally relevant examples illustrating the content points made in the course.

Understand Urban & Rural Differences

Urban students often have similar backgrounds and a common frame of reference. This enables the instructor to use "mass media" instructional approaches and technologies such as prepackaged telecourses that capitalize on this common background. In contrast, rural learners often have culturally diverse backgrounds and limited shared experiences. Meeting the needs of these students typically requires a more targeted instructional and technological approach that enables the instructor to individualize distance teaching strategies to meet specific needs.

Family Support Is Critical

Distant students, especially in multi-cultural settings, often balance many responsibilities, including employment and raising children. Often their involvement in distance learning is unknown to those they work with locally, and goes unnoticed at home. Student performance is enhanced if learners set time aside for their instructional activities and if they receive family support in their academic endeavors.

Create Suitable Learning Environments

Distance learning is enhanced when local facilities are available for class and study. These facilities should include adequate learning resources (voice, video, and data) and a communal learning environment.

Provide Timely Feedback

Timely and informative feedback is essential. It is critical for teachers to respond to students' questions, assignments, and concerns in a personalized and pleasant manner, using appropriate technology such as fax, phone, or computer. Informative comments that elaborate on individual performance and relate content to the student's cultural context are especially helpful.

Promote Student-Student Interaction

Students in multi-cultural learning environments often learn most effectively when they have the opportunity to interact with other students with shared and diverse backgrounds. Interaction among students typically leads to group problem solving and should be encouraged. When students reside in different rural settings, appropriate interactive technology such as electronic mail should be provided to encourage small group and individual communication. Consider assignments in which students from different cultural backgrounds work together and then report back or present to the class as a whole.

If multiple students reside in the same community, every effort should be made to have them participate as a class as often as possible. This group interaction is critical, even if available technology permits individual participation from home.

Enhance Student Motivation

High student motivation is required to complete distant courses because the day-to-day contact with teachers and other students is typically lacking. Instructors can help to motivate students by providing consistent and timely feedback, encouraging discussion among students, being well prepared for class, and by encouraging and reinforcing effective student study habits.

Foster Face-To-Face Contact

Distance delivery is no replacement for in-person contact. If possible, teach from distant sites early in the course and meet individually with students. If this is impossible, arrange to meet with students when other business brings them to your community or vice versa.

Provide On-Site Facilitation

An on-site facilitator who shares the same cultural background as the distant learners can be an effective bridge linking teacher and students. While a facilitator with content expertise is especially valuable, even non-content facilitation can help the instructor gain a better understanding of the students and develop more responsive instruction. This is especially critical when urban instructors from a different cultural background teach rural students.

Reduce Attrition

Student attrition is typically higher in distance-delivered courses than in on-site instruction. This can result from various factors, including limited student advising and counseling, poor family support, inadequate feedback, late return of assignments, and lack of personalized teacher-student and student-student interaction. The best way to reduce attrition is to treat each student as an individual, communicate with them often, and assist in establishing local or regional student support networks.

Help Students Keep Up

Unclear performance expectations and a failure to keep up with assignments early in a course are primary causes of student attrition. Providing adequate time to complete assignments and making performance standards explicit, especially early in a course, will discourage students from falling behind.

Put Time Into Course Adaptation

Even a course taught often in a traditional format will typically require significant adaptation for delivery at a distance. The same is true for newly developed courses and is especially apparent when the course will be delivered to a multi-cultural audience.

Provide Advising And Counseling

As with traditionally delivered instruction, advising and counseling is critical for the distant learner. The distances involved and the lack of common experiences among counselors and students makes the task of providing effective advising and counseling even more challenging. When possible, counselors should share a common cultural background with the students they will be advising.

To enhance advising and counseling at a distance, consider using a toll-free phone number before, during, and after the course has been completed.

Be Sensitive To Hearing Problems

Distance learning is often critically dependent on a student's hearing ability. Unfortunately, hearing problems typically go undiagnosed. Occasionally, both in and outside of class, ask students if they can hear clearly and make arrangements for hearing tests where potential difficulties exist (2).

Deal Directly With Technical Problems

Regardless of the cultural background of the student's and the technology being used, technical problems will occur. Discuss potential problems and solutions with students prior to the start of class. Focus on joint problem solving, not placing blame for the occasional technical difficulty.

Provide **hands-On** Training **For Faculty**

In-service training for faculty on the technical equipment used in the course (audioconferencing, television, computing, etc.) is essential. This training should be practical in nature and include hands-on experiences (3).

In addition, it is important for faculty to understand the roles being played by other team members, such as control room personnel (directors, camera operators) and support service staff (materials duplication and distribution personnel).

Understand Communication Differences

Be sensitive to different communication styles and varied cultural backgrounds. Remember, for example, that students may have different language skills and that humor is culturally specific and won't translate equally well to all students.

Increase Cultural Sensitivity

Distance faculty must be trained to understand and appreciate the diverse backgrounds and needs of multi-cultural learners. Counselors and peers who share the cultural backgrounds of the target audience can provide insights, as can representatives of the target audience itself.

In Summary

There is no denying that effective distance education in a multi-cultural setting is challenging to both faculty and students. It presents obstacles to overcome and logistical concerns to address. Still, many feel the opportunities offered by distance education outweigh the obstacles. In fact, many instructors feel that the experience of teaching at a distance improves their overall teaching ability and cultural sensitivity.

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ACADEMIC INTERNETWORKING IN MEXICO
The world at the reach of a keyboard

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ABSTRACT

This paper presents the development of the Mexican Academic Internet, as a result of the growing telecomunications infraestructure of the country, Government support and converging telecommunications technology.

BACKGROUND

Before 1985 the data communications infrastructure in Mexico consisted mainly of switched telephone or leased lines, and TELEPAC an X.25 packet switch public data transport network providing speeds suposedly up to 9600 bps. The domestic Morelos Satellite System (MSS) launched in mid '85 provided Ku & C band capability giving way for satellite based data networks at speeds tipically of 19200, 64000 & 128 Kbps. It was not until 1990 That TELMEX, the monopoly phone company began offering digital links up to E1 speeds via its overlay digital network mainly in Mexico City and Monterrey, later Guadalajara and other cities were included.

ITESM network

The Instituto Tecnologico y de Estudios Superiores de Monterrey (ITESM), a succesful private academic institution based in Monterrey was founded by Grupo Visa one of the leading Industrial groups of Mexico. The ITESM System has an operating budget of $319.2 MDD, with 57000 students, 4000 CPUs including Mainframes, Workstations and PCs, and 26 campuses spreaded all over the country. A Morelos Satellite based network was the ideal solution to its communication needs.

The ITESM began communications tests in 1986 with SCPC technology at 64 Kbps using 1.8 m antennas. By 1987 they had 9 nodes up and running and by 1990 the full 26 bridge based Campuses were interconnected over the MSS. The System's Hub antenna is located at the Estado de Mexico Campus. As for the land based communications they leased from TELMEX an E1 link between Estado de Mexico and Monterrey and a 56 Kbps dedicated line between Monterrey and ANS at Houston Texas were they connect to the Internet. A second link to the Internet goes from Estado de Mexico Campus via satellite to the National Science Fundation in Boulder Colorado at 64 Kbps, assuring in this way alternate paths.

The communications protocol of choice is TCP/IP. The current aplications offered are the tipical E-mail, Remote Terminal, and File Transfers, plus education via Satellite: a voice and image application named "Sistema de Interaccion Remota" in effect since 1991, it is based on Spectrum Saver CLI Full Motion technology.

UNAM network

The Universidad Nacional Autonoma de Mexico founded in 1551 as the Royal and Pontifical University of Mexico, nowadays with a population of 350,000 students, is the largest and oldest in the continent. At the end of 1989 an ambicious project was set up to modernize the University's voice and data communications infrastructure to be completed in 36 months.

At the end of 1991, together with the instalation of what would be the first supercomputer in Latin America a CRAY YMP, the Mexico City Campus LAN began switching from a coaxial cable based Bridged Network to a Fiber Optic based Multiprotocol Routed Network with an FDDI backbone between the three main nodes: DGSCA the Cray site at the Academic Computing Center; ASTROS, at the Astronomy Institute where the link to the NSF via satellite was set up few years before, and IIMAS the Institute for Applied Mathematics and Systems. The infrastructure has an instaled capacity to handle 110 LANs. Actually it interconnects 1400 computers within the UNAM.

The Fiber Optic cables run a distance of 62.5 Km. In each cable there are 8 fibers giving a total distance of 500 Km of operational Fiber.

In the Metropolitan Area Network there are seven UNAM installations linked to the Ciudad Universitaria campus at the south of Mexico City. Four of them via microwave links with speeds ranging from 2 to 10 Mbps and three other via Telmex E1 links.

There are several academic and research institutions connected via serial links to UNAM network, as it is the Colegio de Mexico, Instituto Mexicano del Petroleo and others.

In its Wide Area Network there are 12 Satellite Earth Stations using FDMA, all over the country providing connectivity to other UNAM locations as well as to other academic networks as MEXNET via ITESM, RUTyC via U. de Guanajuato and SESIC, and the link to NSF.

Connectivity to other Academic networks: To NSF-net via satellite link to NCAR at Boulder CO., also via CICESE Ensenada-SDSU San Diego, and via ITESM Monterrey-ANS Houston TX.

This network provides for remote access via plain old telephone asynchronous serial lines through a bank of modems connected to a communications server.

RED UNIVERSITARIA DE TELEINFORMATICA Y COMPUTO (RUTyC)

The Ministry of Education's Undersecretariat for Higher Education and Scientific Research (SEP-SESIC) put forward a project to build a satellite based network with the State Universities.

It began in 1991 with a point to point SCPC star shaped pilot network with five nodes: U. de Guanajuato (Salamanca), U. de Colima (Colima), U. de Chiapas (Tuxtla Gz.), U. de Tabasco (Villahermosa), U. de Nuevo Leon (Monterrey) and SESIC (Mexico City). The Network Control Center was located at Salamanca, mainly because of its geographical location at the center of the country as well as its potential for qualified human resources.

For the complete network, a study done by SESIC's Advisors revealed the benefits of using a Ku band, TDMA, VSAT technology, leaning on the X.25 service provided by Telecomm's operated Morelos Satellite System. For this second phase of the project, ownership of the satellite communications equipment, savings in monthly fees and not having to pay for an expensive Hub antenna where key factors, offseting the may be slow speed of the X.25 transmission. The protocol of choice was TCP/IP over X.25 for the WAN.

A third phase may include terrestrial E1 links between four to five main computing centers that will act as feeder nodes for nearby institutions, provide redundant data paths and benefit from their routers infrastructure.

A fourth phase, or when traffic demanded it, may include a Hub antenna and a speed upgrade to 64 Kbps using a different transmission scheme. This will require upgrading the satellite earth equipment, provision taken before it was purchased therefore included in the specs to the supplier.

From a total of 32 Universities, 16 of them had their system up and running by early December 1992.

MEXnet

MEXnet is a non profit entity, incorporated in 1992. Its mission is to provide to the Mexican Academic and Scientific community with an electronic communications network to foster research and technology development in the country.

Its 22 members as of Dec. 1992 are composed of 7 private institutions: ITESM, ITESO, ITAM, LANIA, UDLA, UDEM & Inst. de Ecologia.
15 public institutions: U. de Guadalajara, IPN, CIQA, Col. de Posgraduados, U. de Guanajuato, IT Mexicali, U.A. de Coahuila and U. Veracruzana, U.A. de Puebla, INAOE, U. Antonio Narro Coah., CINVESTAV, U. A. de Guadalajara, UNIVA, IT Veracruz. This means some 700 000 potencial users.

Its infrastructure is mainly terrestrial based on leased lines at speeds going from 9600 to 64 Kbps, for data only. A Multiprotocol Routed network, its NIC will be located for the first year at the ITESM.

In Mexico it has links to UNAM, RUTyC, ITESM and CONACyT. To the US with CERFnet, NSFnet and NCAR.

Among its goals there is to provide connectivity to interested private enterprises for non comercial purposes, the connexion fee is US$7,500 a year. The physical link set up costs to the nearest node have to be covered by the new user. The minimum link speed is 9600 bps. A new member or affiliate must provide an aditional communications port at no cost, to wich another member or affiliate could connect. There are other restrictions and recomendations regarding protocols, node operation time etcetera.

All enquires should be addressed to the Network Information Center at:

Centro de Informacion de MEXnet (CIM)
Departamento de Telecomunicaciones y Redes
ITESM Campus Monterrey
Sucursal de Correos "J"
Monterrey, N.L.
Mexico, C.P. 64849
Tel: (83) 58-2000
FAX: (83) 58-8931

CONACyT network

CONACyT, the National Council for Science and Technology has coordinated since 1989 a series of meetings among the academic community to set up a country wide network, in wich at some point in time all institutions will interconnect.

Its effort is begining to materialize late in 1992 in its new building in Mexico City were the Hub antenna was placed.

It is planed that the router based network will start with 18 nodes; seven in Mexico City to be connected via radio modems at 19200 bps: SPP-INEGI, CECODES, Inst. de Ecologia, INFOTEC, SECIL, CINVESTAV, SPP and twelve remote nodes via SCPC satellite links: CICY in Yucatan, CICESE in Ensenada B.C., CIMAT in Guanajuato, CIB in Baja California Sur, CIES in Chiapas, CIATEQ in Queretaro, IMEC in San Luis Potosi, CIQA in Saltillo, CIATEJ in Guadalajara, CIATEG in Guanajuato and SPP-INEGI in Aguascalientes.

At some nodes a connexion to other networks is inminent: CINVESTAV-MEXnet, CIQA-MEXnet, CICESE-MEXnet, and Via MEXnet to RUTyC, UNAM, and to the Internet.

SATEX network

This network was promoted by the Instituto Mexicano de Comunicaciones (IMC), for the purpose of interconnecting mexican research institutions that participate in space research activities.

The first two nodes set up in 1989 were the CICESE in Ensenada and UNAM's Engineering Institute in Mexico City.

The Hub antenna is located at the IMC facilities in Mexico City.

The technology used is satellite based FDMA/SCPC at 64 Kbps, offering data and voice services.

The other four locations to be installed will be the IPN in Mexico City, IIE in Cuernavaca, INAOE and UAP in Puebla.

As it can be noticed this network can interconnect to all the others in one node or another, eventually reaching the Internet.

INTERNET

Along this paper it is mentioned that most networks reach the Internet. For those who are not familiar with it, the Internet was sponsored by the U.S. Department of Defense and the National Science Fundation. Actually it consists of more than 5,000 networks across 35 countries servicing more than 3 million users. It is based on the TCP/IP protocol suite, defined as the de facto standard for interoperability. Here the importance of becoming a part of it.

CONCLUSION

The convergence of telecommunication technologies has been particularly beneficial to the academic community in Mexico. After years of isolation, in a record time of 3 to 5 years almost all important academic institutions of the country are or will soon be interconnected, literally bringing a potencial of hundreths of thousands of students, teachers and researchers to the Information Technologies era. This I see as opening gateways to the rest of the world's knowledge. Let us hope we learn to use it for good.

What could be the social implications of this internetworking?. Besides the chance of improving the communication and learning processes among the users, I am not sure yet in how many ways, if there are any, and in how long, this spill of technology and information could help toward speeding up the developing process of the different localities involved, further improving the quality of life, thus preventing people to migrate to biger Cities in search of better schools and better jobs. In this sense it will be much healthier to live in the countryside than contribute to the pollution of the main Cities.

SOURCES OF INFORMATION

This paper was written based on first hand information by iterviews to the network managers, network coordinators, or responsables, and documents handed out by these persons.

The HI-NEST Model: An International Computer Network for Support of Program Implementation

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1. ABSTRACT

The Hawaii Network for Education in Science and Technology (HI-NEST) is an international computer network designed to support the implementation and use of the Foundational Approaches in Science Teaching (FAST) program. FAST is an exemplary middle-school science program developed by the Curriculum Research and Development Group (CRDG) of the University of Hawaii.

HI-NEST provides a new and potentially powerful tool to assist teachers in implementing the program more effectively in their classrooms by providing continuing follow-up services as they struggle with adapting to new teaching strategies.

2. BACKGROUND

2.1 DEVELOPMENT OF MULTIMEDIA COMPUTER-BASED TELECOMMUNICATIONS

Previous papers (1) have reported on our work in exploring and developing integrated multimedia telecommunications for educational applications. Early efforts by Southworth tested the communication capabilities of PEACESAT for educational conferencing, coupling conferencing with electronic computer mail for asynchronous communications, and establishing the Hawaii Global TELEclass Project using integrated videophones and electronic mail to enrich foreign language classes. These laid the groundwork for later explorations of the use of facsimile and video slow scan images. Project MENTOR (2) successfully demonstrated the capability for educators in the marine sciences to communicate with one another in the United States and overseas. MENTOR, funded by the National Science Foundation under its Information Dissemination for Science Education program, was one of the first telecommunications efforts (in 1980-81). It was based on a secondary marine science program developed by the Curriculum Research & Development Group (CRDG) of the University of Hawaii.

Building on these pioneering experiences, CRDG in 1988 began a joint project with the New Jersey Institute of Technology (NJIT) called the International Network for Education in Science and Technology (NEST). The emergence of applications software and inexpensive hardware suddenly made computer networking affordable on a large scale for individual schools. Funded by the Hitachi Foundation, NEST was designed to develop cross-cultural and environmental awareness by linking schools in Hawaii, New Jersey, North Carolina, Maine, Minnesota, California, Singapore, Hungary, and Japan. In these locations students of middle-school age were using the Foundational Approaches in Science Teaching (FAST) program developed by the CRDG. Students involved in the pilot project communicated with one another via the Electronic Information Exchange System (EIES) using computer facilities at NJIT. Students shared data they collected on environmental topics such as weather patterns, acid rain, soil analysis, ozone depletion, and similar topics. Data collection was coordinated by the Hawaii site; EIES technical assistance was provided by NJIT.

2.1.1 EIES

Since the early 1970s scientists and engineers have used wide-area telecommunications as one method of communicating with each other. EIES1, a state-of-the-art computerized conferencing system based at the NJIT was developed under National Science Foundation sponsorship in the late 1970s. Its advantages include involvement at the site, time, and pace of the participants' choice, a variety of experts as resources, interaction with peers and experts, a written transcript of the proceedings, and minimal costs compared with telephone, mail, and travel. By using this network students expand their experiences beyond, but not excluding, textbooks and local activities to develop strategies that will help develop a world view. With the computer used to store and organize their communications, students are able to carry out a variety of projects despite the fact the they are located in different states and/or countries. In 1991 a new system with enhanced features called EIES2 replaced EIES1.

There are four main communications capabilities or structures within the EIES2 system to replicate existing forms of communications. Figure 1 displays how traditional means of communications are replaced by EIES2 communication features (3).

EIES 2 Structures and features	Replaces
Messages	Letters Telephone Conferences/meetings
Conferences	Conferences/meetings Sending or drafts or preprints Necessity for co-authors to be co-located Newsletters Journals and abstracts
Activities	Questionnaires Remote assignments
Notifications	Receipt of message

FIGURE 1. COMMUNICATIONS FEATURES OF EIES2

These features allow participants to address messages to one individual, several individuals, a conference or a group. The messages may be signed or anonymous. This allows members to get individual attention or assistance and offer other members advice.

Conferences are spaces for group discussion in which the computer stores the comments in the order in which they are entered and keeps track of where each member is in the proceedings. When entering a conference members are told how many new items are waiting. EIES2 permits multiple "threads" of discussion to allow tracking of related items.

2.1.2. Variables Affecting Participation

Our research verifies that of others (4) regarding the weaknesses of telecommunications systems such as NEST. Three variables appear to affect NEST participation. These can be categorized technical, social, and topical. There are technical issues of communications that are inherent in the medium. A characteristic of computer-based conferencing is that messages are stored in the host computer until it is convenient for members to receive them. The time lapse between the entry of a comment and when it is read by each member is unpredictable. This implies that it cannot be used for information needed immediately.

In addition, if participation is a goal, topics of discussion must be interesting and relevant for the community of members. The use of a common science program appears to enhance participation, however, once again, technical difficulties emerge as the most overwhelming obstacle.

Another feature of EIES is that the audience is unseen. The potential audience for a conference comment is unknown. Topics of messages, both private and conference, play a more critical role in the beginning of interaction in computer-based communications than in face-to-face communications (5). In a face-to-face meeting an introduction, or sheer proximity, may initiate interactions. In computer-based communications proximity is irrelevant. The content of the messages plays a larger role in determining whether interactions will begin. Kerr and Hiltz have stated that reliance on message content as a characteristic of new users in particular.

The importance of an active and structured moderator in producing successful group discussions cannot be overemphasized. The moderator is responsible for setting communications agendas, issuing warm invitations, sending encouraging messages to compliment individual members and comment on their entries, suggesting what they may be uniquely qualified to contribute to.

2.2 CURRICULUM RESEARCH & DEVELOPMENT GROUP

The Curriculum Research & Development Group (CRDG) conducts systematic research, design, development, publication, staff development, and related services for elementary and secondary schools. The group has curriculum development projects in science, mathematics, English, Pacific and Asian studies, Hawaiian and Polynesian studies, Japanese language and culture, music, health and nutrition, art, drama, technology, and computer education. Research and school service projects focus on educational evaluation, teacher development, reduction of in-school segregation of students, and programs for students educationally at risk. The work of CRDG is to find ways to put research findings into practice in classrooms. A theoretically sound curriculum that does not meet the test of usability and productivity in schools is judged only a partial success, because CRDG expects its courses to change what happens in schools.

The curricula that CRDG develops are expected to produce "paradigm shifts" in how subjects are taught, not merely improved versions of standard approaches. Typical of such shifts are (1) teaching students to use inquiry procedures rather than memorize or "master" the subject matter, and (2) integration of subject areas within courses, or (3) helping teachers to change their teaching theories and approaches, not merely the content they teach. These changes in instructional patterns are typical of CRDG's *Foundational Approaches in Science Teaching* (FAST) program which departs radically from conventional approaches to science teaching at the middle school level. It has taken 20 years for its approach to catch on nationally; now over 2,500 schools in 36 states are committed to the program and it is in use in 8 foreign countries. FAST has been cited as an exemplary science program by the National Science Teachers Association and the U.S. Department of Education's National Diffusion Network (NDN) program. Professional associations such as American Association for the Advancement of Science (AAAS) and National Science Teachers Association (NSTA) are now calling for similar approaches in the teaching of science at the secondary level.

2.3 FOUNDATIONAL APPROACHES IN SCIENCE TEACHING (FAST)

The *Foundational Approaches in Science Teaching* (FAST) program is a second-generation inquiry science curriculum designed specifically for middle-school students. FAST has been designed for students to replicate the activities characteristic of the science disciplines at a level appropriate to the developmental stages of 12 to 14 year-old students. Content is organized into three strands called physical science, ecology, and relational study. Relational study focuses on the interrelationships of the science disciplines and the interactions of science and society. The program consists of three 1-year courses intended to be studied sequentially.

FAST is designed to provide investigative experiences and inquiry activities in the physical, biological, and earth sciences as well as in the application of the knowledge of these sciences to environmental issues. The goal of FAST is the development of a scientifically literate student who has 1) the background necessary for understanding the environmental concerns arising in our technological society, and 2) the foundational tools for further study in the sciences. The principal objectives of FAST are to develop thinking skills, laboratory skills, and knowledge of foundational concepts of the disciplines of science.

FAST instructional strategies were formulated to take advantage of the major characteristics of middle-school students—their high energy level and curiosity, their need for social interaction, and their developing ability to deal with abstract thinking. Students work in small groups where they are encouraged to talk with one another about their experiences and ideas, thus directing their need to talk toward meaningful communication and learning. The developmental structuring of FAST begins with concrete, real experiences from which students derive concepts and language, thus facilitating their development of abstract thinking.

Of particular importance to NEST are the ecology and relational study strands of FAST. Students learn how to collect environmental data, how to analyze it and how to report their findings. They also learn how to use reference material to supplement their studies. The relational study strand serves several purposes within the program. Its content is drawn from the fields of philosophy and history of science as well as from the study of current environmental issues. Relational study shows the connections between the sciences, technology, and the world of the citizen. At the end of each of the three courses there is a relational study unit that is designed to cause students to draw on all their experiences in physical science and ecology and to apply their new knowledge to the study of an environmental issue. Relational study exposes the limitations of scientific knowledge in the arena of social decision making. The input of the sciences is seen as but one of the many factors (moral, ethical, aesthetic, economic, political, and others).

Students using FAST already collect local environmental data on weather, air quality, and water quality as part of their studies. However, before NEST no mechanism had been utilized to enable students to share and compare environmental data. Utilizing the EIES system provides that valuable component.

FAST was also selected because of the diversity of locations available for data collection. FAST has been adopted by schools in 36 states and is also used in schools in the Virgin Islands, Pohnpei, Kosrae, Australia, Japan, Abu Dhabi, Singapore, Jakarta, and Budapest. These various locations provide environmentally diverse measurements as well as an opportunity to develop global understanding of environmental issues and cultural diversity.

2.4 HI–NEST

The expanded project that builds on our previous work is called the Hawaii Network for Education in Science and Technology (HI–NEST). In addition to serving students and teachers using the FAST program, HI–NEST is being designed as a network that can provide invaluable assistance in the dissemination, implementation, and support of other CRDG programs. Though the environmental data sharing activities among students and the communications among teachers using FAST in the United States and elsewhere continues in HI–NEST, much greater attention is being directed to the use of the computer network in support of new teachers using FAST for the first time and to keeping the FAST Certified Trainers continually up-to-date on program development, issues, and evaluations.

The use of FAST is growing at an unprecedented rate. Some fifty ten-day teacher institutes were conducted in summer 1992 bringing the total number of FAST teachers worldwide to over 4,500. In 1992–1993 it is estimated that over 450,000 students are taking one of the three courses in the FAST program. Projected figures indicate that by 1995 over 8,000 teachers will be teaching FAST with more than 600,000 students. Currently schools in 36 states and 8 foreign countries are using the FAST program. It has been translated into Braille and Japanese and efforts are currently underway to translate FAST into Russian, Hawaiian and Slovak languages.

The central question being explored through HI–NEST at this time is how multimedia telecommunications can be used to meet the diversity of needs of teachers and certified trainers in ensuring successful and effective program implementation. Project staff have designed the HI-NEST computer network as a powerful support tool to ensure the success of FAST as it expands and provide for meaningful interactions among FAST students, FAST teachers, and FAST trainers. Not only are participants linked with their peers around the world, but they also benefit from developing understanding of global issues and communications technologies.

Specifically, HI-NEST is designed to

- provide student-to-student conferences in which students share the environmental data they collect in their FAST investigations, collaborate in ideas, and conduct research with other students around the world.
- provide teacher-to-teacher conferences in which teachers not only work with their students in sharing data, but where teachers can communicate regularly and as needed with one another and with the FAST project staff about program use and issues.
- provide certified trainer conferences through which FAST trainers participate in the student and teacher conferences described above and in addition can communicate with other trainers and with project staff about training and support issues. FAST trainers also use the telecommunications network to communicate directly with the teachers they trained in FAST institutes.
- provide support for translating and adapting FAST to other locations and cultures.
- evaluate the potential of telecommunications to support teachers in group situations and in independent, isolated situations.
- examine the types of network users and their motivations and aspirations including the use of a common science program as the basis for telecommunications among participants who have never had face-to-face contact.
- evaluate the use of emerging technologies such as FAX, video phone, videodisk, and others for providing follow-up support to program users, providing feedback to program developers for the improvement of both program and training components, and developing global awareness.

3. PROGRAM DISSEMINATION AND IMPLEMENTATION

The process of research and development of CRDG science programs is lengthy and includes researching, developing, testing, redesigning, retesting, and refining. The average length of time for development is 5–10 years. When we are satisfied that the program works well with the target audience(s), it is ready for dissemination.

Our experience with dissemination, implementation, and institutionalization verifies the findings from the research reported in the literature (6). The availability of innovative programs by themselves has little impact on changing teacher behaviors or improving instruction. Without careful attention to staff development and ongoing, continuous support, little change or improvement is likely. Programs that do not attend to these human factors will have little effect. The most important conclusions about what is necessary for successful implementation and improvement are the following:

- The most powerful factor in implementation is locally available, on-going inservice.
- A variety of follow-up services is essential. Users will need different services at different times in their own development and professional growth. Not all sites require follow-up.
- Two factors determine the degree of implementation: the quality and amount of follow-up services; and sustained local support.
- Successful implementation is an individual development process within the organizational constraints and supports provided.
- Effective implementation requires opportunities for people involved to talk to one another. Comprehension and mastery come with time and with teachers talking with teachers about what they are doing.
- Changes in attitudes and beliefs follow changes in behavior (7).

- Complex programs are harder to understand, comprehend, and master, but are also more likely to result in non-trivial results.
- Successful implementation takes time; 3 to 5 years for most worthwhile efforts. Follow-up services should be provided through the institutionalization phase when schools take ownership of the program.

Through our research efforts we have designed a model for implementing meaningful change in schools through our science programs. The model consists of 4 phases, Entry, Goal Setting, Inservice Training and Coaching, and Institutionalization and Maintenance. Completion of all phases is expected to take from three to five years.

The model is currently being used in the national dissemination of three innovative science programs, Developmental Approaches in Science & Health (DASH) for grades K–6, Foundational Approaches in Science Teaching (FAST) for grades 6–10, and Hawaii Marine Science Studies (HMSS) for grades 9–12. In order to understand the context of the use of the model it is important to note that each of these science programs is complex. Each is intended to replace the existing science program in schools, not just supplement it. Each requires changes in the approach to teaching science, in teacher behaviors and in student behaviors, and in expectations of students. Each requires 10 days of training prior to classroom use.

3.1 ENTRY—GETTING TO KNOW YOU

The entry phase of the dissemination/implementation model includes a variety of ways that have proven effective in making potential adopters aware that a new program exists. These include direct mailings to schools, teachers, and administrators, journal advertising, journal articles, personal contacts, conference presentations, conference exhibits, computer conferences, awareness workshops for teachers, and awareness workshops for administrators.

A most effective dissemination strategy is what we call the "infection model." It starts with a quality implementation and spreads by word of mouth. It has a personal touch. Our experience is that when teachers and administrators find a program that works well they want to share their excitement and enthusiasm with others.

The entry phase ends with either a rejection of a program as not meeting local needs, or a request for more in-depth information and assistance in planning for possible adoption.

3.2 GOAL SETTING—MAKING COMMITMENTS

During this stage, objectives of the program and school are clarified, costs of implementation and maintenance are analyzed, a timeline for inservice training and follow-up is developed, and time commitments are made. For our science programs, the goal-setting phase ends with written agreements of responsibilities for training and follow-up (an adoption agreement) and contracts for initial training. Written statements are important public evidence that each party, CRDG and the adopting school or district, have made commitments to one another over time.

3.3 INSERVICE TRAINING AND COACHING

All CRDG science programs require intensive, program-specific teacher training prior to implementation. These teacher institutes are designed to provide hands-on experience as a learner in the program with extensive modeling and discussion of the teaching strategies inherent in each program. Opportunities to practice the new teaching strategies are provided as well. In essence teachers go through each entire program so that they know the activities and investigations well.

Teacher institutes are taught by certified trainers who have actual classroom experience and success in teaching the new science program and have received additional training in how to train teachers. Each of our science programs has a cadre of certified trainers in various geographic locations available to assist in the inservice and coaching stage of implementation.

However, we have learned that pre-implementation training alone is not sufficient for successful use. What is needed is on-going follow-up, coaching, and inservice <u>during</u> implementation. Follow-up services provided during the implementation stage include those described in Figure 2. It is in the inservice and coaching aspects of implementation that the research on changing teachers' classroom behaviors is most relevant. We had to learn through bitter experience to be patient, to listen, and to design inservice and follow-up activities that respond to the levels of concern of users.

For example, we now know that teachers' concerns are mostly at the personal stage prior to and during initial training. Our teacher institutes are designed to focus on these levels of concern through modeling of the appropriate teaching strategies by the certified trainer and through discussion of what was done, how it was taught, and the effect on learning. The trainers focus on the excitement and enthusiasm of the new activities. Knowing that there is great self-doubt about whether "I" can do it, the trainers encourage teachers to take some risks in trying out new teaching strategies. They are supportive and, because they have been in the same position themselves, are empathetic.

As teachers begin to implement the new science program, they begin to shift to a concern over actual use. Because they have experienced how the new program was intended to be taught in the pre-implementation training, teachers generally begin by repeating what they did in their training session. One of the clearest implications here is that the design of the initial training must focus on the most important and exemplary aspects of the new program. In general, during the first year of implementation, teacher use is mechanical. They do with their students what they did in initial training.

During this period of initial use communication among teachers and between teachers and program developers is essential. Support must be provided to be sure that the equipment and supplies are available and present; that teachers have opportunities to observe one another teach and to meet and discuss their successes and problems with one another; that follow-up inservice is available as needed; that communication with the CRDG staff is open and responsive; and that teachers are encouraged to continue even when the new style of teaching feels awkward or even frustrating. This stage of teacher development and support services lasts from 1 to 3 years. During this time, the full range of follow-up activities shown in Figure 2 are often employed, though not necessarily all at one time. Services are roughly listed in order of increasing expense.

3.4 INSTITUTIONALIZATION—MAKING IT OURS

As teachers master the new science program, their concerns shift to student impact. In FAST, for example, teachers begin to adjust their teaching. The new style of teaching through inquiry feels more comfortable, and in fact few would ever go back to their old ways of teaching. It is at this stage that we have successfully engaged teachers in a series of professional development seminars designed to explore areas beyond the day-to-day use of the program in their classrooms. Group meetings that previously dealt with the mechanical problems of implementation often begin to deal with philosophical issues such as what is worth teaching and what is the nature of science or to research applications such as how can the research on learning styles or cooperative learning or thinking skills help teachers to teach their program more effectively to more students. It takes 3 to 5 years for most teachers to reach this level of mastery. It is in at this stage that evaluation of the impact of the program is most appropriate, when teachers are no longer struggling with understanding the innovation, but are refining it and personalizing it.

Follow-up Type	Examples
Direct mail	Certificates; Newsletters; Updates; Advisories; Adaptations; Recognitions; Parent letters; Evaluation data.
Phone contact	Administrative follow-up to see that materials have arrived; Project hotline to answer immediate questions on investigations or teaching; Service from developer on evaluation, proposals, parent concerns, etc.
Teleconference	School department with developer; Regional meetings of users with developer; Conference meetings with developer.
Computer Network	Communication from local coordinators, teachers, and administrators; Bulletinboards; Sharing environmental data among users.
Certified Trainers	Providing continuous follow-up and support for own district and local area; Continuous training of new staff.
Site Visitations	Classroom, by developer, local coordinator, or certified trainer; Administrative, to build understanding and support for program; Observation and feedback using Classroom Observation Instrument; Additional training if necessary.
Conferences	Drive-in conferences by region; Group meetings at state science conferences; NSTA Share-a-Thons; Exhibit booth where users can meet one another and developer.
Institutions of Higher Education	Provide research and credit for professional growth; local adaptations; Provide for development, local adaptations, and evaluation; Provide subject area experts as needed.

FIGURE 2. FOLLOW-UP ACTIVITIES IN THE CRDG IMPLEMENTATION MODEL

4.0 THE HI–NEST MODEL IN SUPPORT OF PROGRAM IMPLEMENTATION

The FAST project staff have always been committed to providing training and follow-up support services to teachers. However, as use of the program has grown in numbers worldwide, this has become increasingly difficult.

HI-NEST is a powerful support tool to ensure the success of FAST as it grows and provide for meaningful interactions among FAST and nonFAST teachers. HI-NEST provides a progressive network whereby project staff can more readily support all teachers and trainers involved with the program. Not only do teachers and students benefit from an understanding of global issues and communications technology, they are linked with their peers from around the world.

The HI-NEST model is based on a hierarchy of users engaging in increasingly complex and rich sets of interactions. These are diagrammed in Figure 3 and described below.

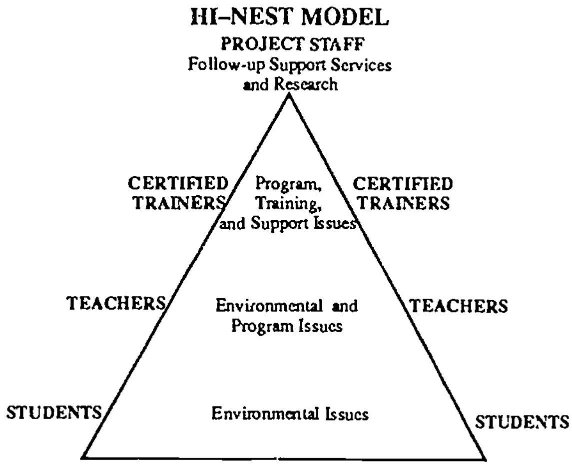

FIGURE 3. THE HI–NEST MODEL

4.1 STUDENT-STUDENT CONFERENCE

Through the student conference HI-NEST provides students the opportunity to share environmental data and observations, collaborate on ideas, and conduct research with other students throughout the United States and around the world. This aspect of the project continues the activities begun under the original NEST project funded by the Hitachi Foundation.

4.2 TEACHER-TEACHER CONFERENCE

Participating teachers working with their students share the benefits of conducting research and sharing environmental data on a national and global basis. In addition, HI-NEST provides a network whereby teachers can communicate regularly with one another and with project staff about program issues.

4.3 CERTIFIED TRAINER-TRAINER CONFERENCE

As described in the previous section, teacher institutes and follow-up support services are an integral part of the FAST program. Classroom sets of materials are only made available to teachers who have been trained to use them. FAST teacher institutes are a combination of theory and application which includes intensive study and engagement with the FAST program. Teacher institutes are conducted by FAST project staff and certified trainers. These trainers are experienced, highly motivated FAST teachers who have had additional training from FAST staff in conducting teacher institutes.

The HI-NEST certified trainer conference serves multiple purposes. First, since all FAST-certified trainers are also classroom teachers, they too share in the excitement with their students of engaging in study of globally relevant issues and communicating with other FAST students and teachers worldwide. Second, the HI-NEST creates a network of certified trainers who can communicate regularly with one another and with project staff about training and support issues relevant to providing timely and up-to-date teacher institutes. Third, and perhaps most importantly, HI-NEST provides an opportunity for certified trainers to communicate with and support those teachers that they trained in FAST teacher institutes. Fourth, all FAST-certified trainers are active EIES users and beginning in 1993 will incorporate computer network training into the FAST teacher institutes they conduct.

4.4 PROJECT STAFF

FAST project staff members include program developers, content and training experts, field support personnel, technical advisors, and the HI-NEST network moderator. The network moderator provides the link between project staff, certified trainers, and network participants.

Specifically, HI-NEST enables FAST project staff to

- communicate directly with certified trainers providing program updates, revised and improved teacher institute schedules and approaches, and general information designed to keep certified trainers at the cutting edge of program improvement.
- provide support directly to middle-school teachers. *Support* includes assistance with the content, pedagogy, objectives, investigations, and other program issues.
- provide service directly to middle-school teachers. *Service* includes technical assistance with telecommunications software and connections, computer and modem, and EIES in general.
- expand and improve follow-up services by engaging FAST-certified trainers in providing direct communications with teachers they have trained.
- provide a network moderator who monitors student, teacher, and certified trainer conferences, analyzes and summarizes student-collected data, and links teachers and certified trainers with appropriate FAST project staff for follow-up support services.

4.5 RESEARCH

An integral part of HI-NEST is the on-going research into the use of emerging technologies. Of particular interest are the following:

- evaluate the use of emerging technologies such as telecommunications networks, FAX, videophone, satellite synchronous and asynchronous communications, videodisk, videotape, and others for developing global awareness, providing follow-up support services to program users, and providing feedback to project staff for program and training improvement.
- examine the types of network users and their motivations and aspirations including the use of a common program as the basis of communications among participants who have not had face-to-face contact.
- evaluate the potential of telecommunications to support teachers in group situations and as independent, dispersed users of a common program.

HI-NEST uses FAST as the unifying, common science program from which the initial environmental investigations selected and adapted for use by students and teachers. Implementation of FAST represents a significant change in teacher and student behaviors. In addition, HI-NEST itself requires teachers to become involved with and master technologies that are unfamiliar. It is well established and recognized by the project staff that there are several barriers to the implementation of any program such as FAST and HI-NEST on a universal basis. Among these barriers are the

- lack of funds to support any science program changes.
- reluctance to embark upon new and significant changes in curriculum design among those in key administrative or decision-making positions.
- reluctance of teachers to actually change their teaching methods from content orientation to inquiry/discovery teaching involving students in conducting science investigations.
- state textbook adoption and framework policies.
- reluctance of teachers to spend time in in-service training.
- unwillingness of districts to financially support in-service training.

The project staff also recognize that 1) students and teachers should not be excluded from participation because of these barriers, 2) teachers of programs other than FAST will want to participate in HI–NEST and use the FAST investigations, and 3) nonFAST teachers have many ideas and functional environmental investigations that they can share with their FAST colleagues. These facts were well established in the NEST pilot project. Therefore, we are currently researching the impact of the HI–NEST model across four distinctly different groups of teachers.

- Group 1. FAST teachers meeting regularly in group setting to design and plan student activities, carry out data collection, and communicate with others teachers and FAST project staff.
- Group 2. FAST teachers who are isolated and unable to meet with other teachers, but want to participate and share student data and communicate with other FAST teachers.
- Group 3. NonFAST teachers meeting regularly in group setting to design and plan student activities, carry out data collection, and communicate with other teachers.
- Group 4. NonFAST teachers who are isolated and unable to meet with other teachers, but want to participate and share student data and communicate with others.

Each group poses special problems and opportunities for continuing research into the use of these emerging technologies for global and multicultural awareness. Groups 1 and 3 share the tradition of knowing one another through face-to-face contact. HI–NEST provides a way for them to communicate with each other and other members of the network following their regular meetings.

Group 2 teachers are isolated either geographically or socially. They may be the only FAST teacher in a district or the only one in Singapore. These teachers are crying out for opportunities for their students to share and compare the environmental data they are collecting and to communicate with other FAST users and with project staff for support on program issues.

Group 4 teachers share the same sense of isolation as the Group 2 teachers, but in addition do not have a common program like FAST to link them with other teachers. These teachers wishing to participate in HI–NEST are provided copies of the FAST investigations to use with their students and provided both support and technical assistance in using HI–NEST capabilities. This has been the case in the participation of Russia and Japan in the pilot NEST project.

Group 1 includes locations where FAST certified trainers already exist. These trainers serve as facilitators of regular group meetings of FAST teachers in their respective regions to share environmental data, provide program and background information updates, and encourage participation in HI–NEST. There are currently 66 trainers located in California, Connecticut, Florida, Hawaii, Illinois, Maine, Minnesota, Missouri, New Jersey, New York, North Carolina, South Carolina, Vermont, Virginia, and Washington.

The intent of the research on four groups of users is to develop knowledge on how best to serve the needs of students and teachers that each group represents. At present, NJIT has extensive experience in working with groups of teachers in face-to-face meetings followed by electronic communications when they return to their classrooms. Similarly, the FAST project has extensive experience in designing effective, quality instructional materials and teacher development institutes relevant to using these materials. Little is known about how to most effectively incorporate telecommunications technology with an exemplary science program that is being used by students and teachers on a global basis. No other existing network is using a proven science program as the basis for communication electronically.

The operating hypothesis is that if teachers no matter where they are located share a common training, teaching philosophy, and quality program as well as training in how to use the technology of HI–NEST that they will more likely become involved in telecommunications activities, will further develop their skills and knowledge as teachers, and will involve their students in examining global extensions of the investigations they are conducting in their classes.

4.6 INTERNATIONAL TRANSLATIONS

International participants currently include students and teachers in Jakarta, Japan, Singapore, and Budapest. HI–NEST staff are currently working on adding participants from Bangkok, Moscow, Paris as well as Townsville in Australia, Nitra in Slovakia, and both Kosrae and Pohnpei in the Federated States of Micronesia.

A recent agreement between the Ministry of Education and CRDG has been executed to translate FAST into Russian and to pilot test its use in schools in Moscow. A similar agreement exists between the University of Nitra and CRDG for use of FAST in Slovakia. We believe that this is the only science education program currently being considered for such international exchange in Russia and Slovakia. FAST is currently being translated into Hawaiian and we are considering developing a Spanish edition.

These new research endeavors create new problems of communication. For example, in programs such as FAST, a central concern is the translation of the spirit of inquiry in addition to the problems of literal translation. HI–NEST is already serving a vital communications link during this translation process and will be even more important as the pilot testing of the program begins in these foreign locations.

Participants from each group will be monitored closely by the HI–NEST moderator to determine their degree of participation, the barriers to participation, the degree of success students and teachers experience, and the kinds and level of support and services required to maintain participation. These data will enable project staff to design a more functional network capable of responding to individual and group needs.

A further significant involvement is the interface of HI–NEST with TeleClass International, a non-profit, educational telecommunications program based in Hawaii. TeleClass International is designed to connect native language speakers in the United States with students in their home country. HI–NEST provides substantive science, environmental, and global issues for these students to discuss. Through TeleClass International we have the potential of adding participants in Korea, the Philippines, Germany, and many other countries.

4.7 IMPACT ON THE CRDG DISSEMINATION AND IMPLEMENTATION MODEL

Though not intended in the original design, HI–NEST has become increasingly important in all phases of the CRDG dissemination and implementation model. At the entry phase, for example, HI–NEST is already serving as a new and effective program awareness tool. Since there are many teachers using the EIES system who are not FAST teachers, the visibility of the HI–NEST activities in the network has attracted numerous inquiries from teachers wishing to learn more about FAST.

At the goal setting phase, HI–NEST has the potential of providing instant communications between potential adopters of FAST and the FAST project staff as school personnel consider the advantages of using FAST and its potential impact on students, teachers, classrooms, and the school community. At this early stage of review, schools have many questions that need carefully considered answers before commitment to training and implementation can take place.

We have already described the importance of HI–NEST in keeping open communications with FAST trainers and keeping them up to date on program developments. Training in how to access the computer network services is now being incorporated into the FAST teacher institutes. Active participation at this level will also include communications among trainers and teachers during the summer teacher institutes.

During the early stages of classroom implementation, HI–NEST will provide invaluable services. In addition to providing a network for teachers to communicate with the FAST project staff on implementation successes, problems, and questions HI–NEST also provides for FAST trainers to communicate directly with the teachers they trained to assist them through the implementation process. Future developments include an on-line newsletter and journal for FAST teachers and students, professional development seminars conducted on-line, as well as via live, interactive multimedia technologies (e.g. Hawaii Interactive Television System (HITS), a statewide, full-motion instructional TV system) and collecting student impact data on program effectiveness.

5. CONCLUDING REMARKS

HI–NEST is a practical, cost-effective model in support of program implementation. It addresses the topical, social, and technical issues identified in other research projects as barriers to effective use of telecommunications networks. Topical problems are addressed through the use of a common science program among all users. Topics are directly relevant to everyday classroom activities of students and teachers. Social issues are addressed through direct familiarity of teachers with the instructors they know and trust and through relevant and timely support in implementation. Technical issues are addressed through face-to-face training of participants in the FAST teacher institutes and providing accurate and responsive help on-line and by phone. The project provides a variety of follow-up support services including a HI-NEST moderator who is responsible for energizing, guiding, and monitoring activities using the telecommunications network. Future developments will include a HI–NEST newsletter, educational journal, and staff development seminars.

HI–NEST will undoubtedly play an important role in the translation of FAST into other languages and cultures and in monitoring its implementation in other countries. The model has potential applications beyond FAST. Other CRDG curriculum development projects in science and math will be added to the system as they are available.

At this point several observations are clear. First, an international network connecting science teachers involved in teaching the same program is feasible. Second, there is a great deal of interest in and excitement about sharing data collected on environmental issues on a global basis and in teachers sharing classroom experiences. Third, HI–NEST is a viable way to improve global awareness of environmental issues, understanding of other cultures, learning about new communications technologies, and supporting the widespread implementation and use of exemplary science programs.

6. ENDNOTES

(1) See Kingan, et.al., 1990; Southworth, 1977; Wollstein, 1986; Gullickson-Morfitt, et.al., 1992
(2) See Southworth and Klemm, 1985; Klemm, 1990
(3) See Hiltz and Turoff, 1978
(4) See Gullickson-Morfitt, 1991; Hiltz, 1988; Hiltz and Kerr, 1982; Kerr, 1983
(5) See Katz, M. et.al., 1987
(6) See Fullan, 1987; Huberman and Miles, 1984, Joyce and Showers, 1984; Crandall, et.al., 1983
(7) See Fullan, 1987

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A System Architecture for Ideographic Language Support

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1. Abstract

This paper describes the development of a system architecture to support ideographic languages. Since each country expects vendors to communicate using the correct names and addresses of its members, this support of local Asian languages will meet the cultural and regional needs of the American Express card members in Asia.

2. Introduction

American Express is recognized as a quality supplier of financial services throughout the world. In Asia, a requirement for quality services is the support of local languages. Customers expect vendors to communicate to them in the language of their choice. In Asia, this entails support for ideographic languages (comprised of symbols) which include Chinese, Japanese and Korean in their written forms.

The strategy in Asia and the Pacific is to develop a solid technological platform and system architecture that supports ideographic languages at the same level that the company supports English. The system includes the following concepts: an automated and integrated approach, flexible and interactive graphic user interfaces across countries and business units, a portable and scalable system design, and on-line help and on-line reference capabilities. A system incorporating these concepts enables an agent to conduct business at a workstation in an ideographic language in the same way as an English speaking counterpart.

3. Project Scope

The Ideographic Language Support project is a three year, three phased project with deliverables at the end of each phase.

Phase 1 provides improved linguistic support for card members, Service Establishments and clients of American Express. This includes fixing current language code set incompatibility problems, automating present font creation processes, expanding font libraries, providing ideographic language translation on names and addresses, and enhancing the quality of printed output.

Phase 2 will develop client/server architectures which optimize ideographic language support in the operations groups. This phase will apply new technology to scalability of fonts, expansion of fonts in workstations and printers, and the interactive addition to font databases and machine recognition of unique language problems.

Phase 3 will apply voice, image scanning techniques, artificial intelligence and multimedia technologies. Advanced processing will utilize server resident expert paradigms to form the correct mix of ideographic characters. Also included are multiple language support for English, Chinese, Japanese and Korean in printers and workstations.

4. System Environment

The alphabets of the ideographic languages are very large. Hanzi, the language spoken in the People's Republic of China and Singapore, has 7,445 characters; Hanyu, spoken in Hong Kong and Taiwan has 13,735 characters in normal use (10 times as many in total); Kanji, spoken in Japan, has 12,800 characters; and Hanja and Hangul, spoken in Korea, have a total of 8,224 characters. [Pan 1991] In addition to having to deal with the large number of characters, the processing of information in an ideographic language is made even more difficult since the languages have numerous characters with complex patterns, ambiguous word segmentations, and multiple homonyms. [Matsuda 1985] Consequently, to provide ideographic language support, a new system architecture is required for database structure, data input, data processing, and data output.

Database structure: Although two-byte representation is adequate for Japanese, additional bits are required for Chinese fonts. Techniques to create, update and retrieve characters were investigated. Since some languages (e.g., Chinese) don't have alphabetic order, search and sort issues needed to be addressed.

Data Input: The large number of ideographic characters have made traditional keyboards inadequate. [Huang 1985, Becker 1985] Keyboard alternatives have resulted in linguistic advances in input which assist this complex problem. The use of graphical interfaces facilitate the complete support of the language. Past advances have affected computing in other nations. Scanning for instance, was perfected to support Japanese, and expanded to handle other graphics work.

Data Processing: Additional processing power is required to handle the expanded characters. Unique versions of operating systems compensate for double-byte support and provide the capacity to handle ideographic and non-ideographic languages. Programming languages and applications must be modified to reflect the enhanced data and textual requirements. Applications such as word-processors must be adopted to the ideographic language requirements.

Ideographic Name and Address Support: To provide ideographic language support, we need to develop dictionaries and data processing techniques to map from one language representation to another. This is not a new problem and a wide variety of techniques currently exist. However, we need to identify and develop the particular ideographic support that would satisfy our business and system requirements. Our approach is to develop a multi-lingual database that has the capability of displaying names and addresses of all American Express Card Members and Service Establishments and has all the internal code information for the user that is accessing the data. Once we create the supporting dictionaries, we can develop an American Express specific translation system which contains business related words, phrases and other necessary information. The American Express translation system would be based on current translation technology with added American Express specific vocabulary.

Data Output: Printers and the operational software must be defined which support the full range of the language. Output is also affected by automated language translation as results are shifted across countries. Cash dispensing terminals use multiple languages including Japanese and Chinese. Precision translation between English and Japanese or between English and Chinese is a requirement which can be assisted by technology developments.

5. Major System Components

In developing a system that takes into consideration these environmental requirements, our approach is to always think globally but realize that sometimes a unique local solution will be required. This will allow us to reuse existing facilities when possible. With these thoughts in mind, the major components of our system are as follows:

Client/Server Environment Direction

Client/server computing is an architectural concept that supports the division of an application into its component parts. Each portion of the application can then run on the appropriate platform. Although modular programming techniques have existed for some time, client/server computing is relatively new. This new processing concept has seemingly unlimited potential for converting the current mainframe-based environment into one which can support American Express' information processing needs well into the next century. Key components of the client/server computing environment include the deployment of ultra high-speed networks, the industry-wide move toward open systems, and the availability of mainframe-equivalent processing power in workstations. However, the client/server architecture will not replace the mainframe.

To identify an appropriate client/server architecture. we worked with our offices in the local regions. Based on our initial discussions, the client/server architecture will include a Font Server, Display Server, File Server, Printer Server, and Database Server. A Token-Ring Network could be used for the client/server architecture. Considering the performance, local regions may need several LANs with an appropriate number of workstations. How many LANs are required and their relationship with each department needs to be further studied. With a relatively low investment in LAN equipment, users can achieve the following benefits: distributed processing, lower costs through shared resources, access to shared data, better use of existing resources. display/workstation freedom of choice, centralized back-up, interconnectivity, and high-speed communication.

Since the client/server architecture will be for all applications (including ideographic), we need to build up this foundation for all regions so that everyone can obtain local language support from the same environment. As such, the client/server architecture must be in accordance with American Express' Technical Infrastructure Roadmap developed by Operational Systems Planning Worldwide Information Processing and Telecommunications. We are extending this roadmap to include an architecture that supports double byte characters (and possibly 3 or 4 byte characters) for Chinese and Japanese.

In essence, our long-term strategy is to deploy a fully distributed environment on a worldwide bases. In this integrated environment, all processing functions will be provided with the same standard processing platforms. These platforms will include RS/6000s, STRATUS Fault-tolerant Processors, and other DCE-compliant servers. In this project, we will work with our Taiwan office to develop a RS/6000 client/server prototype. Since client/sever issues involved with supporting a Chinese environment is a more complicated problem, we will be able to migrate our solution to other regions.

The client/server architecture that supports two to four byte characters for Chinese and Japanese can be defined as follows:

Font Server: PS/55, PS/2 or IBM compatible PC can be the font server for a Japanese, Chinese, or other Asian region system. For IBM AIX, the font files are stored in a RS/6000 and are loaded into X stations whenever it is requested by users.

Display Server: Since X windows is based on a client/server architecture, besides X stations, PCs can also become display servers by installing X server.

File Server: RS/6000 will be used for file servers.

Printer Server: Either AS/400 or RS/6000 will be used for printer servers.

Database Server: RS/6000 will be used for database servers.

Databases: Since American Express has selected Sybase as our database partner, we will use Sybase with Chinese/Japanese client/server architecture. Sybase supports DOS, OS/2, AIX and Macintosh.

Internal Codes for Different Regions: EUC (Extended UNIX Code) is recommended for workstations since American Express is using IBM AIX. IBM AIX uses EUC as the internal code and has defined 14,023 Chinese characters. Each Chinese character can take two or four byes. EUC defines a total of 141,376 Chinese characters. This is enough for any language. Since same characters may have different appearance in Chinese and Japanese and may have different meaning, it is hard to define unique code for both Chinese and Kanji characters. To access data in other areas among different regions, we will use IBM AIX to provide multiple languages environments.

Intelligent Letter Generation

We have started to develop an intelligent letter generation system that will facilitate the process of generating letters in Japanese or Chinese to card members in Japan, Taiwan and Hong Kong. Such a system will allow the user to input customer specific information. The system will then retrieve any additional needed information regarding the customer from the host computer database. The system will then decided which type of letter template should be used and then merge the customer information into the letter template. The system will then open an ideographic language word processor to allow the user to make any modifications to the generated letter. Once the letter has been finalized, the system will print the letter. In addition, the system will automatically store the letter in a database along with such information as the date it was written and the author's name.

To ensure the development of one standardized personalized correspondence system, we will use an expert system American Express is currently developing. This system will address all issues of customer correspondence including automatic letter generation and network issues. Once this system is completed, it will be translated into Japanese to support our Tokyo office. We will then translate the system into Chinese to support other markets. This approach will result in one standardized system for all regions.

The development of a truly multilingual input/output system would be the next step. Such a system would not simply be a collection of language-specific I/O routines to suit specific applications. Instead, it would contain a formulation of how to specify characters in different languages. This would enable an application to perform character I/O in any language on an equal basis. [Kataoka et al., 1991]

Resolve Chinese code set incompatibilities

In the system currently being used by our Taiwan office, the internal code set is not compatible across different computers. The goal of this task is to find a package and customize it to resolve this incompatibility.

Character/Font Management

There is a need to develop a tool set which supports creating, managing and distributing the DBCS character font sets. Currently, whenever a new Chinese character is required, a Xerox has to be requested to create the corresponding font. The font and associated internal code must then be added to workstations, data capture equipment and the remote mainframe as well as printers in Taiwan and Hong Kong. The problem is that the font may not be created in timely manner resulting in inconsistencies among the fonts in the mainframe, PC, printers and data capture equipment.

We are studying the market to identify solutions for character/font management. Since the character/font management needs of Taiwan and Japan differ, two solutions will need to be developed. For instance, in Taiwan the Ming font style is popular for Chinese characters. Our Taiwan office has little requirement of multiple font support for Chinese character output. In Japan, the Mincho and Gothic font styles are popular for Kanji characters, and the Italic and Script font styles are available for non-Kanji characters. Our

Japan office expects to have multiple font support for Kanji character output, such as Mincho, Gothic, Italic and Script font style.

We are looking at this problem globally as we work with the local regions to find a tool set for them. However, it is unclear whether a global solution exists for character/font management since it does not appear that any one software company offers one management solution for both Chinese and Japanese. However, there is a possibility that a large corporation (e.g., IBM) may have a global solution. We are still investigating this issue.

Intelligent Chinese Input System

We are developing an intelligent method to input information into the client/server environment. By utilizing one virtual standardized keying method and transparent internal Chinese representation, Management Services keying staff could share and backup workloads. Furthermore, incorporating off-line local data entries would speed up data entry and reduce the system's response waiting time caused by interacting with the remote mainframe system. In addition, this would allow for localized design of input screens that could be tailored to meet local requirements.

This task consists of the following major efforts: (1) determine an intelligent input method and (2) develop an off-line local entry system that is integrated with the client/server environment. To develop an intelligent method to input Chinese we will need to decide whether to use Optical Character Recognition (OCR) and/or Intelligent Character Recognition (ICR), decide whether to use hand-written Chinese characters for input for on-line data capture, select a platform, determine which vendor's Chinese character input system to adopt, and we will need to port the input method to the desired platform.

Research continues in this field as to what constitutes an optimal international language interface [Morisaki et al., 1991], an optimal ideographic keyboard [Sheng 1985], and an optimal ideographic character input and processing scheme [Hsu 1991, Tien 1985].

6. Future Directions

There are several new technologies that can enhance an ideographic architecture. These include pattern recognition, natural language machine translation, and new input methods.

Pattern recognition is a technique to match an input pattern against stored patterns to determine the closest match. This technology would be useful in developing a chop verification system. The chop is an item unique to Asia. It is carved with the reversed image of a person's name which is used for official documents. It serves the same purpose as signatures for western countries. Pattern recognition could be used to recognize the chop pattern and thus enable depositors to easily and securely withdraw funds from branch bank offices.

To provide multi-lingual support to its customers, some form of natural language machine translation could be used. This technology could be used to provide well translated multi-lingual documents. However, due to technology constraints, a fully automatic translation system is not available in the near future. However, an understandable translated document is available between some languages and it is useful for previewing untranslated documents.

New input methods such as pen-based computing, speech recognition, and optical character recognition offer alternatives to the conventional keyboard. This is especially important for ideographic languages since keyboard input in not very convenient. Currently, people who use ideographic languages try to map the pronunciations, strokes, or the shapes of the characters to the keyboard. [Cui 1985] These systems are generally not easy to learn or use. In addition, these systems do not provide fast input speed and they require considerable system resources.

7. Conclusion

It is only natural that people expect to have support in their own language. This is particularly true in high growth markets such as Japan, Taiwan, Hong Kong and Korea where over 90% of the preferred language is the national language. American Express is committed to meet both the internal and external requirements for language support. Externally we must communicate with our customers in the language of choice in these markets and we must be capable of supporting their national languages efficiently and effectively. To provide such support, we had to address the client/server environment issues as well as develop software systems that will utilize this architecture. In addition, we had to ensure that the selected client/server architecture as well as developed software systems were in accordance with the American Express world-wide architectural standards. In taking a global approach to the problem, we can ensure that our Asian card members will receive the same quality services as any other card member.

The effective use of ideographic language is still in a rudimentary stage. A good deal of research is needed to facilitate the long-term goal of effective ideographic language support within the various American Express business units. The architecture proposed in this paper, along with ideographic support software, will improve our ability to communicate with card members in their local languages. As new technologies mature, we can expect to further improve the quality of our services to all our card members worldwide.

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Architectural Consideration in the Design of Network Based Educational Systems (NBES)

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ABSTRACT

In this paper we enhance the architectures of both the telecommunication networks and intelligent networks to incorporate substantial component of "knowledge processing". It is then reconfigured to meet the needs of educational and research communities. Processing of knowledge occurs as information flows through the network in two distinct ways. First when the initial interrogation takes place, the subject matter is identified and linked to other knowledge by forward and backward chaining. Second, the function to be performed on this subject matter is also identified and a operator-operand relationship is established to facilitate the network response.

1. Introduction

Network based educational systems (NBES) have started to emerge and isolated cases of a broad spectrum of such networks facilitate distance learning, interactive distance classrooms and video based participation of distant classrooms. Such applications (1, 2) need high bandwidth communication links to permit bidirectional video facilities to be implemented. Such techniques have been operational and proven successful in creating a classroom environment for college education.

Whilst, we commend the progress in this direction, we are also alarmed that the progress in the crucial direction of intelligent networks is not being harnessed for the innovation and development of educational networks. This type of network processes knowledge and its segments intelligently and fabricates the response from a large cross-section of knowledge bases (banks). This network uses the communication capability of the network to collect queries from students in an interactive mode and then poses the question to a "knowledge ring" comprising of numerous knowledge bases arranged hierarchically, and then bursts the response back from an "artificially intelligent instructor". Such a response would be consistent with the response of an extremely knowledgeable instructor but needing streamlined language interface to comprehend the precise needs of the student. Once the query is understood, the system would restate the question back to the student in the way the particular knowledge base is interrogated. Upon confirmation, the system would deliver the response back to the student. In a manner of speaking, this is how the human instructor would have responded in a classroom. We do not promise that this methodology of teaching is applicable in every situation, but there appears to be niche for such an NBES where the students are eager and intelligent to interact constructively with the system. Typical of this environment is the research and development facility of any organization or the graduate research center of any university.

In this paper we present an architectural configuration of the (NBES) system and its components which have all the advantages and features of any intelligent network (3, 4, 5, 6). We also present the areas where these networks differ from conventional intelligent networks and the need for syntactic rule-based "knowledge processing" and the need for "knowledge control point" rather than a service control point (SCP, See Ref 7) of the traditional intelligent network. Finally, we present how these systems (NBES's) are compatible with evolving networks such as the SONET (8, 9), campus networks or any high speed digital network in the circuit or packet mode of function. The asynchronous transmission mode of the ATM or the hierarchy of the SONET rates do not constitute any problem to the evolution of NBES.

We hasten to add that this type of network may be futile and overpriced for environments where the emotional involvement between the student and teacher is high and education is much more than the textual or graphical exchange of information. It is likely to retain some of the pitfalls that the AI techniques are known to have. Overly intelligent abusers can cause serious problems in the functionality of NBES and bring it to "dead-locked" halt! However, NBES can be as useful to the educational community as intelligent network is to the society.

The rest of this paper is divided in two parts. In the first part, we present the educator's point of conceptualization of the NBES. In the second part, we present the networks and communications aspects in the proposed NBES and finally we project how the NBES may be evolved over the next two decades to take full advantage of the already committed networks such as IN/1 (10), IN/1+ (11), IN/2 (12), AIN (13), USIN (14, 15), together with ISDN (16), SONET (8, 9), ATM (17, 18) already appearing in the horizons of our society.

PART I. The Educator's Perspective

2. Features Common to Educational Environments.

If exchange of information and knowledge has been a age old propcsition in schools and universities, then the discipline of communication is at work. The impact of a new field of data communication upon the oldest institution of the teacher-student relation is very likely to cause resistance and friction Be as it may, if the two are going to be merged, then knowledge bases can be installed, interfaces can be designed, and the learning steps can be compiled in processing increments of information which will be collated, sorted, merged, rearranged, graphed, and evolved as a body of knowledge which will be retained in the minds of the learners. Thus knowledge engineering is the concern of every teacher and of every student.

Fortunately, computer science has stream lined some these basic function in all exchanqe of information and data.

More important is the man-machine communication via structured language which can be parsed based upon the rules of syntax, analyzed based upon the rules of the semantics, and if the entire module of communication (i.e., the program) is consistent then the process of assembly and linking can be started to generated the executable codes which the machine simply executes as an independent module or as a binary machine instruction.

Flexibility of language facilitates communication enormously. Now, if a fault tolerant super compiler can be instituted at every man-machine interface then any student can talk to the machine and any machine can become an understanding teacher. The installation of fault tolerant super compiler is an outrageously expensive proposition. But the student can go half way in working with a realistic interface and an inexpensive computer.

3. Role of Networks in Education Environments

Ideally an instructor will able to answer any query on any subject instantly and provide a platform for interactive hierarchy of knowledge. Since the instructor is human, students learn to compromise. If the logical and retrieval part of the instructor function can be automated, then the source of information can be in distant knowledge banks and the role networks to communicate information over long distances becomes evident. In this mechanized environment, creativity of the instructor to foresee implications, the forward vision, the integration of concepts still remains human. But the capacity to store, monitor and retrieve information over long distances brings memory technology and communication engineering within the realm of teacher-student relationship.

When the role of networks is only to gap the physical distance between teacher and student via video and audio channels, distance learning ensues. In addition, when the role of networks becomes intelligent and human in processing and controlling the information communicated, the features of intelligent network ensue. When the role of the network further includes the processing of knowledge by dissecting (parsing) and reforming the syntactic and semantic context of the network queries to assemble a logical response from distributed knowledge bases, then the network based education system (NBES) emerges.

4. Role of Knowledge Bases in Educational Environments

Mechanized storage and retrieval of information offers well documented (19, 20, 21) and distinct advantages to the educational community. In this paper, we shall not reiterate these benefits, instead we will discuss the management and updating of such vast electronic devices that serve the interests of the teaching community. Knowledge is dynamic, quantifiable, and classifiable. If the aforementioned aspects are accepted, then knowledge bases need to be maintained, stored in discrete blocks at finite addresses and can be separated out by the relationship that any finite quantity (e.g. a paper by its title, keywords, etc.; a book by its title, chapters, references, etc; a concept by its origin,its use, its application, etc;, etc.) of knowledge has with respect to prior knowledge about the subject (whose address is known or accessible to the software knowledge-bank managers).

In conjunction with the proposed NBES, knowledge bases need to be addressed by subject and need to be maintained and managed by experts in the field This concept has been well recognized in the telecommunication, credit-card, car-rental, etc., industries and trained staff maintains such databases. In context to the intelligent networks, the service management systems (SMS, see Ref. 22) is viewed as an essential element to maintain, monitor, update, and optimize the service control point (SCP, see Ref. 23). And this SCP is itself a large network database. This SCP has 800, 911, ABS, etc related information in IN/1, and 900, 700, CLASS, etc, related information in the emerging IN/1+, IN/2 networks

PART II. The Network Designer's Perspective

5. Proposed Architecture of NBES

5.1 Basic Existing Building Blocks

5.1.1 Campus Networks (CN): NBES is network based. It interconnects numerous campus networks like MAN's and WAN's interconnect LAN's. Network nodes and gateways in campus networks monitor and direct the flow of information in and out of campus networks to a knowledge query point (See Sec. 5.3.1) and then on to a knowledge ring (See Sec 5.2.1). The outflow of solocitations or commands from students flows up to the knowledge query point and specifically compiled information from the knowledge ring is received in the campus networks.

5.1.2 Very High Speed Data Networks (VHSDN): Classic circuit switched telephone type networks are bidirectional with generally the same data rates. These are likely to become saturated (especially during the peak traffic hours) with the high volume of personalized data traffic in the NBES. However, evolving high speed networks dedicated to the transport of large blocks data offer enormous promise. It can be seen that the student queries need initial processing to remove inaccuracy of the language or uncertainty of the questions posed. But when the formation of the query is complete the database is communicated by a packet by the backbone packet switched educational network (equivalent to the CSS-7 (see Ref. 24) network for intelligent networks). In the conventional sense these CCS-7 control and facilitate the new services and control the circuit switched channels within the SSP's. In the NBES, the knowledge ring now can transmit a large blocks of customized data in the response to the solicitation/command also via a high speed packet network linking the "knowledge ring" and the numerous campus networks. Fast packet transmission technology (25) is also emerging through the national and international networks. It is interesting to note that the normal flow of information becomes unidirectional in NBES as opposed the the bidirectional flow of control information in the conventional intelligent networks. Bandwidth allocation can thus be made optimal in NBES.

5.1.3 Knowledge Bases (KB): If the information contained in the knowledge bases is highly specialized and current and at the state of technology, then a large number of the knowledge bases may become essential. These may be networked or independent. In any case an individual knowledge maintenance system (KMS) for every KB is necessary. Small independent dynamic databases such as stock-market database, airline database, or even patient database exist and can be suitably modified for store modules of knowledge (e.g., papers, equations, technologies, etc., in variable length data structures) to function as rudimentary knowledge bases. Ample literature exists (19, 21) about the existence and fabrication of such bases and will not be discussed any further.

5.2. Other Elements of the Network

5.2.1 Knowledge Ring (KR): Isolated knowledge bases can become too expensive to dispense specialized modules of information. Conversely very widely documented subjects can need multiterabytes of storage space. To contain and manage the storage of very vast bases or very tiny bases, a knowledge ring provides a viable compromise. This ring, capable of accessing numerous bases, caters to growing knowledge and new areas of research by adding a node on the ring. New nodes may also be added to this ring as new disciplines emerge and evolve. Conversely old nodes may be deleted, when it is no longer necessary to retain obsolete bases, or when that particular base is no longer economically viable to sustain. The access and cost of access may then both be controlled by software and protocols as they are used in the nodes that access long distance and trunk facilities of any communication system.

If the knowledge ring is itself designed as network, then its nodes can be assigned logical addresses to correspond to the high level classification of the Dewey decimal system or the Library of Congress classification of the subject matters. The approach permits the designers of the NBES to build an electronic library of any size, in any expertise, and as easily composed as a physical library to by changing the contents of the data structures in the knowledge bases addressed as logical nodes on the knowledge ring.

5.2 2 Knowledge Management System (KMS): knowledge has vague frontiers and it is actively modified, processed and expanded. For this reason the updating of the knowledge bases is crucial. Hence a group of experts to update and modify such a knowledge base is essential. This functionality is human in most organizations, libraries, or even computer systems. Operating System techniques may sometimes be used to retain the most recently used variable/file, most frequently used variable/file, nearest context variable/file, etc. (as they are used in memory and Cache management systems). However implemented, the functionality of KMS in NBES is necessary. At this stage of the development of NBES, we foresee these KMS's to be staffed by human beings (*) rather than a self renovating information system.

There is another side of the KB's and KMS's. When the sources of active knowledge generation (such as research laborrtories, satellite tracking stations, Rand Corporations, Research Institutions, etc.,) centers are networked to feed the KB's directly, then the updating can be automatic. Examples of such automated environments exist. For example, a stock market transaction is automatically entered in the stock market database. Weather satellites automatically update meteorological centers. Defense radar trackers automatically warn national defense networks, etc.. In an paperless society we can foresee the sources of knowledge being in direct communication with the consumers of knowledge via the NBES environments. Check points analogous to the KQP are seen as being essential to the entry of only the authenticated and authorized information in the KB's and in the KR.

5.3 New Key Elements in the Network

5.3.1 Knowledge Query Point (KQP) or Software interface between NBES and CN: In order for the NBES to perform intelligent functions in responding to queries from campus networks, an interpretive interface is necessary to accept structured queries and infer which knowledge base to address in order to generate a response. In conventional intelligent networks the network response in initiated when the service switching point (SSP, see Ref. 26) detects a trigger condition (i.e., the dialing of 800, 911, 700, etc.,) from the subscriber. We see KQP as a new element to the general architecture of networks. The functionality of the KQP is critical to the success of this network environment. It accomplishes the function of a preprocessor (or the very first check point of legitimate users and their transactions (in the form of questions/retrieval that may be initiated) of the queries through the network. In a sense this is software equivalent of the physical door placed at money access center (MAC) systems. At the entry to the network, the KQP performs the student validation function, authorization code, access authorization and billing information, credit card information for the service provided. Transactions of illegal users, hackers, virus planters are terminated at this level by the network.

(*) For a network of KB's one KMS with numerous specialists for each KB with one common interfacing may be sufficient and perhaps more economical. The size of the KB and the dynamic nature of stored information will influence this choice.

This software barrier at KQP also has a query processor which identifies what is asked about which subject matter. The parser in KQP separates the solicitation and/or command from the subject matter in the query. The solicitation can be in the form of what, how, what, why, when, etc., or combinations thereof, about the particular subject matter in the query. The command can be in the form of lookup, retrieve, expand, instances, analogize, etc., the subject matter. Every query and/or command is an operation code with its customized protocol. And every subject matter can be viewed as an operand. Together they form an NBES network instruction. A transaction can be a single instruction or an assembly of such instructions depending upon what the user wishes to accomplish. This assembly is then executed or interpreted by the network. Every instruction accomplishes a finite step in "knowledge processing" in the network.

5.3.2. The Knowledge Transfer Point (KTP): This software system acts as a second check before any transaction with the network takes place. It identifies the subject matter via a modified english language dictionary. Valid dictionary words (including proper names of people, places, materials, objects, about whom information exists in the KB's) are checked to see if they belong to classification of knowledge in the KR. In a sense, KTP identifies the subject matter in context to the structure of the overall knowledge by identifying the "generalized knowledge address" (the Dewey Decimal number, the Library of Congress identifier, etc.; see Ref. 27) of the subject matter sought. Misspelled words, nonsense subject matters and improper query in context to the subject matter are returned to the users. Unauthorized users of the particular subject matter, sneakers, browsers, and accidental information leaks, etc. are expelled for network security.

The modified dictionary identifies the subjects in the knowledge bases within the knowledge ring (KR). The subject matter is itself classified and cataloged according to a subject hierarchy such as the Dewey Decimal System, the Library of Congress system, the Asian Library system, or even the Princeton classification system. The two syntactical components of the initiator's query are reconstructed here. Only and only if the KR can handle the interrogation from the CN will the syntactical components of the query be allowed to proceed in the network. This procedure is similar to the operating system procedure of any computer system which does not permit the execution phase of a program, if there were fatal errors in compilation.

5.3.3 KQP-KTP Combination: whereas the KQP identifies what is to done, the KTP has a knowledge address of the subject matter. Together they are a complete legitimate instruction to the network. Typically, the query is converted to a machine language instruction which has two components in it namely, the operation code (identified by KQP) and the operand/operands (identified by KTP). It is this single instruction or a group of such instructions that drives the NBES like the basic instruction or the microprogram associated with the instructions that drive any computer. We see a lot of flexibility in the implementation of the KQP (such as found in the implementation of basic hardwired or microprogrammed CPU), and this flexibility may used to used to design an optimal KQP for any application (by selecting the most suitable opcodes and/or network microcode for the application.

5.3.4. Knowledge Control Point (KCP): This element finally converts the "knowledge address identifier" to the actual physical or logical address of the locations in knowledge bases where that knowledge is embedded. The knowledge address in any of the knowledge classification systems (such as the Dewey, Library of Congress, etc.) is converted to a network address of the knowledge base. It is necessary to see that this address translation is hierarchical, i.e., the first segment of address alone can identify the KB and the latter segment or segments can actually locate the exact track-sector address of the mass storage system. We foresee the possibility of building massive RAMs which have memory addresses to correspond to the knowledge address of the subject matter, thus reducing the time for address translation further.

5.3.5. Knowledge Logic Interpreter (KLI): When the operation code (query/command) and operands (hierarchical number, e.g., Dewey decimal number of the subject matter) are both identified and validated, the KLI becomes instrumental in dispatching the executable binary language instruction (in any appropriate format or protocol) to the network components. The network components carry out their respective function (as they are performed during call-processing in traditional telecommunications networks) to send the answer back to the initiator of the query. The information sought is extracted from the appropriate knowledge base or ring, and the high speed digital network is used to burst this information the campus network (CN) via its gateway to the VHSDN. At this stage the conventional CCITT X.25, BX.25 or any other suitable network protocol may be implemented. Once again we see the the function of the KLI is not exactly the same as that of the SLI (28) in IN/2.

5.3.6. KCP-KR Protocol: Wherever the physical or logical address of the actual knowledge (the subject matter) may be located, the command (i.e., opcode) for that piece of knowledge has to be communicated to the KB where that subject matter has been located. This network instruction received at the KB is executed in its entirety at its appropriate KB. The protocol can be in the form of operation codes or it can be further condensed to make the best use of the network transmission and protocol processing facilities. If these KB's have central processor units that are function on a standard microcode, then the KCP needs to communicate the address of the microprogram in the control memory of the CPU. Typically we expect the complex queries to have more than one "instruction" to the network.

5.3.6 NBES Network Protocol: We envision that this protocol has its network functions distinct from the common channel interoffice signaling system (CCISS, see Ref. 29) protocol and also distinct from open system interconnect (OSI, see Ref. 30) communications protocol. The functions of the NBES can not be elegantly mapped into the functions of either (CCISS or OSI) environments. The functions of NBES also can not be assembled as a superset from the functions of both CCISS and OSI subfunctions. This protocol has to eventually evolve in its right as any of the other protocol. But at this stage we do not see it as a major problem since the evolution of NBES is still embryonic.

5.4. Existing Platform for NBES

There is some analogy between the functions and components of the conventional intelligent networks (such as IN/2, USIN, etc.) and those of the NBES. But we also foresee that forcing NBES functions from IN/2 architecture is suboptimal if not its misuse. The concept of recognizing the structure of knowledge and then being able to compose a response form the network offers some distinct advantages. Properly designed NBES can eventually combine all the advantage the distance learning, and mass media systems have to offer. We present some of the unique functions in Section 7. For these reason, the implementation of the NBES can be seen as an enhancement of the implementation of the conventional intelligent networks.

6. Architecture of NBES

Two architectural drawings are presented. In Figure 1, a specialized topology is presented. A transactions request is initiated at any of the campus networks. This request flows inwards via the KQR, into the knowledge query ring via the dialog formatter DF. The query format is verified here in DF. The user and operational legitimacy is established in KQR. The information is then fed into the KCP to establish the validity of the subject matter being transacted. The syntax of the command is formulated and verified to check who is doing what to which piece of knowledge.

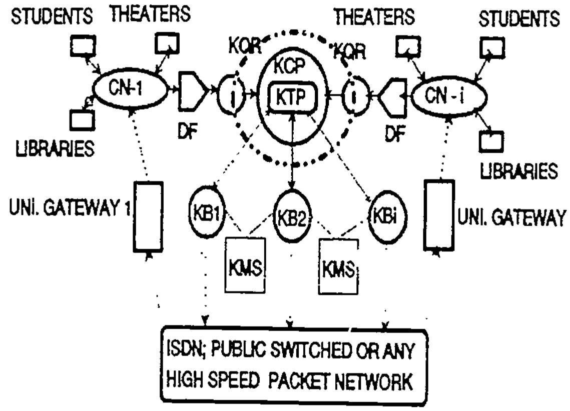

Fig. 1 Typical Architecture of the Network Based Educational System (NBES). CN: Campus Network, DF: Dialog Formatter, KQR: Knowledge Query Ring, KCP: Knowledge Control Point, KTP: Knowledge Transfer Point, KB: Knowledge Base: KMS: Knowledge Management Systems, ISDN: Integrated Services Digital Network.

If such a legitimacy is valid, the knowledge identifier number is translated to the logical or physical address of the knowledge base within the KCP, which dispatches the function (in executable binary code) that the particular knowledge base has to perform. This command to the appropriate KB is dispatched by the KTP via the typical high-speed backbone packet network of the NBES.

The KTP-KB communication is depicted by the outward radial lines to the KB at the outer rim of the diagram. The KMS associated with each KB is also depicted. Clustered knowledge bases and their common knowledge management system (not shown) may also be used here.

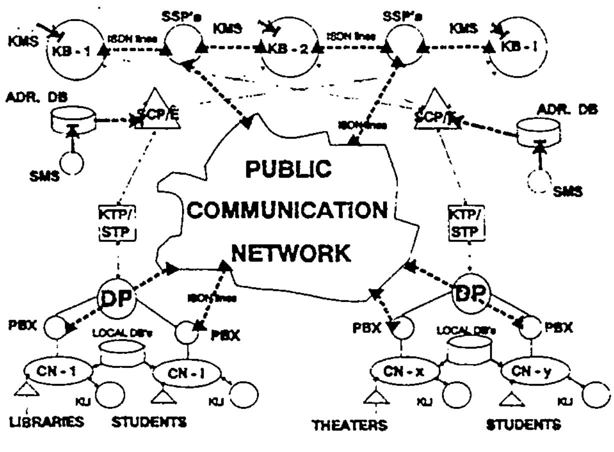

Fig. 2 Implementation of the NBES using existing public domain networks and ISDN lines. CN Campus Networks, KLI Knowledge Logic Interpretters; DP: Dialog Processors, PBX: Private Branch Exchange; KTP/STP: Knowledge Transfer Point/Service Transfer Point, SMS: Service Management Systems, SCP/E: Service Control Point/Educational environment; ADR.DB: Address databases of the Knowledge Bases; KB Knowledge Bases; SSP's Conventional Service Switching Points; ISDN Integrated Services Digital Network The ISDN lines become essential for communication between the various NBES elements since the channel control information is necessary for the newly recovered information to be relayed back from the Knowledge Bases

10_5

Individual instructions or complex transactions needing multiple instructions are executed at the knowledge base. When the response packet of information associated with the NBES instruction is secured from the KB, then that packet is sent to originating CN with user identification (i.e., the actual terminal address) at which the transaction was initiated. Whereas the conventional STP's in intelligent networks function twice in the address translation at SCP, the KTP functions only once. The completion of the transaction takes place via any VHSDN and not the CSS backbone network of conventional communication networks. This is seen as a fundamental difference between NBES and IN's thus leading to much more flexible architecture of the NBES compared to the architecture of IN's.

In Figure 2, the conventional communication networks are used. Three new components KQP, KTP and SCP/E are added since the existing networks do need the NBES functions. Numerous campus networks have access to this computer network that performs the functions of three components discussed earlier. The response from the KB's is communicated via any existing packet network. Even though this suboptimal configuration can work, we see prolonged network response times and suboptimal use of circuit switched networks, if ISDN is used to communicate between KB's and SCP/E's.

7. Intelligent (AI) functions of NBES

7.1 Supplementary Knowledge:

When the KCP has executed a series of transactions for any participant (or student), it has information about the user ID and how the network was queried. Since the information sought by the student follows a certain pattern of interrogation, the network can detect which aspects of the subject matter the student is ill informed and recommend or initiate further instructions to the KB to furnish "readings" rather than the reading lists that the human instructor provides. The pattern of pursuit of knowledge is used to determine the lack of expertise of the interrogator. This function is based upon the sequence of queries flowing through the KCP.

7.2 Complementary Knowledge:

When the KCP has caught on to a line of interrogation, the possible ultimate goal(s) of the participant can be extrapolated (from the the knowledge tree or hierarchy). This gives NBES the distinct capability to be exhaustive about all outcomes rather than the limited search that humans make. The knowledge processing of the network is thus intertwined with the creativity of the participant. In knowledge engineering, forward chaining permits a much wider routine knowledge search than what the mind can perform routinely. We hasten to add that the network acts as a powerful complement rather than a challenge to human creativity.

7.3 Inductive Knowledge:

The KCP can also detect the relationships between the queries, i.e., detect the forward chaining and backward chaining (carried out routinely in knowledge engineering) of the subject matter pursued and lead the student to areas known in literature (and embedded in knowledge bases) which the student may not know. In a sense, the network now becomes an "artificially intelligent instructor" identifying and detecting the cause-and-effect relating the subjects being pursued and indicate other causes or other effects related to the same event/subject matter.

7.4 Analogical Knowledge:

When a researcher uses a chain of interrelationships in what he is pursuing, the KCP is able to detect other disciplines or situations in which such relationships exist. Supposing an anthropologist is seeking certain species in certain geographical regions, the CPU's in the KCP's can list all the common weather pattern in the regions and indicate where else such patterns exist. As a second example, if a petrochemical engineer is exploring a polymer chain, the KCP can alert the chemist where else such chains exist and all the supporting documentation. This functionality is most easily achieved by storing the information in the KB's as relational data structures. Whereas searches based upon byte-strings is commonly done in most databases, the searches that the NBES can perform are based upon the structure of knowledge queried and its relationships to the previous knowledge that has been sought.

7.5 Deadlocked (Self Contradictory) Pursuits:

When the pattern of interrogation is partly established by the researcher at the KCP, its CPU's can complete the linkage of information to provide all the answers sought. However, if the line of interrogation is futile (e.g., list all situations where energy has been created and not transformed), the KCP can provide alternate approach to the problem and inform the user about fundamental laws of conservation of energy if applicable.

The functions that NBES can perform are based upon the knowledge and its structure (via forward and backward chaining) rather than the retrieval of data and it can become much more powerful teaching and service tool in most educational environments. It can also verify the logical inference the student has drawn from the knowledge the student has gained from his interaction with the NBES. This is based upon the logic embedded in the knowledge it has furnished to the student. Any miscommunication and misunderstanding that the student may have gained during the interaction with NBES is thus eliminated.

8. Conclusions

In this paper we have presented two possible architectures of the network based educational systems. Unlike mass media systems, these systems compile and compose the information returned. They are knowledge based and query driven. They respond and monitor the progress of each transaction in context with the capability of the network and the in context with the prior interrogation. They respond by detecting the english language like queries from campus and local area networks. The flow of information is always unidirectional through out the network and duplex mode of data transmission may be completely eliminated. The channel capacities may thus be adjusted much more optimally in the various links of the network.

From a distant perspective this network performs well as high level educator at graduate centers or artificially intelligent knowledge bank to research laboratories. It responds routinely the very first question but immediately picks up the forward or the backward linkages of that particular information that has been transacted by the network. Alternatively, the networks may be programmed to retain a knowledge profile of each student and answer according to the IQ of the student. We see this aspect of the network function to be a challenge to the intelligence and the curiosity of the student based upon the individual traits. This makes the network monitor the learning process of the student like any university or a school.

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Anticipating and Estimating Adoption and Resistance of Interactive Instructional Technology: A Look at Multimedia in Higher Education

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1. Abstract

The purpose of this study was to examine the perception of college professors about multimedia instructional technology (MIT), and the factors that are perceived by them that facilitates or hinders the adoption of MIT in the classroom. Results indicated that individual factors such as awareness, interest, attitude, evaluation, involvement of information technology are common predictors for both early and late adoption. External factors such as perceived administrative and organizational barriers were found, by large, not significant predictors in adoption decisions.

2. Introduction

The idea of transforming classroom teaching and learning through the use of advanced technology is older than the idea of computers in classroom. From textbooks and chalkboards to radio, film, and television, claims predicting extraordinary changes in teacher practice and student learning, mixed with promotional tactics, dominated the literature in the initial wave of enthusiasm for each new technology (Cuban, 1986). Computers joined the list of technologies promoted for use in school more than 20 years ago; but then, after an initial flurry of interest in computer assisted instruction (CAI), the use of computer languished in schools until 1980s. Today, with the advent of multimedia instructional technology (MIT), there has been a resurgent interest in radically reforming schools to allow for more active, hands-on, student-directed learning, independently or in groups; and computers in classrooms are now often seen as both a catalyst and a support for making this transformation (Pearlman, 1989).

However, contrary to this exciting phenomenon, government studies reported that many teachers are not adopting the technology in their teaching. In an unpublished survey by the Center for Social Organization of Schools, it is reported that, between 1983 and 1985, the number of computers in U.S. schools quadrupled from approximately 250,000 to over one million. This number doubled again by 1989 to reach 2,355,000 computers. In 1985, 86 percent of the nation's schools had access to computers, with 24 percent having 15 or more. By 1989, the number of schools with computers had climbed to 96 percent; 57 percent of these schools had 15 or more computers (Center for Social Organization of Schools, 1986 and 1989). In a separate study by the Congressional Office of Technology Assessment (OTA, 1988), it is noted that "schools have acquired computers rapidly... but most elements of the instructional process remain the same. This contrasts with other sectors of society, where technology changed the way business is transacted, medical problems are analyzed, and products are produced." Moreover, "despite the presence of computers in most all American public schools, only half of the nations' teachers report having ever used computers (OTA, 1988)." This astonishing finding suggests that supplying teachers with computers does not assure that they will become used as part of the instructional program at school. It seems that teachers are reluctant to alter their teaching approaches. Graubard (1972) pointed out that the task for educational reform and social change is not to put more computers in schools and to initiate further studies but to equip individuals with the means to understand and struggle against structural and attitudinal impediments to implementing known solutions. In the largest view, therefore, a gauge of teachers' attitudes and evaluation about instructional technology is in part a measure of their commitment to educational reform.

Since World War II, there have been systematic studies undertaken in Western Europe (Rabier and Inglehardt, 1977, 1978; Inglehardt, 1977) as well as in the United States on public attitude about science and technology (Pion, George, and Lipsey, 1981; Etzioni and Nunn, 1974; Laporte and Metlay, 1975; Marshall, 1979; Yankelovich, 1982). The rationale underlying such studies is generally as follows. A positive attitude about science and technology is a necessary value in the cultural and political milieu of a nation undergoing modernization. Not only must political attitudes support leaders favoring the advancement of science but public expenditures for such advancements must be made. Following the same line of reasoning, it would be most appropriate to say that a positive attitude about instructional technology is also a necessary value in the cultural and political milieu of an educational system undergoing advancement and modification.

A review of literature shows that numerous studies have addressed the danger of our educational system being inferior to many western countries such as Japan and Germany. Many studies emphasized how the use of computers can reinforce or enhance the traditional basic skills (i.e., reading and math). But most of these studies focus almost entirely on the measurement of student performance outcome through the use of technologies. Advocates for educational computing, such as Weir (1989), Cohen (1988), Cuban (1989), LaFrenz & Friedman (1989), Pearlman (1989), all have doubt whether transformations in teaching and learning can occur without accompanying social, attitudinal, cultural, political, and organizational changes in school environment. These equally important issues are the focus of the present study. One fundamental question, aside from political and organizational reform, educational reformers must ask is how "individual factors" such as perception, attitude, teachers' theoretical orientations toward teaching and learning, their customary approaches to instruction and classroom management, and genuine interest of instructional technology can affect adoption behavior.

Studies of instructional technology adoption by teachers is not a new undertaking. Teachers' adoption of computers, their configurations of computer use, and their levels of implementation quality, all would be influenced by teachers' personal attitudes, interest, and their evaluation of the technology as well as by administrative supports and constraints seen mostly from their perspective. Critical factors, real or perceived, affecting the adoption or non-adoption of instructional technologies have been examined by (Kell, et al., 1990; and Tucker, et al., 1990). Cited by Collins (1990), Andee Rubin suggested 4 factors that affect the likelihood of adoption for any instructional technology. Rubin noted that (1) male teachers tend to be motivated by their interest in the technology particularly if they have a computer at home, (2) if the teacher feels technology can help students learn a certain subject better, she/he is more likely to adopt the technology, (3) if the teacher feels administrators expect or would value the use of technology, he/she is more likely to do it, and (4) if the teacher has the desire to try something new, then the technology has the appeal. Also suggested by Rubin (1990) are 5 other factors that affect institutionalization and continued use of any technology. These include coordination between decision makers, powerful advocates, student enthusiasm, student learning, and teacher enthusiasm. Rubin explained that computer coordinators, curriculum specialists, and teachers should all be involved in making decisions about how technology is used. Institutionalization will occur if teachers receive strong support from budget-controlling administrators or powerful advocates. Enthusiasm is one important factor which affects both students and teachers. If students are enthusiastic and self-motivated to work on tasks, teachers see tangible effects on learning, teachers are rewarded and will use the technology. Finally, Rubin added that if the teacher shows interest in the technology and feels it improves his/her teaching, teachers will be more likely to continue use of the technology.

Resistors of instructional technologies have used various symbolic strategies to resist innovations. Some perceived technology as a threat to institutionalized power. The more comprehensive the technology, the greater the potential threat. Resistors view teaching as traditionally been a personal process, an intimate relationship between instructor and student. The instructor is the dispenser of knowledge and the student the passive receiver of the knowledge. Jwaidch and Marker (1973) identified some of the "external barriers" commonly perceived by teachers to adoption of instructional technologies and found that many teachers expressed the need, before adoption, for training and support beyond the one or two days seminars or demonstrations, providing encouragement, recognition, time incentive, technical assistance, strong leadership, and handling disturbances.

While a great many factors can influence individual variations in use of instructional technology, this study was particularly concerned with the "external factors." Individual factors will also be examined to gain greater understanding that could be hypothesized to account for variations in levels of adoptions. In sum, these factors were the motives for a survey at the University of Hawaii at Manoa regarding university professors' sense of change in the educational environment over the past 20 years, their interest, attitudes, and evaluation of instructional technologies, and the relationship of these individual factors and other perceived external barriers to adoption and resistance of, specifically, multimedia instructional technology (MIT). Of particular interest in this study was the determination of which specific factors, individual or external, are most associated with early adoption and potential future adoption. This is expressed in the following 2 hypotheses.

H1: Professors' early adoption of MIT is positively and significantly associated with individual factors.

H2: Professors' potential future adoption of MIT are positively and significantly associated with individual factors, and are not significantly correlated to perceived external factors.

3. Method

The survey instrument was constructed and programmed to create an electronic questionnaire by using the CATI (Computer Assisted Telephone Interviewing) software using 4 IBM PS/2 Model 30 personal computers. The use of an electronic questionnaire minimizes data transcription errors, prevents the accidental entry of out-of-range numbers and allows for the automatic execution of skip patterns of the instrument.

3.1 Sampling

The survey respondents were selected through a systematic random sample from the University of Hawaii at Manoa (1992) telephone directory. There are approximately 1500 faculty at the University. 6.8% of the sample points were instructors, 4.2% lecturers, 20.1% assistant professors, 22.6% associate professor, 45.7% full professors, and the remaining 0.4% were emeritus professors. The fielded period for data collection ran from October 19, 1992 to October 30, 1992. A total of 389 respondents were called and 240 telephone interviews were completed in the study. A response rate of 61.7% percent was achieved.

3.2 Plan for Analysis

After responses to the questions were evaluated using usual survey analysis procedures, several indices were created to serve as a basis for a more detailed statistical model of the relationships between "individual factors" and "external factors" toward multimedia instructional technologies adoption or resistance. First, a descriptive analysis of responses to questions on awareness of change, attitude, evaluation, interest and involvement of technologies will be presented. Second, a series of discriminant analyses were performed using each of the indices as independent variables and early adopter/non-adopters as dependent variable. Third, a regression analysis will be presented to examine factors that best predict likely-future-adoptor and unlikely-future-adoptors.

3.3 Construction of Variables

In order to assess and compare college professors' progress in implementing instructional technologies in the classroom, a measure was needed that somehow captures differences in the degree to which teachers made use of the technologies.

3.3.1 Dependent Variables: Current Adopters and Future Adopters

Respondents were asked if they have been a frequent-user of multimedia instructional technology in their teaching. Of the 218 responded to the question, almost 50% considered themselves as frequent-users (early adopters) of MIT. The remaining half were considered as non-adopters or potential future adopters. Seventy-three percent of the potential future adopters reported that they will try MIT in the future (likely-future-adopters) after they have read and heard so much about the benefits of the technology and 27% said they will not (unlikely-future-adopters).

3.3.2 Independent Variables: Internal and External Factors

Six independent variables were constructed from the data set to reflect the awareness, attitudes, evaluation, interest, use of old instructional technology, and personal involvement in new information technologies. Their construction is summarized as follows.

(1) Awareness: Awareness of change in the educational environment was measured by asking respondents whether they agree or disagree with the following 2 statements: (1) Over the past 20 years, instructional methods in higher education in the U.S. has, in general, changed a great deal, and (2) Considering the changes that have come about in the last 20 years, instructional technologies (such as microcomputer and multimedia) have been playing a very important role. A factor analysis of the questions suggested that there was indeed a single underlying dimension structuring responses (eigenvalue=1.27 and accounted for 42.8% of the variance). Summation of these 2 variables yielded an index ranging from 2, representing a high level of awareness, to 8, representing little awareness of change in the educational environment.

(2) Attitude: To determine attitude towards instructional technologies, respondents were asked whether they agree or disagree with: (1) "I believe that the computer 'as a teacher' can facilitate

student learning," (2) "Since computer can visibly increase office productivity, we should attempt similar applications in the instructional environment," and (3) "I like the idea that computer-aided learning promotes discovery, creative thinking and problem-solving." Agreement was taken as a positive attitude towards instructional technologies, and disagreement for negative attitude. Summation yielded an index ranging from 3, representing the most positive attitude toward instructional technologies, to 12, representing the most negative attitude. A factor analysis of these 3 items resulted an eigenvalue of 2.31 and explained 19.3% of the variance.

(3) Evaluation: The index for evaluation of instructional technology (IT) was measured by summing the positive responses for the statements about "IT changes learners' experience from passive to active" and "increased use of IT has been a great benefit to education." The index ranges from a "2," meaning a positive evaluation, and an "8" meaning a negative evaluation of instructional technologies. A similar factor analysis had an eigenvalue of 1.55 and accounted for 32.2% of the variance.

(4) Interest: In measuring interest in instructional technology, respondents were asked whether (1) respondents like technology and experimentation and often try something new in their teaching and (2) respondents are skeptical about technology in the effectiveness in teaching. Summation of these two questions yielded an index ranging from 2, representing the highest level of interest, to 8, representing the lowest level of interest in instructional technologies.

(5) Use of Old Technology: In assessing professors' use of old instructional technologies, respondents were asked if they have been very often, sometimes, rarely, or never using some traditional teaching tools such as transparencies, slides, and educational films or videotapes. The index ranges from a 3, meaning "often use," and a 12 meaning "never use."

(6) Involvement of New Information Technology: The measure of the use of new information technology was assessed using a series of additional questions that asked how often respondents used (1) computers at work or at home and (2) e-mail for correspondence with colleagues. The involvement of new technology measure was then transformed from the original questions to an index ranging from 2 to 8, with 2 meaning high involvement and 8 meaning low involvement with new information technologies.

4. Analysis and Results

4.1 Basic Attitudes and Sample Characteristics

Table 1 shows that, in general, early-adopters and potential future-adopters have a positive attitude and evaluation, keen interest, and high awareness of change as opposed to non-adopters and unlikely-future-adopters. Over 73% of the sample felt that instructional methods in higher education in the U.S. has changed a great deal and have been playing a very important role over the past 20 years. However, over 57% of the respondents said that they find it difficult to talk about instructional technologies because they don't know enough about it. About 71% of the respondents reported their academic department is equipped with a computer laboratory. With regard to experience, 44% were full-professors and about 56% were tenured or tenured-track non-full

Table 1
Individual Difference in Early and Non-Adoption
(in percentage)

	Early Adopter N=108	Non-Adopter N=101	Likely Adopter N=71	Unlikely Adopter N=30
Individual Factors				
Awareness[a]	73	51	59	35
Interest[a]	78	43	68	24
Attitude[a]	80	65	74	52
Evaluation[a]	59	37	54	27
Use of old technology[b]	78	48	57	31
Use of new technology[b]	57	38	44	31
Years of teaching	39	27	35	30
External Factors (perceived barriers)				
Lack of successful application in the educational market[c]			32	70
Lack of time and incentives for me to experiment with new instructional methods[c]			59	64
Lack of leadership support from administration[c]			53	48
Lack of personalized training and support by staff[c]			50	56
Lack of assistance and support by colleagues in the faculty[c]			42	44
Lack of microcomputers on campus[c]			57	54

NOTE:
a. Percentage responding either "strongly agree" or "agree" before indices were created.
b. Percentage responding either "very often" or "sometime" before indices were created.
c. Percentage responding either "strongly agree" or "agree" to "I have not been using multimedia instructional technology in my teaching because:"

professors. One interesting note is that more than 65% of the respondents in the survey had more than 10 years of teaching experience. In addition, 82% reported that they use a personal computer very often at work or at home and about 50% said they use e-mail very often or sometimes to do correspondence with colleagues (Table 1 shows detailed individual and external differences in each sub-groups of the sample).

4.2 Early Adopters

Table 2 presents the results of a discriminant analysis treating the whole sample as 2 groups: early-adopters and non-adopters of multimedia instructional technology. Discriminant analysis constructs a dimension that maximally separates the groups. Thus the contribution of any given variable to the discriminating dimension can be evaluated holding all others constant. The awareness, interest, attitude, evaluation of instructional technology, technology use, and experience variables were used as predictors, and a stepwise procedure of discriminant analysis was employed to eliminate those variables without satisfactory discriminating power. The procedure locates the variables that best discriminates between the groups, finds the next best discriminator given the first, and so on.

Table 2
Discriminant Analysis of Multimedia Instructional Technology Early Adoption Groups with Individual Factors as Predictors

	Function 1 (N=207)
Interest	.51 (.66)
Awareness	.25 (.44)
Use of Old Technology	.43 (.51)
Evaluation	.33 (.55)
Attitude	.08 (.41)
Use of New Technology	.36 (.20)
Years in teaching	.18 (.27)
Eigenvalue	.44
Canonical Correlation	.55
Degree of freedom	7
Wilks's lambda	.69
Significance	p=.0000

NOTE: A stepwise procedure was used to identify the significant discriminating variables in the order of their contribution: interest, awareness, use of old technology, evaluation, attitude, use of new technology, and teaching experience. Variables are ordered above based on their function loadings. Standardized canonical coefficients and structure coefficients (in parentheses) are reported.

Multiple discriminant function analysis based on the remaining variables yielded one significant discriminating function (Wilks's lambda = .69, p<.0000). Table 2 reports standardized canonical coefficient, which may be interpreted like beta weight in multiple regression. The structure coefficient reported are analogous to loading in factor analysis and represents the correlation of a variable with the underlying function. Pehadzur (1982) notes that these loadings with values of .30 and above be treated as meaningful. As shown in Table 2, the canonical discriminant function was significant, X^2 (7,1)=73.34, p<.0000.

Based on the discriminating power of each variable in the discriminant function, results indicated that early-adopters of multimedia instructional technology tend to like and experiment with technology in general, and are individuals who are less skeptical about technologies in their effectiveness in teaching. Early-adopters tend to be more aware of the role of instructional technology in higher education in the past 20 years. Early-adopters of MIT also are frequent users of transparences, slides, film and videotape regularly as aids in their classroom instructions, they also tend to have a very positive evaluation and attitude toward instructional technology. The use of new information technology and teaching experience did not yield a significant contribution in the function. As a test of classification accuracy, the discriminant function yielded a hit-ratio of 75.73% for the analysis sample with 77.7% for the early-adopter and 76.9% of the non-adopters groups correctly classified.

4.3 Potential Future Adopters

To respond to the second hypothesis, a stepwise multiple regression procedure was performed to determine how individual factors and other perceived external factors were related to the likelihood of multimedia instructional technology adoption in professors' future methods of instruction. Criteria for inclusion were highest initial correlation and subsequent highest correlation with the dependent variable. Table 3 presents a summary of the results.

Based on the standardized beta weights, results indicated that likely-adopters tend to agree that instructional methods in higher education in the U.S. has changed a great deal and instructional technologies, such as microcomputers, have been playing a very important role. Likely-adopters of MIT in the future tend also to have a keen interest in technology, use transparences, slides, film and videotape regularly as aids in their classroom instructions, and believe instructional technologies have great benefits and have changed learner experience from passive to active partner in the educational process. In addition, results also showed that likely-adopters often use computers at

Table 3
Multiple Regression Analysis of Multimedia Instructional Technology Future Adoption Using Individual and External Factors as Predictors

	Standard Beta
Individual Factors	
Awareness	.20[a]
Interest	.19[a]
Attitude	.15
Evaluation	.22[a]
Use of old technology	.26[b]
Use of new technology	.25[b]
Years in teaching	.11
External Factors (perceived barriers)	
Lack of successful application in the educational market	-.21[a]
Lack of time and incentives for me to experiment with new instructional methods	.15
Lack of leadership support from administration	.10
Lack of personalized training and support by staff	-.03
Lack of assistance and support by colleagues in the faculty	.12
Lack of microcomputers on campus	-.04
Total R^2	.33

NOTE: Figures are standardized beta coefficients for variables entered hierarchically ((N = 96).
* Variables entered as 6 external factors
a. p<.05
b. p<.01

work and at home; and believe that they will use the technology if there were more applicable or successful application in the educational market.

External factors (administrative, bureaucratic, or organizational), as suggested by Rubin (1990), perceived to be important factors associated with adoption behavior for future-adopters were found, by large, not to be significant predictors for adoption decisions. With the exception of "lack of successful application in the educational market" indicated a significant relationship to future adopters, all other perceived external factors were found not powerful predictors of adoption behavior in the future.

5. Discussion and Recommendations

The goals of this study were (a) to examine professor awareness, interest, attitude, and evaluation of instructional technologies, (b) to determine factors that could explain why professors are early-adopter or non-adopters of multimedia instructional technology, and (c) to determine individual or external, real or perceived, factors that best discriminate individuals who will likely and unlikely adopt multimedia instructional technology in the future.

According to Cohen (1987) and Cuban (1986), a review of the history of previous technological innovations in education reveals at least two distressing observations: we have "inflated hopes for their effects" and "few of these technical innovations "were adopted, or widely used" (Cohen, 1987). LaFrenz and Friedman (1989) added that there is little doubt that the vision of the computer's power to transform education has not been fulfilled. The hard fact is that the impact of the computer on the teaching and learning process has not yet been significant. Public schools and university administrators have long recognized the need to provide computers for teachers and professors to aid their classroom instructions, but being "available" or "accessible" is a far cry from being successfully implemented and used effectively affect students. Why are computers constantly in use in some classes by some teachers and idle in others? Why do some efforts to use technology in instruction succeed while others fail? While it has been established that external factors, suggested by Rubin (1990) and others, were important criteria associated with instructional technology adoption decisions, this study found that the relationship between adoption or resistance of MIT to individual factors such as awareness of change in the educational system, interest, attitude, and evaluation of instructional technology are to be much stronger than external factors.

In a rapidly changing and growing field, it is imperative that all involved must stay abreast of innovations or changes in the field. This means that professors, likely-future-adopters and unlikely-future-adopters, must be alerted to relevant seminars, workshops, literature, and resources that are available to generate high levels of awareness, interest, positive attitude and positive evaluation toward instructional technology. Finally, practical application of this research to budget-controlling power-advocates or administrators is to create a shared vision of teaching and learning, opportunity for communication and debate and even nurture the resistant colleagues. Only then, appropriate supports with hardware and software will see fruitful results.

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DEVELOPMENT AND TELECOMMUNICATIONS TECHNOLOGY IN PACIFIC ISLAND MICROSTATES

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1. ABSTRACT

Summarized in this paper are some of the preliminary results of a comparative study of the role and impact of telecommunications technology on development aspirations in the Republic of the Marshall Islands (RMI) and the Cook Islands; two freely associated Pacific Island countries (with the United States and New Zealand respectively). The broader social, economic, and political impact of recent telecommunications developments are briefly examined in light of the two country's seperate development programs and their desire to increase their respective participation in the global economy. In the conclusion, two 30 year scenario projections are outlined which present different policy options which must be considered if either country is to realize their preferred course of development. It is argued that if the positive aspects of the scenarios are to be realized, their respective national telecommunication policies must attempt to achieve multiple objectives, some economic and some social. Thus, a balance must be reached so that the pursuit of one set of policy objectives do not harm the achievement of the others. This will call for creative and "forward visioned" policy formulation by both respective governments.

2. INTRODUCTION

The new telecommunications and information technologies have come to be seen by many, both inside and outside the industry, as facilitators of economic development. They have also been increasingly viewed as sources of global competitive advantage, as providers of social and welfare benefits, as contributing to reducing urban-rural disparities, and as providers of information for the general edification of the population. However, even in the more developed countries of the Pacific Rim, telecommunication technologies have only recently become dominant concerns in the formulation of national development policies; even as the Uruguay Round of GATT negotiations served to illustrate that information and knowledge are increasingly being considered strategic resources and telecommunications the primary means determining their availability (Pipe 1990). It is also increasingly evident that telecommunication matters are becoming important for national, economic, and social policy formulation in all countries. As such, it seems equally important that a policy framework for making telecommunications a truly universal resource will need to emerge in the near future (Hansen, *et al* 1989).

Yet, for many developing countries - the Pacific Islands not withstanding - one of the central problems is how to ensure that the existing telecommunications infrastructure incorporates new technical developments efficiently to satisfy urban users, while at the same time maintaining provisions of the more "traditional" services—telex, HF and single side band radio for example—where such services are the most effective, and sometimes the only service available to many rural users. No where are such concerns of more pressing importance than in the Smaller Island States (1) of the Pacific Basin.

With such concerns in mind, a research project was initiated with support from the Pacific Telecommunications Council during the final quarter of 1991 to explore these issues in two of the smaller Pacific Islands countries. The initial terms of reference included a comparison of all aspects of recent telecommunications developments in the Republic of the Marshall Islands (RMI) and the Cook Islands; two freely associated states (United States and New Zealand respectively) which have recently embarked upon ambitious upgrades to their telecommunications infrastructure, but in decidedly different ways. As well, the broader social, economic, and political impact of such developments were to be examined in light of the two country's development programs and their desire to increase their respective participation in the global economy.

The field work consisted of extensive interviews with government officials, business leaders and individuals in both countries Government representatives, academicians and Islanders residing in Hawaii and New Zealand were also contacted for their input. Relevant documents from the University of Hawaii's Pacific Collection, the National Archives in Wellington, New Zealand and at the South Pacific Collection at the University of Auckland Library, provided necessary background material. As well, historical documents, development plans and other related materials were examined in the respective countries under study Field visits took place from early-November through mid-December 1991, and again from late-February through early-April 1992.

This paper reports, in encapsulated form, some of the findings of this work and builds on the preliminary report submitted earlier (2). The two alternative scenarios also take-off from projections developed earlier and benefited greatly from structured feedback in the form of a Delphi questionnaire sent to aproximately 50 informants (with a 45% response rate) and informal feedback to the published preliminary report.

3. REPUBLIC OF THE MARSHALL ISLANDS (3)

The RMI consists of 29 atolls and 5 coral islands in the Central Pacific. There are some 26 populated islands distributed along two roughly parallel chains; the eastern *Ratak* (Sunrise) group, and the western *Ralik* (Sunset) group. The total land area is approximately 70 square miles scattered over a sea area of 750,000 square miles. The 1988 census put the population at 43,380 with an annual growth rate of 3.8 percent per annum. The projected population for the year 2000 is estimated to be 68,415. Almost half of the population lives in the capital on Majuro Atoll, while another 20 percent reside on Ebeye Island in Kwajalein Atoll. The other 40 percent are scattered among what have come to be called the "outer islands."

As in the case of similar atoll countries, RMI's development is limited by its small and scattered land area, lack of on-shore resources, distances to overseas markets, problems of communications, and risks to natural disasters. Land, minerals, energy resources, fresh water, flora and fauna, are all limited in amount and variety. The major agricultural resource is 22,000 acres of coconut plantations of which only 16,000 acres are currently productive, yet coconut products accounts for 90 percent of exports (coconut oil and copra). It is the territorial waters of the Marshall Islands that provide abundant marine resources and what the government considers, along with tourism, to be the greatest potential for future economic growth.

The modern sector, based almost exclusively in Majuro and Kwajalein, is sustained largely by the RMI Government and the US missile range on Kwajalein through their expenditures. Wages, salaries and other compensation paid to employees from these two sources are the major determinants of the country's GDP and contributed over 50 percent in 1990. The service sector of the economy accounts for 69 percent of all employment, while agriculture and fishing make up just over 21 percent and manufacturing 9 percent (4).

Development efforts in the RMI, since ratification of the Compact of Free Association in 1986, has focused specifically on fostering economic growth. Primarily, the government has chosen to concentrate on three areas; fisheries and marine resources, tourism, and light industry. Discussion has focused on developing a local fishing fleet to service, primarily, the *sashimi* market for fresh tuna Purchase of a DC-8 to add to the government owned national airline (*Airline of the Marshall Islands*) was justified on the grounds that its larger cargo hold will be used to fly tuna to the fish auction in Hawaii. It was also expected that the larger seating capacity would contribute to increasing tourist traffic. Aquaculture projects such as giant clams, trochus, pearls and eatable seaweed, have also been discussed as showing economic viability but have not been vigorously pursued

Tourism is really in its infancy in the RMI and much is being invested to increase hotel accommodations (primarily on Majuro), promote the construction of outer island "guest houses," and to develop and promote tourist attractions. Sport fishing, diving and the RMI as a "tourism adventure," are some of the promotional alternatives being discussed. It has been argued that the RMI's beaches and clear lagoons, with WWII relics and friendly people, are its main attractions; particularly in the outer islands, since the urbanized areas of Majuro and Ebeye suffer from extreme environmental degradation.

In both of these cases, marine resources and tourism, issues surrounding the environment and environmental preservation are seen as central to "sustainable development." The RMI government, in the past, entertained various ideas and schemes which had created substantial outcries, both internationally and locally, over their potential negative impact on the environment; including, most recently, the shipping of oil-contaminated soil to be "treated" and used as fill on the Ebeye to Gugeegue causway on Kwajalein (Polhemus 1992, November 22; see also Fujii 1990, September 2). Environmental issues have now come to be of such increasing political and popular concern that it has become a matter of public policy that all development efforts must first have an environmental impact assessment before starting and the national development plans must contain a "state of the environment" report. Likewise, the RMI Environmental Protection Authority has had its powers increased and its role expanded. On the more ominous side, issues of global warming and potential sea level rise have cast a shadow over present development efforts and raised much concern over future national viability.

Light industry developments have focused mostly on promoting support services for a national fishing fleet, ship repair and fuel depot, cannery facilities, etc. Some recent efforts have also been put into upgrading the copra processing facilities in conjunction with increasing power generation capacity on Majuro. Large construction projects like the new capital building complex and urban infrastructure improvements have also been undertaken.

3.1 TELECOMMUNICATIONS

A modern telecommunications infrastructure in the RMI presently exist only in the urbanized areas of Majuro Atoll and the islands of Ebeye and Kwajalein on Kwajalein Atoll Other than the periodic mail service by sea and/or air, the remainder of the populated atolls rely exclusively on HF or single side band radio to meet their communication needs It is argued that if tourism is ever going to be developed in the outer islands, this situation must be improved.

By some estimates, computer usage in government and business in the Marshall Islands is well below its potential with only about 10 percent penetration; this is despite the increasing popularity of computer training courses Many believe the RMI could significantly benefit from an increased diffusion of both computers and telephones; especially if it is ever going to develop in a "positive and open way." Part of the perceived problem is that information is very "secretive" in the RMI because it has traditionally been seen as a source of power or control; those who know certain things that others do not can use it to their advantage. Computers, particularly, are seen as an "equalizing agent" in that anyone with a little training, regardless of traditional title, can gain access to important information and know how to use it. Knowing what the resources are and how to use them wisely is perceived to be an important part of local community empowerment, particularly for the outer islands, and may be seen as a potential threat by members of the central government—the majority of whom are traditional title holders. The mass media, specifically radio and television, are expected by many to be the future vanguard in supporting education and the spread of information and knowledge. Likewise, satellites, telephones and facsimiles have provided a way for the RMI to communicate with the outside world more efficiently than even 10 years ago. This has helped to foster the outward expansion of Marshallese as they seek education and employment opportunities overseas (primarily in the United States), while at the same time maintaining important kinship ties with family back in the RMI. The general opinion is that the RMI is no longer just a small isolated country, it is fast becoming a part of the global community and can no longer afford to be isolated.

In 1987, a government statutory authority, the National Telecommunications Authority (NTA), was created to assume ownership of the outside plant and the responsibility of providing telecommunications services previously provided directly by the Ministry of Transportation and Communications, which had inherited the task from the former U.S. Trust Territory of the Pacific Islands administration (TTPI). At the time the NTA was formed, the satellite earth stations on Majuro and Ebeye were owned and operated by the US based Communications Satellite Corporation (COMSAT). These earth stations were purchased by the RMI government in 1989 and turned over to the NTA to manage. In 1990, the NTA was restructured as a Marshall Islands corporation with all assets transferred to the NTA by the government (*Nitijela*, P.L. 1990-105). A U.S. Rural Electrification Administration (REA) loan for US$18.8 million was later secured to fund a 3 year expansion and modernization program. In a move to further the process of privatization, a board of directors was put in to place and the sale of shares to RMI citizens initiated in early-December 1991. Of the total 360,000 shares to be issued, 90,000 shares were issued to the RMI government, equal to approximately 25 percent of the total and representing a controlling share in NTA. The government will also retain control over any unsold shares.

A 1987 survey indicated that NTA had a total of 587 telephone subscribers; 206 residential subscriber and 256 business subscribers on Majuro, and 39 residential and 86 business subscribers on Ebeye. According to more recent data, after the installation of a new digital switch on Majuro, total subscriber numbers nearly doubled to around 1,000 overall. Such growth is expected to continue because of the substantial backlog of prospective telephone subscribers which cannot currently be accommodated. It is anticipated that by the end of the 3 year REA funded modernization program, NTA's subscriber base will expand to just over 3,000 and that this will further increase to around 3,600 within another 2 years. It is likewise anticipated that, within the next 3 years, the international connections will also be upgraded from an analog to a digital format, substantially increasing present capacity. Later, as consumer demand requires, additional international capacity may also be installed.

The NTA currently has the exclusive right to erect, install, maintain, operate, and manage domestic and international telecommunications services in the RMI. While several individuals and companies from the RMI and elsewhere have sought permission from the government to install cellular telephone systems and provide other telecommunications services in the RMI, the NTA's management is reasonably confident that the high start-up costs of providing alternative telecommunications infrastructure and the limited exclusivity granted them under public law, has thus far been enough to discourage entry by newcomers. However, NTA is equally confident that if the government does grant such requests in the future, their experience and efficiency in the telecommunications field will ensure their dominant position in the RMI.

3.2 *Development Concerns*

When examining the issues of development, and the role of telecommunications in facilitating development, several concerns on the part of RMI citizens come to the surface. First, much concern was expressed (especially during the weeks leading up to and immediately after the national election!) over the seemingly disproportionate amount of money being spent on "large" development projects. Past and present policy has tended to cater to large-scale development projects relying on joint-venture foreign capital and/or overseas development loans to build office buildings, resorts, and industrial projects. This has resulted in a current debt load of nearly US$600 million by some estimates, and the apparent diversion of monies from social services to fund such government "priority" projects. It has been argued that, over the last 40 years of TTPI administration, nothing really happened to significantly develop the RMI. Now, the impression is the present government is trying to make-up for lost time and has thus fallen "victim" to donor country ideas of what development should be—a condition some critics of the present government have termed "new country syndrome." Many, alternatively, have argued for small-scale fisheries, diversified marine resource developments, and a "go slow," cottage-based approach to tourism as more appropriate in the RMI context and as being a more "affordable" type of development; economically, ecologically, socially, and culturally.

Second, human resource development has been perceived as taking a back-seat to economic development despite government rhetoric to the contrary. Presently, the education department reports some staggering figures. In broad terms; 25 percent of first grade students are dropping out before finishing junior high school. For those who graduate junior high, 30 percent do not even get into high schools because there is not enough room for them. Of those who do get into public high schools, 50 percent drop-out before graduation (a total of 30 percent when combined with private high schools). Only 10 percent of all high school graduates go on to college, and of these approximately 50 percent drop-out within their first two years. With the RMI's present population (over 50 percent under 15 years of age) and the rapid population growth rate, this situation is seen as untenable and a potential "social time bomb." The Ministry of Education now has a ten year master plan (in its fourth year of implementation) designed to improve education and human resource development, including the possible use of satellite based instruction for the outer islands. However, they admit that without the budget to realize the goals outline in the master plan, "...it is just so much paper."

Compounding this problem is the lack of visible improvements to the standard of living in the outer islands causing many to migrate into the district centers (Majuro and Ebeye) seeking employment possibilities. But the low levels of skilled labor in the RMI (despite the relatively large pool of unskilled and semi-skilled labor) has resulted in many jobs in the construction and service industries going to overseas nationals (mainly Korean and Filipino contract workers). There is a perceived need, addressed by the Education master plan, for increased focus on vocational training to reverse this trend. However, for those who do find employment, many face frustration because of a lack of upward mobility and a degradation of their standard of living due to an increasing dependency ratio (the result of an explosive population growth rate, and relatives moving in from the outer islands). Those with marketable skills are frequently deciding to leave for the United States where they have free migration access and can get higher paying jobs. These people end up staying for prolonged periods of time, usually returning only for brief visits, because of the better educational opportunities presented for their children in the US in comparison with the RMI.

Finally, telecommunications receives mixed reviews. Many are fearful that the US$18.8 million REA loan is just another one of the RMI government's "big bang" development projects, that it will increase the national debt burden but will not result in any real improvements in the standard of living. On the other hand, there is an equal number who are also of the opinion that telecommunications infrastructure expansion is important in fostering economic development and national unity; particularly if the sub-district centers of Jaluit and Wotje are ever to be develop to their full potential. The outer islands increasingly want telephone communications without restrictions; initially, this will no doubt require some kind of subsidy. If tourism is also to be fostered, than data links will also need to be established for travel and accommodation reservations.

Likewise, government administration, tourism and local business developments are seen as requiring timely information. For the RMI, and particularly if the outer islands are to benefit, satellite deliverable domestic and international telecommunications are seen as a cost effective and necessary infrastructural development going hand-in-hand with reliable domestic and international transportation.

4. COOK ISLANDS (5)

The Cook Islands comprise 15 islands divided into a Northern Group of predominantly atolls, and a Southern Group of mostly high volcanic and/or raised coral islands The total land area is approximately 94 square miles in a sea area of 714,000 square miles. The main island is Rarotonga, on which the capital Avarua is located, and accounts for nearly 60 percent of the population with the remainder of the Southern Group accounting for another 29 percent while the Northern Group comprises the remaining 12 percent of the total Cook Islands population. The 1991 census puts the population of the Cook Islands at 18,552 reflecting nearly a 6 percent increase since the last census in 1986 (much of this due to return migration). This counters a long standing trend of negative net population growth as large numbers of Cook Islanders migrated to either New Zealand or Australia seeking better employment and education opportunities. There are presently estimated to be over 20,000 Cook Islanders living in New Zealand and/or Australia.

As was discussed earlier with regard to the RMI, the Cook Islands also experience constraints on their development primarily due to the scattered nature of the archipelago, remoteness from markets, dis-economies of scale in transportation and increasing competition for market share with other developing agricultural countries in the Pacific region. In the past, the main export cash crops have been bananas, pineapples, papayas, citrus, and other fruits along with vegetables and root crops. The pineapple industry has basically collapsed, banana exports ceased due mainly to inconsistency in quality and the irregular nature of shipping, and while citrus continues to be produced for the local market, exports of fresh fruit and juice have not been able to successfully compete with South American produce. Thus, the agricultural production of the Cook Islands in 1989 was reported to have fallen by approximately 20 percent from 1981 levels and further decline is expected. The Ministry of Agriculture is attempting to lead away from bulky, perishable crops which had been the mainstay of export agriculture in the past, to those with longer storage life and ease of transport without quarantine restrictions, such as arabica coffee and vanilla. This is currently being met with a modest amount of success.

However, it is the backward and forward linkages associated with the tourism industry that has caused the Cook Islands government to identify it as the lead sector for economic development. Between 1972 and the end of 1991, visitor numbers to the Cook Islands have more than trebled from approximately 10,000 to over 30,000 arrivals per year. The tourism industry is estimated to be worth approximately US$18.4 million annually, making it the major foreign exchange earner for the Cook Islands economy.

The significance of this industry is most obviously represented by the shift in the structure of local employment patterns. The tourism and related services sector now accounts for over 65 percent of total employment compared with 55 percent in 1971. The primary and secondary levels each account for 16 percent of total Cook Islands employment with an additional 6 percent remaining unspecified. It is expected that the importance of the tourism industry to future economic growth is likely to continue; provided the special attractions which draw tourists to the Cook Islands in the first place are not destroyed in the process (CITA 1991). It is ventured that the appeal of the Cook Islands is derived mostly from a blend of the friendly and hospitable people and the resplendent scenery.

Environmental issues have recently come to dominate much development discussion in the Cook Islands focusing mainly on the degradation of the costal zones. Protected areas development in the Cook islands has also been characterized by "too many words and not enough action." Education and publicity efforts from local organizations such as Public Health and the Cook Islands Conservation Service (CICS) have, in the past, been marred by the lack of funds and expertise to provide a continous flow of information and communication. Government policies on the environment are presently provided for under the ruling Cook Islands government manifesto and are covered principally under the policies of the CICS and to a lesser extent by the Ministries of Marine Resources, Culture, Beautification, and Works (respectively). Likewise, many of the outer island councils have their own environmental and conservation by-laws (Rongo 1991).

Although the marine resources of the Cook Islands have received increased attention in the past few years, there has been only limited harvest of pelagic fish resources within its 200 mile exclusive economic zone (EEZ) and an even more limited exploitation of artisanal fisheries—primarily for personal consumption or to supply the local market. It is, however, the lucrative and expanding pearl industry in the Northern Group which has received the most attention. Currently, and since 1985, the focus has been on the farming of pearl oysters for both cultured pearl and shell on Manihiki, with Penryhn and Suwarrow currently under investigation for possible expansion sites. Other commercial lagoon fisheries include trochus and the re-introduction of giant clams. Eatable seaweed was introduced several years ago, but was wiped out by hurricane Sally several years ago and never restarted. The Cook Islands also control within its 200 mile EEZ, an estimated 25 percent of the worlds cobalt reserves (in the form of crust deposits on seamounts and the ocean floor). Whereas the cost of accessing this potential mineral resource is presently prohibitive, it is expected that in the future the Cook Islands will be able to successfully exploit these deposits to their economic benefit.

Economic development in the Cook Islands has been quite volatile, but on a general upward trend. There has been noticeable increases in per capita income, but typically only for the residents on Rarotonga, with little improvement being realized in the outer islands (Manihiki with its pearl industry, and Aitutaki with tourism, being the notable exceptions). GDP growth between 1983 and 1990 averaged 6 percent with sharp upward and downward surges with drops of between 7 and 11 percent; further illustrating the enormous volatility of the GDP growth rate to global conditions and the "boom" or "bust" nature of economic development. As well, this also serves to illustrate the significant role government infrastructure and development investments have played in Cook Islands economic activity.

Finally, the Cook Islands offshore financial center is credited with infusing new life into the finance and business services sector which has grown from approximately 2.5 percent of GDP in 1982, to 12 percent in 1990. When taken together with other service related sectors, including tourism and government activities, value-added services account for almost 77 percent of GDP in 1990, while agriculture and fishing contributed less than 18 percent. This indicates a shift from a predominantly agriculture production oriented economy, to a tourism lead service economy over the course of the past decade.

4.1 TELECOMMUNICATIONS

As the Cook Islands shifts more and more into a tourism lead service economy, good quality, reliable international and domestic telecommunications have become very important. The feeling is that the Cook Islands need to be "plugged in" to the global telecommunications system for hotel reservations, air transportation, international business communications, etc. It is further perceived that such developments would also go a long way towards fostering continued growth in offshore banking. The Cook Islands is currently the only off-shore facility in the Pacific with registered listed companies approved by the Hong Kong stock exchange and only the third jurisdiction, following Bermuda and the Cayman Islands, to obtain such approval (Miller 1991). Obviously, good quality and reliable international teleconnectivity on demand is required to facilitate such connections. Likewise, the growing pearl industry and tourism's expansion into the outer islands also requires extending the same type and calibre of communication services that are available in Rarotonga into these locations. Proponents argue that if the Cook Islands want to be part of the global network, and if it wants the tourist industry to grow and succeed—especially in the outer islands—than it must have efficient and reliable telecommunications.

This argument, along with expressed political will (6), has been used by the present government to justify not only the introduction and expansion of broadcast television services on Rarotonga and to the outer islands, but also a US$8 million loan from the Asian Development Bank (ADB) and Export Credit Finance organization of Australia for the country's telecommunications development. Likewise, following the setting up of a joint-venture telecommunications corporation, Telecom Cook Islands, Ltd. (TCI) in 1989 (7), the government then forced early contract termination and compulsory acquisition of Cable and Wireless operations in the Cook Islands by legislative act in 1991 (8). It was argued that the Cable and Wireless monopoly prevented the government from putting in to place its plans for the joint development of the outer islands and international telecommunications. Therefore, the provision of telecommunications services were determined to constitute a "public purpose," and the monopoly agreement was terminated with a decision on adequate compensation to Cable and Wireless going to arbitration.

By Christmas 1989, Rarotonga had broadcast television coverage as a "Christmas gift" from the government. In December 1990, Aitutaki became the first of the outer islands to be provided broadcast television coverage (with service again being offered by Christmas). Just prior to the initiation of television service in Aitutaki, the old manual telephone exchange with 200 lines was upgraded to an automatic exchange with 300 line capacity (upgradable to 600) and is now provided with international direct dial for the first time. Mitiaro, another island in the Southern Group, also received an earth station and a small automatic exchange with international direct dial expected to be added soon. In total, approximately 8 outer islands will be connected via satellite to the domestic (and international) telecommunication system via the Pacific Area Cooperative Telecommunications (PACT) Network, while one will be connected via UHF (line of sight microwave) and the others will continue to be served by HF and single side band radio. The PACT Network is a regionally focused and operated DAMA (demand assigned multiple access) satellite service designed and maintained by the Overseas Telecommunications Corporation, Inc. of Australia (OTCI), and put into service in 1989 (*cf*, Masterton 1989). All of the inhabited islands in both the Northern and Southern Groups are expected to be connected into the national telecommunications system by as early as March 1993.

Presently, The Cook Islands have a total of 25 incoming and 35 outgoing trunk lines available for international service via the (now) TCI Standard B earth station in Rarotonga. International direct dial accounts for 66 percent of these lines. Rarotonga, Aitutaki and most recently Mitiaro, are presently the only islands with telephone service, but expansion is proceeding to connect another 6 islands. Rarotonga presently has over 2000 subscribers with residential subscribers comprising approximately 72 percent, business subscribers 26 percent, and the remaining 2 percent being public pay phones. There are an estimated 40-50 facsimile machines, mostly in Rarotonga, currently operated by Cook Islands businesses. Until the ADB loan was acquired, telecommunications growth in the Cook Islands was primarily a function of the ability of TCI to supply the service, since the waiting list for telephone hook-up was several years backlogged and the network was near capacity. In other words, capacity could not keep pace with demand. With the initiation of the current modernization and expansion program, network capacity is expected to keep pace with subscriber demand with sufficient surplus and network expandability to meet future needs as they arise.

4.2 Development Concerns

Issues of the future direction of Cook Islands development and the possible role of telecommunications technology in facilitating development reflect some of the same concerns on the part of Cook Islanders as were expressed by the Marshallese. Like the RMI, the Cook Islands have incurred a substantial debt load to finance several large development projects; such as the Sheraton Hotel, the SEDEP electricity project, and the construction of the Cultural Centre for the 1992 South Pacific Festival of Arts. Prior to 1988, the Cook Islands had borrowed little and since self-government in 1965 (in free association with New Zealand), had never had a national debt to speak of. Development loans taken out since 1988 to finance "big" projects amount to an estimated current national debt of around US$150 million. It has been argued that the current "boom" in the Cook Islands economy is really a result of deficit spending on the part of the present government and is argued by some to be building a weak foundation for further economic growth which may result in collapse when it comes time to repay the loans. The government argues that, over the next 10 years, such public sector investments will result in an expansion of the private sector that would more than match the overseas debts with concomitant increases in government revenues. Opponents argue that it appears as if the Cook Islands have "jumped on the 'think big' band wagon" and are pursuing a course of development more in line with lending countries than Cook Islander aspirations.

There is also growing concern that too much emphasis on tourism and the pearl industry will result in unbalanced growth, highly vulnerable to the vagaries of global events and weather conditions, and that the fruits of this economic development will not be evenly distributed. Many argue that "equality" of economic development is a more appropriate course for the Cook Islands to follow. Emphasis on agricultural development, focusing on small scale, "intensive," family farming of a diverse range of food and cash crops, was often mentioned as a direction the government should pursue in leu of large scale agricultural projects supplying the export industry, or speciality crops for tourists Such a policy would also reduce the number of part-time farmers—though never eliminating the family garden—forcing many to choose between full-time farming or full-time non-agricultural employment; further readjusting employment patterns. In the outer islands, agriculture should continue to be encouraged as a part of the life-style while some efforts are made to encourage small business development.

With the substantial impact that tourism has had in the Cook Islands, it is interesting to note that many outside the industry do not like the direction it is going. It is argued that the Cook Islands have enough "big" resort-type hotels What is now needed is to encourage cottage-based "eco-tourism" (nebulously defined) in the outer islands. This is seen as a move away from "numbers" tourism and towards "quality" tourism. Likewise, it is suggested that small scale tourism developments encourage the largest amount of local participation in the industry and "keep the dollars at home" rather than expatriating the profits.

The pearl industry is seen as only benefiting the very few. Whereas many believe it should be continued and even expanded, others feel that the Cook Islands should seek to diversify its marine resource base.

Finally, telecommunications, having become a government priority, have come to be viewed as a positive contribution to present and future development. The perception of telecommunications' positive contribution in support of tourism and off-shore banking were often stressed. Likewise, the outer islands are anxious to have modern communication capabilities without restrictions. However, the bottom line is, who is going to pay for these services? Broadcast television was introduced into the Cook Islands on the heels of a very controversial increase in the local income tax; primarily for "cultural development." But it was indicated that a portion of the funds raised would also go toward the establishment of the Cook Islands Broadcasting Corporation for the provision of television service, and will likely continue until the service becomes self-financing Now many wonder if the same will eventually apply to the present telecommunications expansion. Whereas this seems unlikely, there is, nonetheless, substantial public concern.

5. Summary and Preliminary Scenarios

Given the above discussion, the following two scenarios take the present and preferred course of development and role of telecommunications technology for each country and projects them approximately 30 years into the future. These scenarios are a composite "sketch" for *both* countries and, as such, are broad brush strokes. Nevertheless, they represent the common aspirations, fears and desires expressed in the previous sections.

Several factors have been taken out for the sake of brevity and clarity. First, the possible impact of global warming and sea level rise have not been factored into the scenarios. If the "worst case" scientific predictions are correct, within the next 30 years the RMI and Cook Islands will begin to feel the effects of these environmental conditions (Kabua 1991) and this could, of course, significantly alter (if not discount all together!) the following scenarios. The likelihood that such environmental catastrophy would out weigh any other development concerns, should they eventuate, has also contributed to the decision not to present a "negative" scenario. This is also due in part to some of the perceived "dysfunctional" attributes of the status quo. Finally, there is also the possibility of "wild card" occurrences that cannot easily be accounted for in building the following scenarios (e.g., global conflict, collapse of associated metropolitan economies, large meteor striking the earth, etc.). What could possibly be said with reasonable certainty is that the actual outcome would conceivably contain aspects of both scenarios, and yet be completely different from either.

5.1 The Status Quo

In both countries, there is a general recognition of their relative developmental limitations in terms of land area, population, and low real GDP growth rates resulting from their remoteness from major markets, dependence on few export commodities, high cost of transport, limited economies of scale, a high dependency ratio, and the high cost of government administration. However, the respective government's development philosophies espouse a rhetoric—and to some degree a belief—that "self-reliance is self-respect." Government development efforts aspire to focus on marine resource development, infrastructure improvements, and expansion of tourism in order to solve economic and social problems as well as build national pride and unity. Unfortunately, the general impression is that the pursuit of some "big" development projects on the part of government (usually financed through an increasing number of international loans and unlikely to be economically viable) is "over-morgaging" their respective country's future and taking scarce funding away from other needy sectors (mostly in productivity and social services). Likewise, there is a perception that some of the projects being pursued are likely to produce a cycle of more dependency instead of less There is also continuing doubt that emphasizing the monetary side of economic development will result in genuine and equitable improvements to the standard of living in both urban and rural areas and has created an atmosphere of "expectation" which may be difficult to actualize. Social stratification has intensified markedly over the past decade and is expected to intensify further. Generally, there is a feeling of guarded (hopeful?) optimism, but many feel insecure and pessimistic about extending present practices too far into the future.

Telecommunications has frequently been viewed by the respective governments as an adjunct to the transportation sector in its contribution to respective national development. Recently, the telecommunications sector in both countries have undergone a "corpratization" and consolidation process in an attempt to modernize the organizational structure and to operate domestic and international communication services more efficiently and with a view towards government gaining more direct revenue from it. Full privatization has often been mentioned as the ultimate goal. It has always been realized that an efficiently run, corporately responsible (to make a profit for its private share holders and/or the government) telecommunications organization which can provide good quality, reliable, local and international telecommunications will have positive "spin-off effects" throughout the economy As such, the primary concern of the respective governments has thus shifted towards how best to achieve a bigger share of telecommunications revenue, and secondly, to accomplish an expansion of basic telephone services for the bulk of their respective populations. Since placing a relatively high priority on improving the adequacy and efficiency of the basic national network, "favorable" development loans from outside the country have recently been secured; a strategy being pursued by other Pacific Island countries. However, the respective governments have also placed equal emphasis on telecommunication's social responsibility; such that, improvements to the urban infrastructure and extension of services to rural areas are seen as being of equal importance and contributing to their respective national unity. Thus, participation in a regional satellite network for meeting domestic and regional communication needs has been viewed by both countries as the most cost effective way for each to service their widely scattered populations.

5.2 *Preferred Development*

An alternative vision of development takes off from the same recognition of each countries respective limitations, but outlines a preferred course of development in each country which pays much closer attention to the social and physical environment (in the latter case this includes the greenhouse effect, environmental degradation, lagoon pollution, etc.) and focuses on issues of "sustainability." This course of development is seen as being less concerned with "short-run" development projects and/or stabilization problems, and instead, places more attention on the "long-run" fundamentals of development; such as resource endowments, income and trade entitlements, productivity, technological progress, social structures and institutions, and cultural preservation (Bertram 1991, September). Key to this course of development is the "wise" use of a diverse range of marine resources, the promotion of indigenous agricultural production, continuing to develop (but not overly emphasize) "flag of convenience" industries (e.g., foreign ship registry and off-shore banking), and a generally "go slow, stay small" attitude towards tourism. Equality across urban and rural sectors is also stressed for infrastructure developments (transport, telecommunications, electricity, waste treatment, and potable water) and income distribution in order to lessen the disparity between urban district centers and rural outer islands as one measure to prevent rural-urban drift. Furthermore, recognizing that the major resource in each country is the development potential of their respective populations, more funding is put into education in order to prepare the young to cope vocationally, intellectually, and culturally as the country increases its participation in the global economy. However, given present development practices, there is expected to be only a 25 percent likelihood of such a benevolent future eventuating.

In this somewhat more positive scenario, telecommunications increasingly becomes one of the leading sectors helping to foster development—and this becomes extremely important for smaller Pacific Island countries (like the Cook Islands or the RMI) which would depend on information-based industries (off-shore banking, foreign ship registry, tourism, etc.) in the employment of thier population. Telecommunications also comes to be seen as a national asset and as such, would be protected as a "natural monopoly" from foreign take-over or preditory competition Through cross-subsidizing profits from international communications, the domestic—and particularly rural—telecommunications infrastructure is greatly expanded. The increased penetration of primarily telephone and facsimile services into the more remote outer island areas of each country is seen as mandatory if the preferred development goals are to be met. General development projects in rural areas are greatly speeded-up and operated more efficiently because of the improved communications links. As a result, there is a general improvement in the living conditions in rural areas which further attracts additional project development aid. Improvements in international telecommunication connectivity also begin to attract more local and foreign business investments in such sectors as data processing, off-shore banking and in marine fisheries as well as undersea mineral resource identification and acquisition; thus, providing jobs for an increasingly more skilled and technically sophisticated local work force Satellite based distance education at the secondary and tertiary level, tele-medicine providing remote diagnosis of medical ailments, improvements inter-island transportation, and a general upgrading of disaster warning and preparedness likewise provide for a higher and more equitable standard of living. However, the cost of building and maintaining such a telecommunications infrastructure in the face of an increasing national debt load out of all proportion to the size of the economy in either country, has many concerned that such a preferred future could be aborted before it is established.

5.3 *Policy Considerations*

It may perhaps seem obvious that the main concerns and priorities of telecommunication policy makers in Pacific Island microstates differ significantly from those in highly industrialized and post-industrialized countries. Progress in establishing and expanding a telecommunications infrastructure in these two countries has been extremely difficult due to the specific conditions of their smallness and their isolation. But telecommunication network expansion in the RMI and the Cook Islands differs also in respect to their need to accommodate the new technological demands of their urban subscribers while attempting to provide basic services to remote communities. For both of these countries, the problem is attempting to create a set of institutional relations that will achieve these two objectives.

If the positive aspects of either of the above scenarios are to be realized, national telecommunication policies must attempt to achieve multiple objectives, some economic and some social. A balance must be reached so that the pursuit of one set of policy objectives do not harm the achievement of the others. Obviously, in either scenario, the highest priority for telecommunications investment must be in building up the national infrastructure. This calls for creativity in financing and pricing such services so as not to increase the national and/or corporate debt burden. This should be possible, given that investments in telecommunications infrastructure have yielded, in the past, internal rates of return of 15 percent or more, and if the social externalities are factored into the equation, the returns are even greater (Jussawalla & Ogden 1989) Expanding user access to international teleconnectivity should become the next priority as each country seeks their "competitive advantage" in the global market.

Issues of "direct competition," which are of increasing importance in metropolitan countries, become moot in such microstates as the RMI and the Cook Islands (indeed, even in other Pacific Island countries). Given their lack of economies of scale, such issues really take attention away from the main task at hand; i.e., national network expansion and increased international teleconnectivity. However, policy decisions should be taken to outline the priority areas for future desired development and the respective role that telecommunications is expected to play. Then, if deemed appropriate—and in cooperation with the national telecommunication network operator—circumstances in which other suppliers could be encouraged to enter the market as a means of extending the capability and capacity of the total telecommunication system could be explored.

6. Notes

(1) The Smaller Island States, as defined by the South Pacific Forum, include the Cook Islands, Kiribati, Nauru, Niue, and Tuvalu. Also included in this definition, but not formal members of the Summit of Smaller Island States, whose inaugural meeting was held in January 1992, are the Republic of the Marshall Islands and the New Zealand dependency of Tokelau.

(2) The preliminary report was submitted to PTC in August 1992 and published in abridged form as; Ogden, M. (1992, September). *Communications technology and development in Pacific Island microstates*. **Pacific Telecommunications Review**, 14, (1), 9-16.

(3) Unless otherwise indicated, all data related to the Marshall Islands comes from the RMI Office of Planning and Statistics, Majuro.

(4) As a point of clarification, manufacturing consists mostly of handicrafts and copra processing, and accounts for less than one percent of GDP.

(5) Unless otherwise indicated, all data related to the Cook Islands comes from the Cook Islands Statistics Office, Rarotonga.

(6) The present ruling party, the Cook Islands Party, stated in their manifesto that improvements to communications between islands through the upgrading of the telecommunication system utilizing modern satellite facilities (as well as adding automatic telephone exchanges, telex, and facsimile services to outer island communication facilities) would be a matter of priority. Likewise, the current Prime Minister has promised several outer island communities television service as a "Christmas present" at various times during his administration.

(7) The Cook Islands government owns all physical assets which it leases to TCI. The government also owns a 60 percent interest in the company with the remaining 40 percent owned by Telecom Networks International, a Telecom New Zealand owned corporation.

(8) The British company, Cable and Wireless plc, had negotiated an exclusive external telecommunications agreement with the government of the Cook Islands in 1979 to provide international communication services as the monopoly carrier until 31 March 1995.

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Assessing Videotex Diffusion and Usage Patterns in a Manufacturing Organization: A Case Study

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1. ABSTRACT

Analysts have suggested that the adoption and use of new computer-based information technologies in the workplace can facilitate and enhance the efficiency of various tasks[1]. This paper addresses the human factor in the diffusion and use of computer-based communication systems. After a discussion of the importance of evaluation research in an organizational setting, a case study is presented.

2. BACKGROUND

During the last decade, the use of computers in organizations has become standard practice. Increasingly, computers are being interconnected and communication-oriented applications such as E-mail and videotex systems are being adopted by companies[2].

A recent report by International Data Corp. maintains that, among Fortune 500 corporations, E-mail penetration jumped from 67% in 1990 to 98% in 1991[3]. Business analysts relate the success stories of such large companies as Xerox Corp. who implemented computer-based information systems. In the case of Xerox, the implemented system was said to have improved the company's capacity to communicate and modified its managerial transaction procedures[4]. Similar accounts are given concerning Eastman Kodak[5], Deere & Co., Hughes Aircraft Co., and Chase Manhattan Bank[6].

The stories of success with computer-based information systems suggest that such systems can indeed contribute to an increase in efficiency in an organizational setting. These technologies can be utilized to simplify otherwise multi-step transactions such as sending messages, filling out applications, placing orders, checking inventory etc.

Analysts have cited the many benefits that computer-based information systems can have in an organizational setting. Among these benefits are:

i. helping to increase sales and reduce costs;

ii. offering new market opportunities;[7]

iii. tracking product flow;

iv. producing general and comprehensive reports on production;

v. combining engineering and statistical process control data with product flow data for product history and the study of process trends;

vi. informing people of factory and product issues[8];

In this sense, it is argued, such information technologies can contribute to the competitive advantage of a company.

Researchers, however, agree that the main prerequisite for such potential contribution to materialize is achieving what is termed "critical mass"[9]. Simply put, critical mass, as applied to computer-based information technology, is the point at which collective use justifies the costs of implementation and leads to an exponential growth in system utilization.

The importance of "collective use" in achieving "critical mass" highlights the influence of the individual users who form the collective entity. The human factor, therefore, influences the degree to which a computer-based information system can achieve its potential in an organizational setting.

3. THE HUMAN FACTOR

Despite the importance of the human factor in computer-based information system usage and diffusion, this human element has traditionally received inadequate attention by information system managers. In fact, a glance at the leading handbooks and manuals on information system management reveals that these references pay virtually no attention to the human factor following a system's implementation[10]. A simplified process for information system management recommended by these references consists of three main stages:

a) Needs assessment;
b) Design;
c) Implementation.

The human factor is taken into consideration at the needs assessment and design stages of the process. This is where the particular needs of the organization are assessed in order to build an appropriate information system to cater to those specific needs. For example, a manufacturing organization finds that its field sales staff spends too much time on the phone inquiring about product information. The information system manager would begin to assess the firms' needs. This assessment stage may reveal the need for a centralized system that field sales staff can remotely access in order to check inventory, pricing or other product features. If the system is approved, then the system's design would take into consideration the type of information required by field staff personnel in order to make such data available to them on-line. Once the technical aspects of the system have been developed, the help of a few employees is enlisted to test the ease of the system's use. Implementation of the new system usually ensues.

After incurring the heavy costs of implementing a computer-based information system, companies seldom bother to assess the users' reactions and feedback regarding the new system. Companies assume that since the designers have determined that the system is easy to use, the actual users will find little or no difficulty learning and using the system. In the absence of post-implementation user assessments, and since the users are often not motivated to volunteer their opinions, the company risks having its hefty investment in equipment be under-utilized. In such a case, computer-based information technologies would not be conducive to more efficiency as the extent of their utilization determines their contribution to the competitive advantage of the organization.

The lack of attention given to the human factor following a system's implementation is perhaps due to the fact that early use of computer-based information systems in organizations was confined to those technically or scientifically trained and oriented. During the last decade, however, the users' profile has dramatically changed. When a computer-based information system is nowadays implemented, employees from all departments, levels of education, backgrounds, and specializations are given access to it.

Another reason for the lack of attention to the human factor could also be that information system managers are almost always technological experts and are not trained to study human-machine interactions. With the changes in user profile, however, it is essential that an expert in the study of human-machine interactions be available to assess any employee problems in using the newly implemented computer-based information system.

After all, it is the degree to which these employees utilize the system that determines whether a critical mass will ever be achieved, whether the investment in equipment will ever be justified, and whether the system will ever be able to contribute to a company's competitive advantage.

4. FACTORS INFLUENCING HUMAN USAGE OF COMPUTER-BASED INFORMATION TECHNOLOGIES

The literature on information system management does not adequately address the issue of the human factor. Other areas of human behavior study, however, have devoted considerable attention to this very topic. The following will look at some key factors that contribute to the lack of collective usage of a computer-based information system. Since "collective", in this context, means numerous individuals, the unit of analysis in the paragraphs that follow is the individual.

Using a computer-based information systems necessitates interacting with a computer. A number of studies, have attempted to asses the variables that influence individuals' use of computers[11]. Researchers argue that a typical model that explains and predicts computer use is[12]:

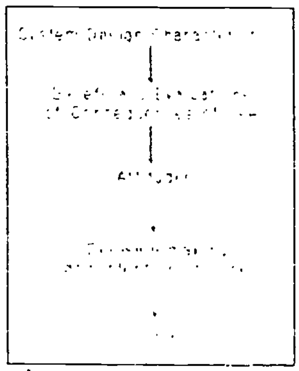

Figure 1

In Figure 1, the characteristics of the system design (interface, accessibility, availability, etc...) would influence an individual's beliefs and evaluations of the consequences of system use. This, in turn, would influence the attitude of that individual toward the system. The individual's attitudes then influence that person's decision making and intention of use which, in turn, influence the person's actual usage of the technology.

There are many reasons an employee would be reluctant to utilize a computer-based information system:

External factors include:

a) Information on system is useless or irrelevant to employee's job;

b) Inadequate or complex interface or applications;

c) Inappropriate and/or insufficient formative training;

d) Lack of sufficient technical support;

e) Lack of periodic training refreshers;

f) Lack of incentives.

Beside external factors, the possibility also exists that internal factors would influence an individual's system usage. These internal factors include:

a) Technostress;

b) Computer anxiety.

The reasons cited above are typical. There may be others. It would virtually be impossible for an information system manager to diagnose the variables that may be affecting the employee's lack of usage of the company's computer-based information system. The need for post-implementation evaluation is therefore critical. Unfortunately, many information system managers are not trained to diagnose such problems. Hence the need for an information specialist that would make use of the current research and methods to develop a custom-made evaluation program for the particular organization.

The specialist would utilize both current research knowledge and data from the evaluation to recommend to the information system manager to:

a) modify the system characteristics of relevance to users;

b) develop training programs that take into consideration the level of knowledge and skills of all employees;

c) develop incentives that would facilitate an employee's evaluation vis-a-vis the consequences of using the system; later these same incentives could be used to encourage the intention to use;

d) create special hands-on training seminars in order to help users develop positive attitudes toward the system;

e) Reinforce usage in order to encourage repeat behavior.

After taking each of the above steps, a separate evaluation would be necessary. Evaluation, in fact, would need to be periodic. Progress monitoring is essential and stage repetitions imperative as new employees are hired.

By looking at the list of internal and external factors presented above, it would seem, at first, that the external factors that affect an employee's utilization of a computer-based information system would be easier to alter than internal factors such as technostress or computer anxiety.

Researchers, however, have found that prolonged and repeated usage of computers does reduce individuals' computer anxiety ($r=-.20$, $p<.05$) and does improve individuals' attitudes toward computer-based systems ($r=.42$, $p<.01$)[13]. Researchers have also found that the quantity of E-mail communication is correlated with attitudes toward E-mail ($r=.25$, $p<.05$)[14]. The more a person uses E-mail, the better that person's attitudes toward E-mail will be.

These findings suggest the existence of an association between an individual's length of experience using a computer system and a reduction in that individual's computer anxiety. The longer the individual's experience, the lower the anxiety. Length of experience, however, could, in turn, be influenced by some or all of the external factors identified earlier.

In sum, both external and internal factor may be interrelated in a complex manner. Only evaluation research would be able to diagnose the factors specific to a particular organizational setting and indicate the priority of attention necessary for each.

5. ADDING ANOTHER STAGE IN THE PROCESS OF INFORMATION SYSTEMS MANAGEMENT

From the discussion in the above paragraphs it becomes clear that a stage needs to be added to the process of information system management given earlier. The new process would therefore consist of:

a) Needs Assessment
b) Design
c) Implementation
d) Evaluation

While evaluation was added to the above process, the method of evaluations are complex. It is beyond the scope of this paper to address the different evaluation strategies and procedures. Post-implementation evaluation necessitates the hiring of a specialist in human-computer interaction.

It is preferable that the specialist be an outsider (i.e. not a permanent employee but a contracted specialist) in order to objectively evaluate the situation and not get tangled in the web of organizational politics.
While hiring an outside specialist may seem like an additional financial burden for an organization, the benefits reaped from that specialist's assessment would definitely be worth the investment. After all, sound and reliable evaluation of the users of a computer-based information system can significantly help a company achieve the critical mass discussed earlier. Since users do determine the extent to which a computer-based information system contributes to a company's competitive advantage, exceptional attention needs to be given to the human factor.

6. A CASE STUDY

The case study focuses on a large multinational manufacturing organization which utilizes the services of a U.S. nationwide network that provides private company videotex services over its host computers. The company engages in the manufacturing of machinery and parts. It provides access to the network to all of its field personnel, marketing staff and dealers from various states. Users can access a large database of prices, product availability and description, in addition to being able to process transactions, send and receive electronic mail messages, browse through company news, job openings, training availability and post product advertisements.

As part of an evaluation of the company's implemented computer-based information system, an exploratory survey was conducted. The survey was designed to examine user profile, usage patterns and user reactions to the opportunities that the system offers. Users were given the chance to respond to both quantitative and qualitative questions[15].

7. SURVEY RESULTS

i. Users' Profile:

The survey respondents were mostly males (76%) with an undergraduate college degree (57%) or some college education (25%). Their average age was 39, the youngest being 24 and the oldest 62. These respondents had spent an average of 11 years working for the organization. The majority were non-managers (53%), with the next largest groups being middle managers (21%) and upper managers (13%). The terminal they use to access the company's information system was mostly either on their desk (46%) or near their desk (46%). A typical user shared a terminal with an average of 3 other individuals.

Most users were <u>told</u> about the <u>availability</u> of the system by a coworker (54%), a company representative (28%), or a supervisor (16%). Users were <u>trained</u> to <u>use</u> the system by a coworker (49%) or by reading written instructions (22%). Only 9% of the respondents indicated attending a formal training class; 19% did not receive any training whatsoever.

ii. System Access and Usage:

The average user accessed the system (both E-mail and other services) an average of 12 times a week. This indicates low overall usage given the fact that the system was designed to make key information available for the users' day-to-day operations.

E-mail use averaged 8 outgoing and 20 incoming messages per week. Individuals, therefore, received more messages than they did send.

Beyond E-mail use, however, the system appears to be dramatically under-utilized. Note that the system was primarily intended to facilitate access to product information, placing orders and other general company announcements and services. Given the uses that the system was designed to make available, the exploratory survey has found that:

a. A significant number of respondents <u>did not</u> access the system to get information on the price of a product or part (69%), to locate (68%), check the delivery schedule for (36%), availability of (58%), or features of (71%) a product or part. In addition, 59% did not order a product or part via the system.

b. Beside product-based information, a sizeable number of individuals did not utilize the system to get company policy information (81%), company news (62%), or find out about job openings elsewhere in the company (95%).

From the above observations, one can conclude that aside from utilizing the system for E-mail, the system is extremely under-utilized.

As indicated earlier in this paper, the reasons that a computer-based information system vary and may be very complex in nature. It was hoped that additional responses would reveal some of the factors at work.

iii. Problem Diagnosis

Since this survey was exploratory, no measures of computer anxiety or technostress were included. Internal factors, therefore, could not be explored. The respondents' open-ended feedback, however, revealed a number of potential external factors:

a. Formative training: Many respondents were not aware of the numerous services available via the company system. Others did not feel they had enough information to access the system. When looking at all open-ended user feedback, demands for training or training refreshers stand out. Typical comments included "Show us more in depth training, not just you punch this and this and you get that"; or "We were only shown how to use only one segment of the system". The inadequacy of training is also apparent in the fact that a significant number of users reported being trained to use the system by a coworker.

b. Interface: A recurring complaint was about the menus involved in accessing the system and the difficulty and lack of flexibility of certain system applications. The menus were described as "complicated" and certain applications as "not user friendly". Some respondents also complained about the profusion of screen codes that they could not understand the meaning of.

c. System-related characteristics: One potentially problematic area pointed out by some users is the delay in updating the information on the system. These users complained that the information that they retrieve is often out of date. If these users are correct, then this is a very serious problem that the company would need to find a solution for. If the users are not correct, but they perceive the information to be out-of-date, then their perception would prejudice their usage of the system. In the latter case, the company would need to engage in a communication campaign reassuring the users of the accuracy of the data that they retrieve.

d. Incentives: Another potential problem that was also pointed out concerns the timeliness of feedback when users send inquiries to the company via the system. After sending such an inquiry, one user complained about "waiting days and days and days... and days for the much needed information". If this is indeed a recurring problem, then the company should revise its procedures for handling requests transmitted via the system. If the user finds that making a telephone call results in a more timely response, then the company would be inadvertently providing incentives to use the telephone and not its computer-based information system for making inquiries.

iv. Assessment

The exploratory survey conducted indicated that the system that the company has spent significant sums of money implementing and maintaining is severely under-utilized. As part of a more complex post-implementation evaluation, the exploratory survey generated a number of leads about potential factors that contribute to the system's under-utilization. Follow-up surveys and further investigation of both users and company procedures would yield more precise data for making recommendations.

8. CONCLUSION:

At the start of this paper, it was argued that the human factor influences the degree to which a computer-based information system can achieve its potential in an organizational setting.

It was also argued that, in the absence of post-implementation user assessments, and since the users are often not motivated to volunteer their opinions, the company risks having its hefty investment in equipment be under-utilized.

The case study presented in the last portion of this paper illustrates an example of under-utilization. The exploratory survey conducted as part of the post-implementation evaluation has yielded several potential factors that influence the under-utilization of the company's computer-based information system.

Pursuing the post-implementation evaluation will further identify and isolate problem areas. The evaluation would subsequently enable the analyst to generate a set of recommendations to the information system manager or others in charge. Periodic post-implementation evaluation can assist a business organization in its quest for achieving a critical mass for its computer-based information system. A critical mass would, in turn, help maximize the computer-based information system's contribution to the company's competitive advantage.

ENDNOTES

1. See, for example, Reark, 1989; Ekerson, 1990; de Jager, 1991.

2. See O'Brien, 1992.

3. See O'Brien, 1992.

4. See Allaire, 1989.

5. See Keefe, 1988.

6. See Cavanagh, 1990.

7. Items i and ii are from Carroll, 1992, p. 40.

8. Items iii through vi are taken from Dean & Trahan, 1990, pp. 48-49.

9. See Oliver, et al., 1985; Markus, 1990.

10. See, for example, Zmud, 1988.

11. See, for example, Crable et al., 1991; Hudiburg, 1989; Kernan & Howard, 1990; Cohen & Waugh, 1989; Hudiburg, 1990.

12. Bagozzi, Davis & Warshaw, 1992, p. 660.

13. Hudiburg, 1990, p. 313. See also Cohen & Waugh, 1989.

14. Trevino & Webster, 1992, p. 560.

15. I would like to credit Dr. Charles Steinfield for initiating the survey upon which this section of the paper is based. I would also like to thank my colleague Kazumi Hasegawa for her conscientious help in preparing the data for analysis.

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AN EMPIRICAL INVESTIGATION OF TELEX DATA AS A USEFUL PREDICTOR OF SOCIOECONOMIC DEVELOPMENT AMONG LESS DEVELOPED COUNTRIES

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1. ABSTRACT

This paper considered the relationship between telecommunications and socioeconomic development in Less Developed Countries (LDCs), defined as countries where the per capita gross national product or gross domestic product is low relative to industrial market economies. Examined were the effect of telecommunications on the social and economic activities of LDCs and the understanding of the contribution the telecommunications infrastructure provides to socioeconomic growth.

2. INTRODUCTION

The issue examined in this study was the economic effect of telecommunications as a factor in sustained growth rates of highly developed regions, and whether telecommunications is essential to the development of LDCs, particularly in being part of global markets.

2.1 BACKGROUND

The provision and proper utilization of a basic infrastructure for the benefit of the community has become a key task for planners. Pioneering work was done in the past by individual researchers (Hudson, Goldshmidt, Hardy et al) demonstrating the disparity between the many millions of people who have not participated in global socioeconomic development, versus those who have. Other organizations such as the United Nations International Telecommunication Union (ITU), The Development Centre of the Organization for Economic

Cooperation and Development (OECD) and the World Bank have sponsored or conducted research on a global perspective. In addition the Center for International Business Cycle Research, Columbia University, New York, has developed and maintained economic indicators for countries in the developing Pacific rim area such as Australia, Korea and Taiwan. The aim of the individual authors and organizations has been to contribute to the general knowledge about and to identify the resources and structural changes necessary, to provide basic communications infrastructure for the underdeveloped regions, in order for them to achieve basic health services, social, and business activities.

2.2 IMPACT OF TECHNOLOGY SERVICES

The new telecommunication services which are now being introduced in industrialized nations are information centered, involving global networks (World Bank, Wellenius, 1987). The increasing world-wide demand for competitively priced manufactured products, commodities and services requires global networks organized and coordinated on a worldwide basis. In order for rural areas and developing nation states to participate in this competitive environment, they need reliable and timely information to gain access to these markets. Careful planning and implementation of telecommunications systems may be essential to high quality business communications, both within the country and as part of an international network (World Bank, Wellenius, 1987).

2.3 PROBLEMS IN PLANNING DUE TO CHANGING TECHNOLOGY

In developing countries the real cost of providing and maintaining telecommunications services has declined in the last several decades and is expected to continue to decline in the foreseeable future (Saunders, Warford, and Wellenius, 1983).

Modern digital technologies, as developed principally for developed countries, however, are not always optimal for rural areas or developing countries. These areas are, by necessi y switching to new digital capabilities because such systems have a number of advantages including improvement of financial control and quality of service (Schware, 1987). Digital systems also permit improved network maintenance and have a higher degree of reliability.

In most countries the benefits associated with technological change are controlled through polices of the government and managers of individual entities, in that they must plan the adaptation of the most appropriate technology to provide telecommunications services. This is particularly important in developing countries where the relatively small size of the initial system coupled with the potential for high growth rates often justify adoption of the newest commercially available technology. Yet if one looks at the distribution of loans made by the World Bank, (the principal source of finance for telecommunications in developing countries), the loans and credits amounted to less than 3.0 percent of its total bank lending since 1960 (Saunders, Warford, and Wellenius,1983).

2.4 AGGREGATE STUDIES

In examining the relationship between Gross National Product (GNP) and telecommunications, the simplest study is comparing telephone density with GNP (Pelton, Toward a Law of Global Communications Networks p. 40). The positive slope indicating the higher GDP or GNP per capita for an individual country the greater the density of telephones per unit population.

Cross-sectional and time series studies by CCITT have also been developed both historically for individual countries and for a set of countries in various stages of economic development (Saunders, Warford and Wellenius, 1983). A study by Yatrakis (Telecom Journal, 1972) analyzed the relationship between international telephone, telex, and telegram and twenty economic indicators including tourism and trade. Telex traffic was found to be closely correlated. Similarly, telex density has also been studied by Wellenius, Budinich and Moral (Saunders et al, 1983) and compared in terms of GDP per capita, value of exports, value of imports, bank deposits, telephone lines, telephones, and energy consumption.

These studies also supported the telephone studies and particularly show a strong correlation with the value of imports since telex has been, in the last three decades, an important element for international trade. This study supports the idea that measurements relating to Gross Domestic Product per capita provide an insight into the relationship between telecommunications and socioeconomic growth of LDC's and provide a beginning point for analysis (Saunders, Warford, and Wellenius, 1983).

2.5 LIMITATIONS OF AGGREGATE STUDIES

Although the use of statistical regression and correlation analysis is useful because of the simplicity of approach and the relative ease in obtaining aggregate data, use of a single equation to describe a complex situation with very dissimilar data and many related variables may be overly simplistic (Saunders, Warford, and Wellenius, 1983). Snow (1987) suggests the assumption that telecommunications infrastructure accelerated economic development implies that key individuals and entities such as researchers, practitioners, policy makers and funding programs were active in the process. Another argument against the single equation approach is that for underdeveloped countries the telecommunications systems have (1) a large number of applicants for new service which cannot be filled, (2) heavy congestion during business hours and, (3) in some case limited service throughout the country. Developed countries on the other hand have very low waiting times (days rather than months or years) and highly advanced telephone networks and exchange systems using modern quantitative methods such as queuing theory.

Additional work by Hardy (Hudson, 1986) examined whether increase in telephone density contributed to distribution of income. His conclusion was that development of the telecommunications infrastructure as represented by density of telephones contributes to the equitable distribution of wealth in nations. His basic premise was that telecommunications does contribute or encourages development of a middle class by moving wealth away from the highest income bracket.

2.6 STRUCTURAL ECONOMIC ANALYSIS

Although correlation analysis applies to virtually all countries, such analysis provides only an insight into the benefits of telecommunications to rural and underdeveloped countries. Saunders, Warford, and Wellenius (1983) suggest this approach is similar to examining the telecommunications structure as an input to a production process. Telecommunications can been analyzed at the level of nation-states and by statistical correlation or regression. This analysis developed a model showing the relationship between economic growth and telecommunication capability. Similarly, oil refining or electrical power generation can be tracked through various stages of production until it is consumed in its final form. This type of analysis, however, does not fully describe the contribution made by the product (and the examination of the economic structure).

2.7 INTERNATIONAL ECONOMIC INDICATORS

Large-scale econometric models have been developed and are being used to model economies and selected industries of industrialized countries within the economy and in some cases specific firms within an industry (Pfaffenberger and Patterson, 1987). Using these techniques, an index of economic indicators has been developed by economists to explain and forecast the level and fluctuations in economic activity and to identify the impact of cyclical activity on different sectors of the economy. Growth cycle chronologies and their turning points are important for two reasons. First, the peaks of growth cycles or "turning points" generally precede business cycle peaks while the low points or recession trends tend to coincide with business troughs (CIBCR, 1988) Using this analytical technique, analysts are able to provide advance warning for cyclical changes which may lead to recessions. Second, the analysis may also identify less severe setbacks in the economic growth which do not develop into declines in level but are rather sustained, low-level rates of growth. This technique has been used in the United States for over fifty years through the U.S. Government National Bureau of Economic Research (Moore, 1980).

The growth cycle analytical approach includes two elements. The first element is the establishment of the cyclical indicator identifying a reference cycle or a set of references such as periods of recessions and peaks or "turning points" of expansion periods. These periods are represented historically by specific dates and appear as peaks and troughs. In this manner the cyclical indicator technique permits an identification of key economic factors in a time series, including those which lead and those which coincide with aggregate economic activity.

Second, these key economic indicators are segregated into lead and coincident time series and combined into aggregate indices (leading and coincident). Typical key indicators are employment, industrial production, stock price index, exports, housing starts, and new business starts.

3. BUSINESS CYCLE APPROACH TO ECONOMIC ANALYSIS

An important task of economists is to predict the level of economic growth and cyclic changes that may take place within the general economy and sectors of business. Economic analysts divide the economy into phases (Samuelson, 1985) marking the highest and lowest point in the aggregate economic activity of a country. These peaks and valleys indicate a turning point in the economy and show the period of time of "recession and expansion". The change in business activities associated with these periods include important activities which affect the entire economy. For example, in times of recession inventories are in general reduced, demand for labor falls, commodity prices fall, and business profits are reduced (Samuelson, 1985).

The U.S. Government National Bureau of Economic Research (NBER) has been one of the organizations which has studied business cycles and developed the cyclical indicator approach (Pfaffenger and Patterson, 1987). Economic cycles have been analyzed using a number of key parameters as indicators to represent the performance of a country's economy. These indicators comprise two categories, i.e., (1) a set of coincident index of indicators representing current economic activity, and (2) an index of leading indicators showing the predicted movement in the aggregate economy. The indicator technique of analysis can be divided into two phases with the first phase identifying specific dates where the aggregate level of the economy has reached its highest or lowest point (peak or valley) and secondly to identify the relationships with the key parameter's peak or valley of the reference cycle. In this technique the cyclic parameter identifies a certain economic time series as those which lead and those which coincide with the overall economic activity (Pfaffenberger and Patterson, 1987). Usefulness of the leading series is in signaling a possible downturn in aggregate economic activity so that appropriate action can be taken before a change in activity occurs in the following:

1). Employment.
2). Inventories and Inventory investment.
3). Consumption, trade, orders, prices, cost, and profits and deliveries.
4). Fixed capital investment. Money and credit.

A separate project was initiated by Geoffrey Moore in 1973 [see Moore (1980)] to provide an international indicator using the techniques developed by the NBER. This project has been continued by the Center for International Business Cycle Research at Columbia University. A number of industrialized countries have been included in the project. In 1977 Australia was added to the program list and a set of leading and coincident indicators were developed by Boehm and Moore (1984).

3.1 AUSTRALIAN STUDY

Defris, Layton and Zehnwirth (1986) used these indexes to determine if telecommunications traffic was responsive to fluctuations in the economic activity and whether the technique, applied to telecommunications, would assist telecommunications organizations in predicting telecommunications traffic activity (number of calls, outgoing telex messages, etc.) and aid in financial planning to augment suitable increases (or decreases) in telecommunication capacity. The principal purpose of their study was to examine and investigate the relationship between telecommunications traffic and the leading indicator index using cross-spectral techniques. Three cator index using cross-spectral techniques. Three telecommunications traffic series were used including the volume of social telephone traffic, the volume of business telephone traffic, and the volume of telex traffic outbound from Australia. The results of their study showed a strong association with the composite leading indicator index. This was measured by the spectral coherence between the three telecommunications traffic series and the composite leading index.

Defris, Layton and Zehnwirth (1986) concluded their study supports the hypothesis that telecommunications traffic does respond to fluctuation in aggregate activity and can be included as an explanatory variable for developing a forecasting model of telecommunications traffic.

3.2 INTERNATIONAL ECONOMIC INDICATOR FOR SOUTH KOREA

An international economic indicator for South Korea was compiled by the Columbia University Center for International Business Cycle Research (CIBCR). in 1987. The CIBCR included fourteen reporting countries, three of which were Pacific rim countries (Japan, Taiwan, and Australia). In 1988 Korea was added to the data base. The index developed by Geoffery H. Moore (1980) followed the same methodology for selecting and evaluating indicators as used by the U.S. economy and published by the U.S. Department of Commerce.

This index provides a monthly observation of the economic time series for Korea including the following:

Table 3-1: Korean leading and coincident indicators

Leading Indicators	Remarks
1. Monthly Hours Worked	Number
2. Manufacturing Rate	1980=100
3. Value of Machinery Orders	Billion Won (in 1980 value)
4. Stock Price Index	January 1980 =100
5. Letter of Credit Arrivals	10 Million U.S. $ (in 1980 value)
6. Ratio of Inventories to Inverted Shipments, Manufacturing	(1980=100)

3.3 STATISTICAL PROCEDURE

The statistical procedure, cross-spectral analysis, is derived from physics applications where light is passed through a prism and divided into the components of its "spectrum". In examining business activities as represented by a time series of economic indicators and telecommunications activity as represented by telex message traffic, the variation in each series is examined by "passing" the time series through a series of "prisms" or "filters" in order to associate the most important component of variation with a particular period (or frequency), where each component is statistically independent (Pfaffenberger and Patterson, 1987).

In the spectral analysis, the total variability of the series is broken down into variability components due to the sinusoidal contribution at each frequency, Sine and cosine functions are used to model periodic movements of the data.

The cross-spectral analysis examines the two series to see if there is a significant association between the series at frequency bands which simultaneously account for a large proportion of the variation in each of the observed series.

3.4 SPECTRAL DENSITY FUNCTION

The spectral density function is a method of considering the frequency properties of a time series. An example of the importance of the frequency may be where the time series varies over several different frequencies, For example, sales figures may have weekly, monthly, yearly or other cyclical variations.
Chatfield (1984) notes that the adjective "power" is sometimes made part of the "spectral distribution function" and it originated from the electrical engineering process of measuring the relationship of electrical current in a circuit. For example, for a sinusoidal input, the power is directly proportional to the amplitude squared of the oscillation, For more general inputs, however, the power spectral distribution function describes how the power is distributed with respect to frequency. In the case of a time series, the variance is the total power. The term "spectral density function' is often shortened to spectrum. The actual meaning of spectrum is the function that represents the contribution to the variance of components with frequency. A peak in the spectrum indicates an important contribution to variance at frequencies in the appropriate region.

3.5 CROSS-SPECTRAL MATHEMATICAL MODEL

The leading index indicator and telex data series can be analyzed where leading index series may be thought of as input and telex series as output. To determine the degree of

association between the leading indicator and telex data series at different cycle lengths or time periods, a cross-spectral analysis is carried out.

The economic indicator series may show a cyclic or oscillating change with respect to time due to the economic fluctuations in the world and individual country's composite economic conditions (Pfaffenberger and Patterson, 1987). As noted above the overall cyclic pattern may be presented by a series of sinusoidal functions, each representing a particular frequency that can be translated into months or years. By examining the frequencies and their strengths or amplitude (e.g.. using spectral analysis), the true contribution to the total variation can be determined for each frequency (or period).

4. SUMMARY

The purpose of the analysis is to assess the contribution or correlation between the leading indicator and telex data series at each frequency component which make up the total cyclic series. In analyzing the cross-spectral results of the two series (coherence between input series-the leading indicator and output series-telex traffic), the most important element is the frequency band which accounts for major variation in the output series. The area under the estimated cross-spectrum range of frequencies indicates the degree of relationship between the leading indicator to telex series (international telecommunications activity) at the band of frequencies.

5. DATA

The telex data was expressed in total telex messages-minutes as recorded in June 1971 compared with telex message-minutes in each month. The leading index indicator data is expressed as a composite in the form of a deviation of trend (for example, the change in growth in June 1980 can be compared with June 1981 with any average growth trend within the period removed).

The economic data for South Korea has been provided by the editor, Ms. Jean Maltz, of the monthly publication International Economic Indicators, developed and maintained by the Columbia University Center for International Business Cycle Research. The data is in the form of deviation from trend on a monthly basis for the period January 1970 to January 1987.

Through the kindness of Mr. Jae mo Kah, Director of International Business, Department of the Korean Telecommunication Authority, the monthly composite of outgoing telex data has been provided to the author for the period 1971 through 1985 in the form of message-minutes.

Statistical techniques for analyzing time series such as the index, are mainly concerned with decomposing a series into a sum of components: a long term growth trend, a seasonal component and other "irregular" variations. The different sources of variation will be summarized.

6. CONCLUSIONS

The principal purpose of this research was to to examine telex data, representing international telecommunications traffic, as a useful predictor of socioeconomic development in South Korea. The approach, using time domain methodology or cross-spectral techniques compared the composite leading indicator index developed by CIBCR with telex data from the period 1971 to 1985. From this analysis the following conclusions may be derived.

First, that there is an association between international telex telecommunications traffic and a composite cyclical economic indicator index, developed by the CIBCR, using the Korean telex data. Examination of the coherence spectrum indicates strong and relatively consistent coherence (**about two and one half years or 30 months cycle-length**) or greatest for the long cycle lengths similar to the Defris et al (Defris, Layton, and Zehnwirth, 1986) study for Australia. The indicator is most useful in anticipating longer term movements. The results are shown in Table 6-1.

Table 6-1: Coherence between telex and leading index for South Korea

Traffic series	Leading index	Average lead time (months)	Cycle-Length for high level of coherence (months)	Coherence
Telex	South Korea Economy	4	30	0.65

Second, construction of a time-domain forecasting model using the cross-spectral methodology, is shown as a useful approach to a study of the economic behavior in the telecommunications sector and its important relationship to the other economic factors. In Less Developed Countries using telex as a representation of overall telecommunications traffic has merit since there is a need to provide an accurate measure of the effect of adequate telecommunications on socioeconomic development.

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Framing our Common Future: Strategies for Promoting Cooperation among Stakeholders

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ABSTRACT

The successful incorporation of telecommunication technologies into higher education requires the orchestration of different types of expertise and reflective dialogue among the stakeholders. This paper will highlight some of the lessons learned by the author and her colleagues during six years of development and delivery of province-wide televised courses — an enterprise which required the cooperation of academics, media specialists, instructional designers, university and college administrators, community-based coordinators and government representatives. The focus will be on the strategies that can help to overcome the barriers to collaboration.

Introduction

Access to higher education has become a strong political issue in many developed and developing countries. Like many other countries, Canada has been experiencing social and political pressure to increase access to higher education and training among adults who cannot attend classes at conventional campuses. It is the largest country in the world in terms of land area but ranks 31st in terms of population. With almost all our institutions of higher education concentrated in the urban centers near the southern fringe of the country, it is difficult to provide equitable access to people living in the rural regions and in the far north. Almost all of the ten provincial governments have supported the development of telecommunication systems which have the potential of expanding access to higher education and training. In recent years, there has been a growing recognition of the need to address the disadvantages of various groups, especially those of Canada's indigenous peoples. Various forms of distance education have been adopted by universities, colleges and secondary schools to improve the equality of education opportunity.

In 1987, the University of Saskatchewan adopted satellite-transmitted interactive television in an attempt to extend first year university courses to students living in rural areas. The successful incorporation of television as part of the teaching/learning process required the orchestration of different types of expertise. The purpose of this paper is to describe the cooperative efforts of academics, instructional designers, administrators, community-based coordinators, and government representatives to design, develop, produce and deliver our telecourses. The mix of dissimilar organizations that constituted the membership of this distance education enterprise was both a strength and a weakness. The paper will highlight some of the barriers to cooperation and the strategies used to facilitate acceptance of a new delivery system.

The Context for Collaboration

Saskatchewan, one of Canada's ten provinces, is located in central Canada and shares with Alberta, our western neighbor, the feature of having no salt water boundary. The province has only one million people and a geographical area of over 600,000 square kilometers. Indigenous peoples make up over 10 percent of the population, the highest proportion among all the provinces. Agriculture is the largest single industry; other major industries include mining and petroleum refining. There are two universities, the University of Saskatchewan and the University of Regina, respectively located in the two largest cities, Saskatoon and Regina. In the late 1980s, dropping commodity and livestock prices forced many families to move from once prosperous rural communities to the cities to look for a stable income and education opportunities for their children. For every family that moved, there was another that could not afford to move but was just as desirous of opportunities for re-training and higher education.

The challenge faced by the University of Saskatchewan in the late 1980s was: In a period of restraint in the provincial economy, with corresponding budget cutbacks in education funding, how can we cooperate with other institutions to meet the surge of demand for access to higher education?

Beginning with the university's agricultural extension services, we have had a 75-year history of taking education directly to small, rural communities. With the introduction of regional community colleges in 1973, the university cooperated with these institutions to offer university classes taught by travelling instructors. The number of off-campus classes that could feasibly be delivered was restricted by the vast distances between communities, the small population, and the number of qualified instructors who were willing to drive an average of 200 kilometers, often under harsh winter conditions. Correspondence courses in the humanities and social science areas filled part of the void. By the mid-1980s, the obstacles associated with providing access to people who could not attend the main campus were accentuated by burgeoning enrollment at the Saskatoon campus.

Could the university use a mix of technology-mediated instruction and traditional delivery methods to solve the problem? Saskatchewan already had a fibre optics broadband network capable of carrying audio-conferencing, educational television, and computer-assisted instruction. However, because fibre lines cannot be buried underground in the permafrost in the north, the network could potentially reach only sixty percent of the province's population. An alternative was satellite programming, which was being used in four other Canadian provinces. Although the university, through the sponsorship of the federal Department of Communications, had successfully participated in satellite transmission field trials in 1981 and 1984, there was no provincially coordinated administrative structure for distance education delivery.

In 1986, a group of "occasional" users of satellite programming banded together to form the Saskatchewan Tele-Learning Association Inc. (STELLA). The founding members included the two universities, a technical institute, several community colleges, and Saskatchewan Health, with the chair held by the Director of Extension of the University of Saskatchewan. A total of 45 programs were developed and aired by 14 education and community organizations during that first programming year. By the fall of 1987, the University of Saskatchewan had decided to invest in satellite technology to deliver its first year arts and science degree courses. This decision was simultaneously influenced by a "seat sale" on the satellite Anik C offered by Telesat Canada and a political problem facing the university at the time. After several years of increasing enrollment with no corresponding program budget increase, the university's largest faculty, the College of Arts and Science, had to impose a quota for the first time in 80 years and turned away several hundred qualified students. Amidst the turbulent sea of protest, the offer from Telesat Canada appeared to be a means of meeting demands for access.

Within six months, the Extension Division had developed and delivered two degree courses, English 110.6 and History 112.6, to 13 locations in the province via the university's studio facilities. The positive feedback (Wong, 1988) encouraged the university to develop a third telecourse, Psychology 110.6, which as delivered to 25 locations in the fall of 1988 (Wong, 1989). By 1989, a provincial distance education agency, the Saskatchewan Communications Network (SCN) was in place to sponsor the development of two more courses in Mathematics and Native Studies, and the number of receiving centers increased dramatically to 52. Each receiving center, in addition to being equipped with Ku-band satellite receiving dishes, has classroom space for discussion groups to meet. By 1992, the number of receiving sites numbered 95 (including duplicate classrooms) and the University of Saskatchewan was contributing over 500 hours of televised instruction.

A combination of several teaching/learning modes were used to achieve three functions: (1) present information to the learners; (2) assist the learners in finding the contexts for understanding the new information; and (3) monitor the learners' incorporation of the information into their perceptions of reality. Information was presented to the learners via televised lectures, which varied between 60 to 90 minutes, and a variety of print material, including several textbooks and a course guide. Information was also shared in local discussion groups led by a tutor. The learners were assisted in their search for understanding by the television instructor, a local tutor, and their learning peers. This assistance was provided via the interactive lectures, the printed course guide, the local discussions, and toll-free telephone consultations with the instructor and designated tutors. The learners' progress in understanding and integrating the information was monitored via their participation in the discussion groups and their input into written assignments and examinations.

The Stakeholders: Orchestrating Different Expertise

The implementation of this teaching/learning model involved the orchestration of several types of expertise. A key component is the instructor — each telecourse was prepared and presented by a professor who is considered to be an excellent teacher as well as a scholar in his/her field. This was important as the telecourses had to achieve credibility within the university community. The Extension Division paid for the release of the instructor from all other teaching duties during preparation of the pilot course; "repeaters" were given release time for twice the amount of an on-campus course.

A second important component of the system is the local facilitator hired by the Extension Division. This role is performed by a tutor or a proctor, both of whom are expected to facilitate local discussions during the off-air periods and assist the students in posing questions during the on-air periods. "Tutors" hold master degrees in the subject area and are paid an additional stipend to mark assignments and provide feedback to the learners. "Proctors" hold bachelor degrees in the subject area — in small rural communities, it was not always possible to find resource persons with advanced degrees. In the course evaluations, some proctors were rated even higher than the tutors because of their outstanding interpersonal skills. On the other hand, some tutors were not re-hired because they failed to provide the kind of empathetic support needed by the learners.

The third key component involves the technical experts from the university's Division of Audio Visual Services (DAVS) who make possible the weekly "live" delivery of the lectures and pre-produce supporting video clips and visual materials. Each telecourse was assigned a television producer/director who was supported by a crew of eight technicians, over half of whom were university students. The use of students helped to keep the cost down but also resulted in some uneven camera work, which was often compensated by a high level of enthusiasm and camaraderie, a factor much appreciated by both the instructors and the studio audience.

The on-site coordinators constitute the fourth important component of the system. The nine participating regional community colleges assigned their own staff to coordinate the publicity about the telecourses and the local facilities. In some cases, they helped to identify potential tutors or proctors from their communities. The coordinators are essential in identifying local problems (whether human, logistical or technical) and alerting the Extension Division office about them. However, because the colleges held different values about the telecourses, some local support were outstanding while others were less than adequate.

Although many successful programs have served to demonstrate that telecommunication technologies can enhance the teaching/learning process, many educators are still wary of the cost-benefit implications of adopting such technologies. The Extension Division, as the principal coordinating unit, played a key role in enlisting support from the university and community colleges. As a team, the Extension administrators and instructional designers were responsible for conceptualizing the teaching/learning model, developing and producing the course guide and other student support material, recruiting and orienting tutors and proctors, liaising with SCN, DAVS and the community colleges re course delivery and reception, and solving problems associated with student registration and delivery breakdowns.

Because the first two pilot courses were developed and implemented within a short time frame of six months, some administrative and technical mistakes were made but were fortunately corrected by the second year. A major problem was time — the senior administrators had underestimated the time it takes to develop a high quality telecourse and corresponding student support services. Part-time project workers were hired to fill the gaps but they required much supervision and additional space and equipment. After SCN began to provide funding for the courses, the grant schedule and the course development schedule were often incongruent. As the number of courses, course teams members and students increased, the juggling of human resources became more precarious.

SCN (Saskatchewan Communications Network) was created in 1989 as a full-scale provincial satellite and fibre optic network with joint federal and provincial support. There are two distinct networks: the SCN Training Network, a "narrowcast" network dedicated to distance education and training, and the SCN Cable Network, an educational television channel distributed to cable subscribers. Funding for the development and production of televised courses is dispersed via a deputy minister's working group, with members drawn from the post-secondary education sector. The emergence of SCN provided a much needed stable source of funding and a provincial infrastructure to deliver distance education courses.

The Politics of Collaboration

The relationships among the instructional, administrative, and technical team members were both enhanced and impeded by the different perceptions of the new delivery system and the value attached to it. Any system can be seen as being at once part of a larger system and as having smaller systems within it. An analogy is how we see different realities depending on whether we focus our eyes on a sheaf of wheat or the whole wheatfield. Ideally, the synergy that comes from collaboration can often yield benefits beyond those originally envisioned, but sometimes the reverse can happen (Paul, 1990).

The academic staff in various departments, the media specialists in DAVS, and the Extension Division administrators and course designers belonged to different units within the same university, but attached different significance to the telecourse delivery system. The instructors, while excited by a whole new way of teaching, were also concerned about tradition and how credible the courses appeared to their academic peers. The DAVS members were keen to produce high quality presentations to "showcase" the technical capability of their staff and facilities. The Extension Division had invested base budget and staff resources in a high risk project with the hope that the increased access to university courses would justify long-term support for distance education from the university and the provincial government.

The regional community colleges, which represented the interests of over 50 rural communities, varied in their support for the delivery system. Some were highly supportive, as the system provided the first opportunity for university courses to be offered in small communities within their "territory." Other colleges which had a tradition of collaborating with the university to offer face-to-face classes were reluctant to give up this option, as prestige derives from the local populace associating these classes with the college. Telecourses originating from the university campus "diluted" the impact of the local college and also decreased the justification for new capital spending on local facilities.

SCN, as the fledgling government-sponsored distance education network, was eager to capitalize on the experience of the University of Saskatchewan but at the same time encouraged other educational institutions to contribute to the network's programming. The committee that was set up to adjudicate proposals and distribute development funds experienced some growing pains and consequently generated frustration for the university course development team, which had to work under very tight timelines. SCN wanted high quality televised courses for their money, but did not want to pay for the accompanying print-based support materials and student support services which the Extension designers considered essential for the teaching/learning process.

The stakeholders, while acknowledging the need for an alternative delivery system to meet the higher education needs of the province's rural population, differed in their perception and support for the system. They converged to share their expertise but still focused their priorities on different aspects of the system. The Extension Division, as the principal coordinating unity, had to adopt a more centralized style than was experienced in previous collaborations. This resulted in increased efficiency but also ruffled some feathers in the process.

Facilitating Dialogue and Cooperation

It has been five years since we initiated our first televised courses. Our experience confirms the observation of some educators that collaboration, especially within the context of adopting "innovative" procedures, is a process fraught with potential pitfalls (Offerman, 1985; LeSage, 1988; Konrad & Small, 1989). The "lessons" we learned as a result of our experience include the following.

- *The goals and rationale of the project should be clearly described, written down, and communicated to all the participants.*

  Because of the tight timeline for development of the pilot courses, there was no time to document the goals and rationale for communication to all levels of staff among the partner institutions and university units. Senior administrators of the Extension Division paid personal visits to their counterparts among the regional community colleges, but many of the staff who had to assist in implementing the project were not aware of the long-term goals and rationale for the project strategies. As a result, some participating staff were not supportive of the innovation. In subsequent years, the Extension Division hosted orientation workshops which introduced the process to all the new personnel among the participating stakeholders. These workshops also served as a social function for bringing together new and veteran staff members and acknowledging them for their contribution to the project.

- *There has a be a clearly established benefit for every participating institution or unit. Participating staff must understand and support the anticipated benefits or gain some personal satisfaction from the project.*

  The University of Saskatchewan was

perceived to be the "winner" in this project because of the favorable publicity generated over the use of a new technology to increase access to higher education. Some regional colleges with very small populations also benefited from the innovation. Other colleges considered themselves as "losers" because the option of travelling instructors was withdrawn from content areas which were offered electronically in their communities. The re-introduction of this option two years later (in addition to the televised format) mollified these colleges somewhat, but the project managers were not able to capture the sense of community that was built among the "satisfied" partners in the pilot year. The instructors who participated in the pilot courses became strong supporters of distance education and managed to "convert" some of their colleagues within the university. SCN was satisfied with the quality of the televised courses and used them as a model for encouraging other educational agencies to contribute to their Training Network.

- *There must be a champion of the innovative project in every participating institution or unit. These individuals must trust each other and be prepared to spend time in building support within their own organizations.*

  In retrospect, the Extension Division administrators can identify specific colleges and units where they could expect active opposition or benign neglect in the delivery of the televised courses. These units usually do not have a "champion" who personally supports the project. In contrast, good personal relationships among certain principal players greatly facilitated the marketing and delivery of the program in specific regions. There are now champions among most of the cooperating units. Their presence helps to widen the base of political support for using telecommunication technologies to increase access to post-secondary education.

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VSAT SOLUTIONS FOR INNOVATIVE INTERNATIONAL AND DOMESTIC SERVICES

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ABSTRACT:

The paper describes applications of VSAT networks for realization of innovative and cost effective networks. In developing countries with inadequately developed communications networks, the use of VSATs can provide quickly implementable solutions for trade networks, tourist and banking networks. Overlay networks for advanced services such as Video conferencing and ISDN are also well achieved using VSAT technology. The paper also highlights the current developments in this field and the need for developing countries to opt for easily adaptable VSAT solutions.

INTRODUCTION:

The potential of VSATs for providing reliable communications over widespread locations has been recognized since the very inception of Satellite Communications. VSAT networks serve a niche area in the spectrum of communications facilities. The ease and rapidity with which VSATs can be installed and their independence from traditional terrestrial communication networks has been perceived by the users to be particularly attractive for applications where the terrestrial networks are inadequately developed or where the delays inherent in providing terrestrial lines are unacceptable. The reliability and quality is also generally superior to terrestrial alternatives.

VSATS - A BRIEF HISTORY

VSATs have indeed a very brief history, dating back to no earlier than the 1980s, prior to which the satellite power limitations did not really allow practical implementations.

The first generation of VSATs thus appeared in 1980. These were generally receive only VSATs operating in C-band and used for one way data applications such as news services (Associated priors, UPI etc.). Based upon spread spectrum modulation and Aloha contention techniques, their use was limited to low speed data services.

Quick to realize the suitability of VSATs for interactive rather than one way data communications, rapid developments were ushered in by manufacturers to bring forth the second generation VSATs. These VSATs available around 1984 could operate in C as well as Ku band to take advantage of large bandwidth available and provide two ay communications.

By now a large number of users were entering the market with their individual hardware, networking & connectivity requirements. Proprietary network and hub techniques were clearly unsuitable for such multivendor hardware and software and shared hub requirements.

The third generation of VSATs, available around 1987 overcome these limitations by providing open networking operating architectures (OSI conformance) capable of supporting interoperability in multivendor operating environment. Better satellite access and bandwidth management techniques (slotted Aloha, TDMA) together with network management capabilities today make for more cost effective and flexible implementation of VSAT networks.

Users in advanced countries like USA and Canada were quick to recognize the unique advantages of VSATs for their business networks which spanned multiple locations spread over a number of cities and rural areas. The VSAT networks were recognized to enable the users to avail of advanced digital services in places where the terrestrial network is not sufficiently developed. Being self contained the VSAT networks are also fully user controlled and lend themselves well to provide a uniform range of services and end to end network management. The high flexibility, quick installation and reliable operation make the VSAT's an indispensable alternative for public and business networks.

2.VSAT TECHNOLOGY-THROUGH THE GATES OF REGULATION

The availability of reliable and Cost effective technology alone does not ensure its optimum utilization. Nowhere is this more evident than in the use of VSAT technology worldwide.

In the US, the use of VSATs for private networks and business applications has been free of regulatory restraints since their very inception in the eighties. This has led to their widespread use. Large VSAT networks such as those of K-mart, GM,Ford and Dow-Jones are indispensable today for the conduct their business.

In developing countries, which could potentially derive maximum benefit from VSAT networks to provide advanced digital services, unfortunately this technology was seen as a threat to the monopolies of the Telecommunications authorities. The ability of the VSATs to by pass the terrestrial networks and the facilities provided by the Telecommunications administrator were simply not acceptable and were stifled by the regulatory framework. This virtually ensured the stifling of innovative and cost effective uses of VSAT technology thus denying these benefits to their users.

In fact, the situation in Europe was the same till the turn of this decade when the restrictions on the use of VSATs were lifted. Rapid developments are now taking place in Europe and multi-national and Pan-European VSAT networks are soon expected to be common place for business and private use.

INTERACTIVE COMMUNICATIONS NETWORKS-THE VSAT ALTERNATIVE:

There is an urgent need to have a close look at the VSAT technology beyond the frame work of regulation and restrictive practices, particularly in developing countries where the telecommunications infrastructure is inadequate or overloaded through the need for provisioning of basic telecommunications services.

The vicious cycle of underdevelopment and globally uncompetitive business can be broken only through the provision of the state of the art communications tools such as advanced digital services, ISDN , videoconferencing etc. to trade and business establishments operating in these countries. The provision of such facilities is also essential for attracting foreign investment and business firms. For, who would like to invest in a country where their plants and offices remain virtually isolated from their global operations and services like Credit Card verification, Videoconferencing, Computer Aided Manufacturing inventory control can not be implemented ?

Telecommunications Administrations in underdeveloped countries usually do a lot of lip service by unveiling grandiose plans of implementation of digitization, ISDN and other services in the network. However, by their own estimates, the amounts involved in implementing even a fraction of these plans are staggering and no one is in any doubt that an early implementation is well-high impossible. Even overlay networks, often promised for early implementation are costly, limited in reach to metropolitan areas, difficult to interface to existing overburdened networks and are still time consuming to implement.Today we need to look at innovative solutions to provide state of the art telecommunication facilities which can be rapidly implemented at low cost even in far flung areas.

The VSAT technology, with its proven capability of being able to provide digital bearers supporting a host of advanced digital services which can be made operational over time frames as short as 24 hours is a candidate meriting prime consideration for such applications.

The unhindered provision of such facilities can bring about dramatic changes in the operating environment and provide innovative services which are truly cost effective. Moreover, where the investments for such facilities are made by private operators who set up their own business networks, the telecommunications authorities need not make large resource draining investments.

3.VSATS IN DEVELOPING COUNTRIES-THE INDIAN EXPERIENCE

The advantages of VSATs are well known even in developing countries, though the regulators are by and large, are unwilling to let go their hold on the networks.

In India, there are two major VSAT networks, the Remote Area Business and Message Network (RABMN) and the National Informatics Centre Network (NICNET). The RABMN is operated by the Department of Telecommunications (DOT) while the NICNET is operated by the National Informatics Centre, a Government agency and thus regulatory problems have been avoided. No other private operators have been permitted to operate any network in India. Both RABMN and NICNET are based upon the spread spectrum Multiple Access (SSMA). The VSATs employ the Code Division Multiplexing technique to encode the VSAT signals. The VSAT terminals operate at 1200 bits per second. The networks operate in the C-band on Transponders provided by the Indian National Satellite (INSAT).

The NICNET is an information network to interconnect all the districts in India to the hub station located at New Delhi. This is basically a government Information network. The networks presently covers about 550 locations and is expected to increase to over 3000 VSAT nodes. It

permits facilities like simple messaging using computer Terminals and is expected to be helpful to create a national database.
The RABMN has an initial capacity of about 1000 VSAT terminals. The users, can set up their own private networks by sharing the hub station.
The C-200 series VSATs used in the network can be put to a variety of users such as Access to X.25 network, simple messaging and remote telex operation through the hub.
The VSATs are manufactured in India through a Joint Venture Company Called ITI Equational Satcom Ltd, which is a joint venture between the India Telephone Industries (ITI), and CONTEL ASC (formerly Equatorial Communications Company, USA.)
While the VSAT networks in India undoubtedly serve an important business need of bank and commercial establishments in rural and remote areas, the choice of technology is an example of how technologies at the verge of obsolescence are sometimes selected by developing countries at high cost to the users. At a time when third generation VSATs with high speed data capability are readily available at low costs ranging from $ 5000-10000 per installation, the use of 1200 Bps terminals does not seem to be the best solution.

VSAT TECHNOLOGY-TODAY AND TOMORROW

The VSAT technology has today come a long way since the 1980's where low speed one way data services were made possible through C-band receive only VSATs based on spread spectrum modulation techniques. Such VSATs found ready applications by news services.
Two way, interactive system soon appeared first, in the C-band, and later in the KU-band (11-14 GHz) where higher speed services were possible. The advent of high powered satellite and improved technologies used in antennas, receivers and modems permit reliable operation of VSAT equipment at digital rates of 64 Kbps, 128 Kbps and above. This improved performance is available at steadily falling costs.
The network architectures available in today's VSAT networks are also more open in contrast to hardware defined fixed access modes and protocols in earlier versions. These permit users to have access to switched network architectures like X.25 which opens a vast range of applications for VSAT networks.
The VSAT networks operating beyond national boundaries using open systems Interconnect (OSI) conformance are indeed suitable for providing a host of applications ranging form switched data, Electronic Mail EDI file transfer and other services.
Continued developments in satellite technology, access techniques and VSAT terrestrial technology promise much superior performance in the days to come with a potential to open a host of new applications.
Speeds approaching primary rate (1.5 or 2.048 Mb) with 1.8M (or slightly larger antennas) are expected to be available. Spar Aerospace have already developed a terminal operating at T1 rates with 2.4 M antenna. The use of demand assigned TDMA techniques should make possible very high traffic capacities on the satellite.
The availability of advanced VSAT terminals at reasonable costs make possible the availability of voice, data, fax, telex and videoconferencing services over wide areas. This is the option that needs to be looked at for innovative and cost effective solutions.

FACTORS GOVERNING THE USE OF VSATS IN DEVELOPING COUNTRIES

A number of factors have turned favourable form increasing application of VSATs in the global scenario including the developing countries.
First of all, there is an increasing recognization that regulation should not come in the way of provision of essential telecommunications facilities for business development. Most countries are keen to create a favourable climate for investment and trade and easier licensing of VSAT networks is on the cards.
The European community Green paper on the regulation, provision and operation of satellite services in serving as an example to the developing countries.
Secondly the availability of a large number of regional and national satellite systems means that satellite capacity can be hired at very competitive rates, with possibility of multiple options to network operators.
Thirdly, the VSAT network costs are on a continuous decline. The costs of space segment are also declining with data compression and video overlay techniques. VSAT Terminal costs below $ 5000 mark and Hub station costs of below $ 100,000 mark are realizable depending upon the type of network.
Fourthly, VSAT networks are no longer being perceived as low bit rate devices capable of only stray applications like data gathering and not really suited for business applications like corporate networking and LAN interconnections.
The capabilities available in the VSAT networks today, which include high speed digital operation, permit a full spectrum of business applications ranging from videoconferencing, computer networking, Fax and voice networking. This coupled with the inherent capability of VSAT's to deliver the services without boundaries

make it the single most attractive alternative for rapid provision of basic and advanced communication services.

A VSAT SOLUTION FOR TRADE NETWORKS IN DEVELOPING ECONOMIES:

The use of value added services like Electronic Data Interchange and Computer-Computer communications have become indispensable for competitive and cost effective operations. Value added networks providing services to Trade and Industry have come up in developed and many developing countries to meet these requirements. Countries in Asia-Pacific, Europe and Africa wishing to remain at the forefront of international trade like Singapore Korea etc. have scrambled to form Trade networks to provide these services.(TRADENET, KT-NET)

These Trade networks need to serve the needs of the major players in industry and trade-manufacturers, cargo agents, transport carriers warehousing agents and port trusts etc. While setting up countrywide trade-nets may be a simple matter for small countries like Singapore, the same is not true for larger nations like India. The facilities needing to be linked via a trade-net could include the following:

Port Trusts
Airport Authorities
Trunk Terminals
Railways
Inland container Depots
Customs Agencies
Excise Central Taxation authorities
Cargo and customs agents
Insurance agencies

Many of these places are widely dispersed throughout the Indian Subcontinent and are generally serviced by inadequate telecommunication facilities.

At the same time, the Indian Business and exporters organisations are today in a strategic position to dramatically improve the exports and overseas trade of cost effective techniques can be implemented leading to strategic and competitive advantages. Most developing countries in Asia and Africa are in this stage where streamlining of procedures and the use of Information Technology can make all the difference between success and failure. All agencies including government agencies are fully aware of the urgent need of network for trade and keen to provide all support to make a trade network possible.

However the main bottleneck usually faced for realizing truly effective trade network is the lack of basic communications infrastructure at far flung locations. Low speed analog networks can not meet the requirements of the voluminous transactions expected to be handled daily on these networks. At the same time, it is unrealistic to expect the local telecom infrastructure to immediately provide high speed digital services.

A VSAT network is ideally suited to create a trade-network in such situations. VSAT terminals can be installed at all key locations such as Railway depots, Inland Container Depots (ICD's) Port, Customs agencies and Airports. The hub station can be integrated with a Centre providing value added services such as EDI. Such a network can be rapidly implemented at a much lower cost than traditional terrestrial alternatives. High quality digital services with high reliability can be provided to ensure optimum performance of the trade network.

VSAT TECHNOLOGY FOR TOURIST -NET

Another area which can potentially derive benefits from VSAT technology is the networking for the tourist, hotel and resorts industry. Countries like India abound in tourist places, wildlife reserves, forest resorts and other places on the tourist trail. Tourism is high on the priority list of most developing countries, yet most of these places located in far flung areas are not adequately served by even basic communications facilities such as hotel and flight reservations. For these reasons they are usually not on the preferred lists of foreign tourists. A low cost VSAT network linked to the worldwide Airline and Hotel reservation network (SITA) is an ideal alternative. The network can be a shared hub network with the resultant cost savings to its customer agencies.

VSAT NETWORK FOR BANKING AND FINANCIAL SECTOR:

There is no sector in the economy which stands to benefit so much from the infusion of Information Technology and networking as the Banking Sector. This sector, in India and perhaps in many other developing countries is characterized by thousands of branches in remote locations and rural areas. Post is primary medium of financial transactions. No countrywide service like ATM's can be introduced as the operations are manual. Even in cities, where computerization is making progress networking is by and large in a dismal state due to inadequate and timely availability of communication links. The problems of security in financial transactions further limit any significant use of the telecommunications networks.

Dedicated private VSAT networks operated for ATM's and interbranch funds transfer and management have the potential to

effect startling economics with the possibilities of recovering investments made within a short time. Such facilities can be installed rapidly where needed and would be fully under the control of the users providing a secure and reliable service.
The solution of networking ATM's in geographically diverse locations using VSATs has been recently implemented in Mexico by Banco Serfin. The Morelos Ku-band satellites were used with 64 Kbps data links to network more than 172 mainland branches and head offices. High economies could be achieved through the use of upto sixty VSAT stations on a single 64 Kbps bearer.

VSATS FOR ISDN SERVICES:

There is an urgent need to provide advanced digital services like high speed leased circuits and ISDN services to companies wishing to set up shop in a country. This is particularly true when firms with global connectivity wish to operate in far flung areas.
The investment required to set up ISDN exchanges in all regions of a country can be unacceptable, not to say of the time needed for such provisioning.
Setting up of hubs providing an ISDN switch and linking to remote sites via VASTs is however a more feasible alternative. Such a hub can link to the international network to provide global connectivity. Services available on ISDN such as G4 FAX, videophones, switched videoconferencing and value added services can be all provided in a flexible manner. VSAT technology has already been exploited for ISDN services. NTT in Japan is using VSATs to provide services to users located beyond the areas served by terrestrial ISDN infrastructure.
A flexible mix of advanced digital services such as "occasional use" leased circuits, file transfer facilities and computer networking can be bundled together to provide a working environment for business which is at par with the world.

VSAT NETWORKS FOR VIDEOCONFERENCING:

The Videoconferencing technology has undergone a dramatic change over the last few years. The application of high technology in codec has led to the realization of videoconferencing technology which can be used over speeds of 64 Kbps, 128 Kbps and 256 Kbps. These standards are gaining increasing acceptance for switched video services. The CCITT has standardized these services for international use in H.261 as Px 64 services for 64-2048 Kbps use.
VSAT networks constitute an ideal medium for providing videoconferencing services in remote areas not served by digital facilities.
The utility of such networks can be manifold, particularly in developing countries. Videoconferencing with one way video and two way audio can be used in interactive educational programs like the 'Class' program in India. The interactive facility makes it a much more attractive and effective medium of education.

INTEGRATED FAX GATEWAY AND MESSAGING FACILITIES:-

Fax is an ideal medium for messaging in multilingual countries like India. Telegrams cannot handle these messaging requirements particularly where messages are delivered in diverse regions.
The use of Telephone networks is however expansive for Fax. The quality of analog telephone line available in various remote regions of a country does not also permit effective use of fax technology. The use of hubs acting as fax gateways can provide an elegant and cost effective solution. An implementation of such a facility e.g at all distinct centres can serve as important communications need serving both rural and urban communities.

CURRENT DEVELOPMENTS IN VSAT TECHNOLOGY

The third generation VSAT technology available today provides high speed interactive data and voice communications and is capable of supporting applications such as distributed computer networks, mobile data communications, video conferencing, LAN - interconnections and electronic messaging (X.400) and Electronic Data Interchange (EDI).
Rapid developments continue at breathtaking pace to bring forth the fourth generation technologies expected to revolutionize the VSAT scene once again. Ultra Small Aperture Terminals (USATs) are expected to be available in the near future, their operation being made possible by more powerful satellites and advances in component technology. The gain and directivity requirements placed on terminals are rapidly diminishing such that advanced antenna design techniques such as phased array can provide better alternatives. The availability of such terminals, in fact, is expected to lead to a seamless bridging of mobile & fixed network technologies & terminals.

OPEN NETWORK MANAGEMENT

The vast increase in the number of terminals as well as networks usually operating across national boundaries in a multivendor environment means the need for the availability of totally open networks management systems. The increased availability of such technology would mean that all components even in the fail circuits could be modified and configured by the network management facility.

SOFTWARE DEFINED VSAT NETWORKS

The high rate of technical obsolescence has brought forth the need of more flexible software architectures. Infact, the trend is towards totally software defined networks where the remote site software is also downloaded from the hub. This permits entire network operating configuration to be altered at will. Networks can thus transform and evolve continuously without disrupting operations, through a regular upgrade of software from a central or remote site.
Direct communication between remote VSATs obviating the need for central hubs are also emerging. This together with appropriate regulatory provisions to allow interconnection of VSAT systems to public networks would revolutionize the range of applications supported & force a transformation of network technologies.
Ultimately, the seamless integration of mixed satellite, terrestrial, cellular and satellite mobile services is definitely on the cards, thus providing total communication solutions to users.

VSAT TECHNOLOGY AT CROSSROADS:

A number of parallel developments in the field of telecommunications have brought forth alternative solutions in areas once considered exclusive domain of technologies such as VSATs. Remote Area and thin route fixed, satellite applications conventionally served by fixed VSAT terminals can equally well be served by mobile satellite terminals.
Mobile Satellite Technologies initially introduced for Maritime mobile (e.g. Inmarsat-A) have evolved rapidly to the stage where medium speed data services can be provided by mobile terminals smaller than a conventional VSAT. The satellite mobile technology developed is specifically suited for marketing the needs of a vary large number of mobile terminals operating at low radiated powers and using services such as fax, data & text messaging. the Inmarsat-M is an example of this technology. Many applications, implementated a couple of years back using VSATs can today be equally well implemented using Inmarsat standard-C terminals, with the possibility of saving costs associated with implementing a private VSAT network.
The "niche" areas for VSATs have thus shifted away from low traffic low bit rate applications towards high traffic high bandwidth applications (usually in the Ku band) where they appear to rule supreme. However, this too may not last for ever.

THE GRAVE YARDS OF TECHNOLOGY: LESSONS FOR DEVELOPING COUNTRIES

How does a VSAT user feel if he gets an offer for a last option on VSAT terminals introduced by him a couple of years back, as the manufacturer decides to globally cease production the terminal due to technological obsolescence ? And yet, such incidences are becoming increasingly common. It is happening today, to the user of C-100 and C-200 terminals, such as those used in India.
The rapid advances on the forefronts of technology are leaving behind a graveyard of technologies rendered obsolete without attaining their prime. The users, particularly in developing countries need to look at alternatives solutions and technologies which have a potential to be altered and adapted with ease.
Technologies which are based on open standards, rather than proprietary are best adapted to survive technological change.
Yet, it must be said that the real challenges which developing countries face are not only due to technological issues but also managerial issues. A clear sense of direction and approach which is essential in this era of rapid changes is usually lacking. The usual approach is to go on implementing the aged plans for telecoms expansion while seeming totally ignore the global developments in the field. However, such an approach together with stifling deregulation only serves to enlarge the graveyards of technology. It is imperative that the developing countries break this vicious circle and look at the most innovative solutions available for implementing an application.

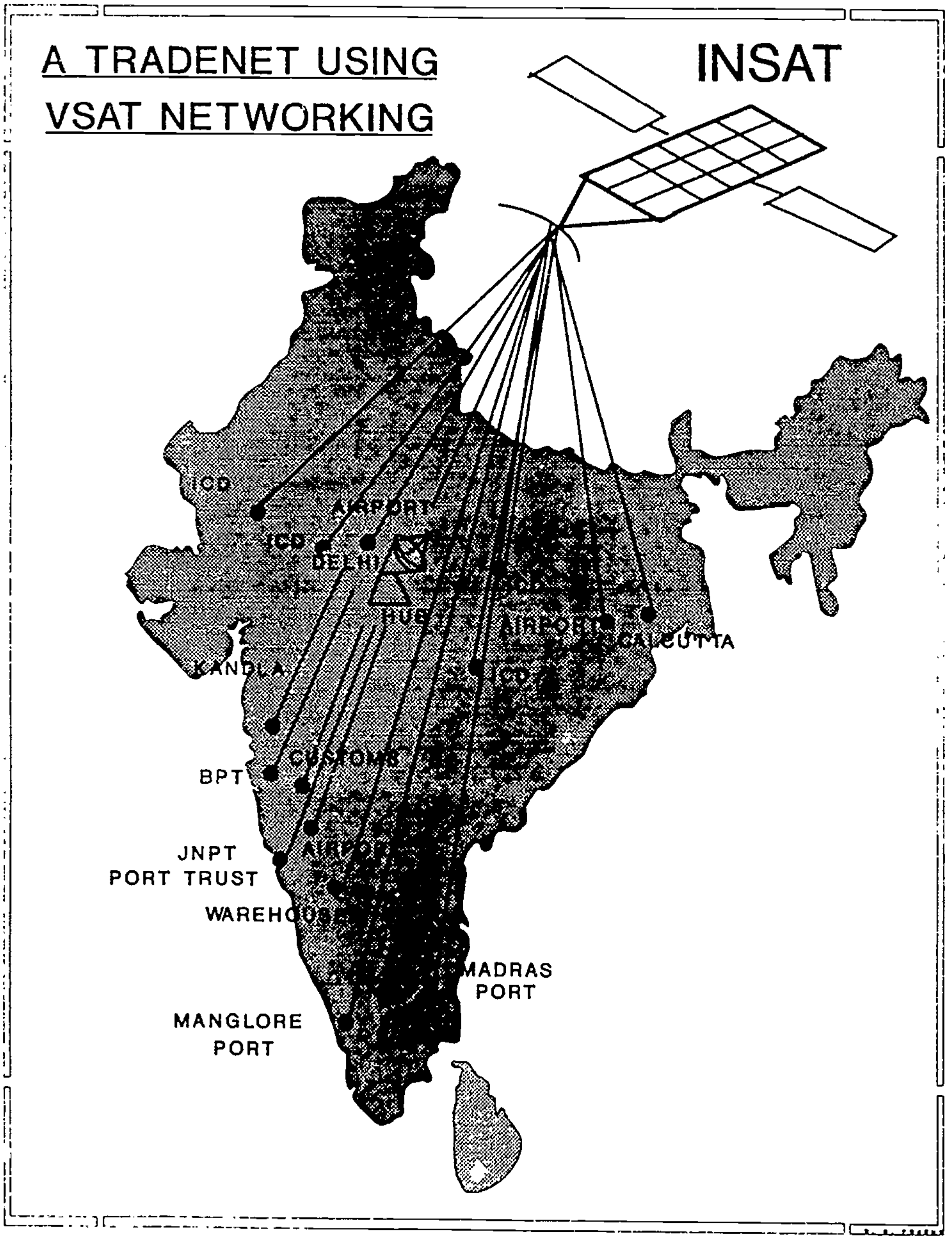
WHAT DO THE STARS FORETELL?

It is not wise to indulge in crystal gazing particularly in the field of telecommunications, where the new developments seem to consistently go beyond the wildest imaginations of the prophets of the future.
It is for example difficult to imagine, what would be the relevance of VSATs in era of globally mobile personal communications such as Iridium and Inmarsat Project 21. The availability of LEOs (Low Earth Orbit Satellites), means that the mobile terminals need to operate

at much lower powers. A small handhled terminal with a phased array antenna would than be able to provide all the capabilities of a VSAT and more. These "Personally Mobile VSATs" would then meet the needs of information of the individual in the information age.
The merger of the fixed and mobile satellite technologies thus continues to gain momentum and promises to bring forth an era of unhindered information exchange.

CONCLUSION :-

VSAT is a technology whose potential has been scarcely recognized in providing cost effective & flexible advanced communication services. Even in advanced countries of Europe, barely the tip of the proverbial iceberg has been unveiled. The prime reason for slow realization of the benefits of this technology have been self imposed regulations - regulations which have served the interests of no-one.
It is time that the unique advantages of VSAT networks are recognized and the curtain of restrictions lifted to realize a new communications dream.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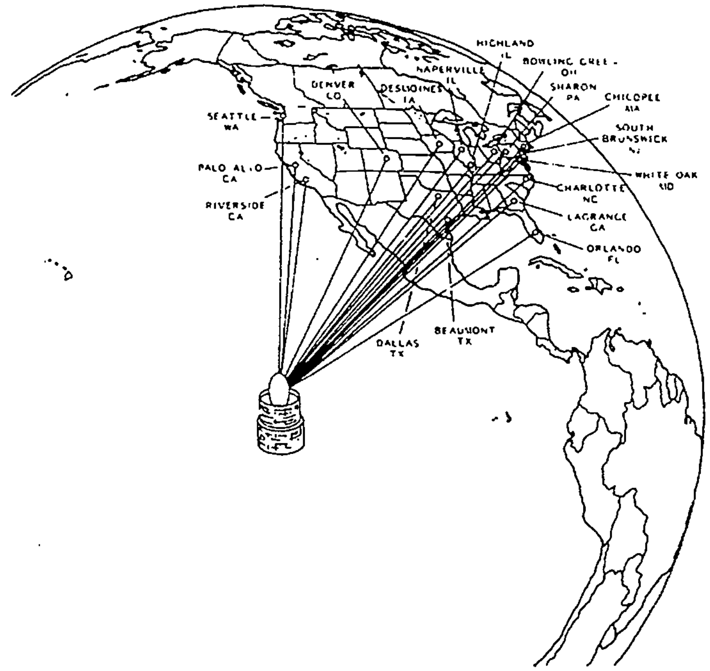
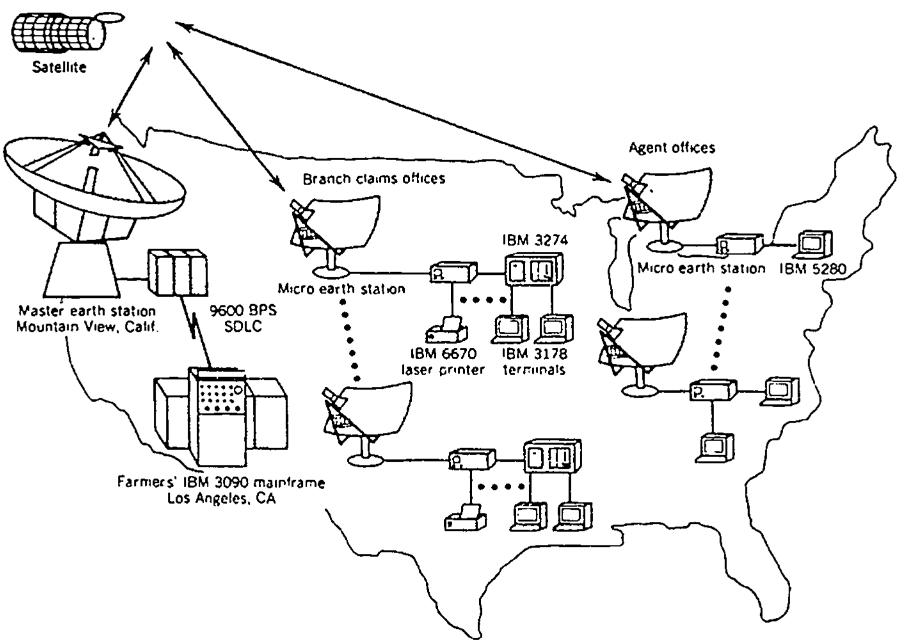


DOW JONES SATELLITE NETWORK

COURTESY BUSINESS EARTH STATIONS FOR TELECOMMUNICATIONS, MORGAN & ROUFFET



U. S. FARMERS INSURANCE GROUP NETWORK

COURTESY BUSINESS EARTH STATIONS FOR TELECOMMUNICATIONS, MORGAN & ROUFFET

VSATs - An Efficient Option for Voice and Data Networking

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ABSTRACT

With over 5,000 VSATs installed and ordered to date, the Pacific Rim is one of the most rapidly growing markets for VSATs today. This rapid growth has been spurred by the dramatic growth in demand for telecommunications services in the region - both basic infrastructure services and sophisticated data networking services. VSATs provide an excellent solution for this need, offering the capability to rapidly deploy cost effective voice and data networking capabilities to regions in cities as well as remote rural areas.

VSATs have traditionally been viewed as a high quality data communications alternative. Over the past few years, however, technology advances have led to an expansion of the VSAT market, enabling VSAT networks to serve an array of new applications. VSATs are enabling businesses to effectively operate in regions where it previously was difficult to obtain reliable, high quality telephone service. And they are enabling the extension of basic telephone service to regions without an established telephony infrastructure. The data applications supported by VSATs are also dramatically expanding. VSATs are now supporting data applications ranging from high data rate LAN interconnection and image transmission to lower data rate point-of-sale and supervisory control and data acquisition (SCADA) applications.

VSATs - An Efficient Option For Voice and Data Networking

Nearly 100,000 VSATs (very small aperture terminals) are being deployed throughout the world, supporting a wide variety of applications including public telephony services, information services (e.g., broadcasting of news), and retail and branch banking communications. Over 5,000 of these VSATs are being installed throughout the Pacific Rim (Figure 1), including over 500 in Australia, over 600 in Indonesia, over 800 in China, and over 300 in the Philippines. Additional VSATs are being deployed in Japan, Thailand, Taiwan, and Korea — organizations within virtually every country are implementing satellite networks to obtain an efficient solution for voice and data networking.

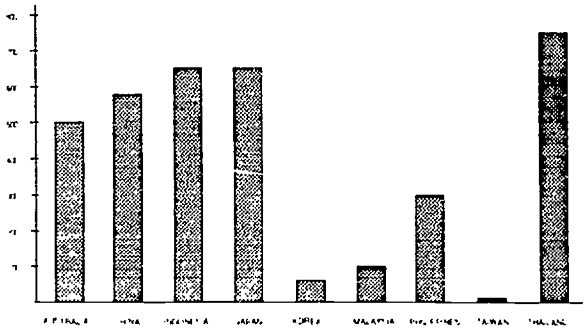

FIGURE 1. VSATs IN THE ASIA-PACIFIC REGION

The rapid growth of the Pacific telecommunications market is evident in the dramatic increase in demand for satellite equipment and services within the region. The strong increase in business activity within the region, complemented by the liberalization of the telecommunications infrastructure in many countries, has made available service alternatives that extend telecommunications beyond the economic feasibility of current terrestrial infrastructures. Progressive rural telephony programs being implemented by many governments are expanding the need for basic telephone service to those remote, hard to reach areas that are well served by satellite technology.

The latest technological advances have resulted in a series of VSAT product alternatives, some optimized for data networking applications and others enabling the expansion of voice networks into areas lacking a basic telecommunications infrastructure.

This paper provides a view into the VSAT market, including a description of some representative network services available within the Asia-Pacific region today. An introduction to VSATs is provided for those unfamiliar with the technology or the recent advances that have expanded the potential markets for VSAT networks.

Why are VSATs the Technology of Choice for Many Organizations?

VSAT networks provide users with a number of strategic advantages, including an average availability of 99.5 percent and ease of rapid deployment in remote or hard-to-reach areas. In addition, with a VSAT network, organization have control over and insight into their entire network from a single point, an especially important feature for an organization with a number of remote locations distributed over a large area.

VSATs are typically used by organizations that require data or voice communications between sites distributed over a wide geographical area, making terrestrial links expensive to set up. While terrestrial links are economical over short distances (e.g., within a city), their cost climbs quickly as the distance between locations increases.

VSAT networks are also often used in those areas where telephone links are overloaded, unreliable, or difficult to obtain. While terrestrial data and voice links are often readily available in large, metropolitan cities, in smaller urban and remote rural areas these links are often difficult, if not impossible, to obtain.

VSAT Network Topologies

There are two types of VSAT networks, mesh and star. Star networks (Figure 2) are used for point-to-multipoint communications such as communications between a bank headquarters and its remote branch offices. These networks have a larger hub station located at the user's data center or headquarters to enable communications into small, inexpensive VSATs located at remote branch offices. Star networks are most often installed to support corporate data communications requirements and also support interactive voice and broadcast video services where regulations permit.

With mesh VSATs the sites communicate directly with each other as opposed to going through a central hub location (Figure 3). Mesh VSATs are most often used for voice traffic, although they also carry data and broadcast video. These are particularly attractive in regions with an underdeveloped telecommunications infrastructure where it is often difficult, if not impossible, to obtain links for voice or facsimile service. Mesh network applications include:

- Private voice networks, connecting a number of private branch exchanges (PBXs)
- Public network extension, to extend public networks into rural areas
- Long-haul connectivity among switching sites of cellular telephone base stations
- Emergency communications/disaster recovery

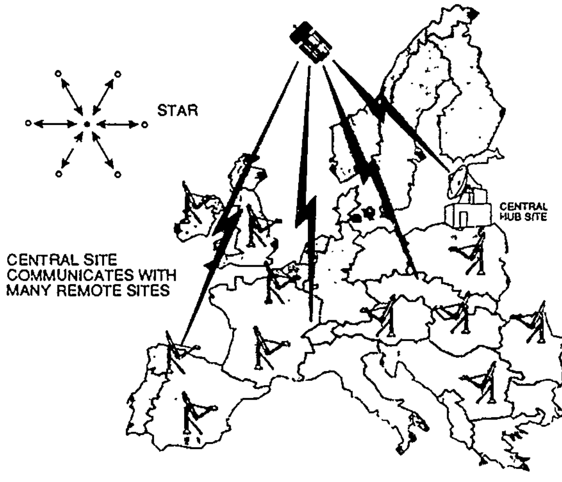

FIGURE 2. STAR NETWORK

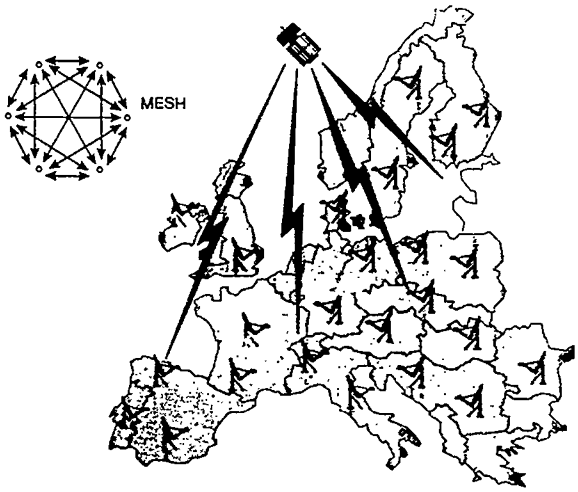

FIGURE 3. MESH NETWORK

Star Networks

Star networks consist of three primary components (Figure 4):

1) Hub Earth Station - In areas where regulations allow private network ownership and the user has elected to manage his or her own network, the hub is located at the user's headquarters or data center location. In many cases, however, users elect to utilize a VSAT network as a service, sharing a hub owned by a service provider with other users to minimize the larger capital cost of the hub and to alleviate responsibility of managing the network. The hub provides the interface-to-user host equipment and has a larger antenna (typically between 6 and 9 meters in diameter) that enables communications with the smaller, remote VSATs.

2) Remote VSATs - A small remote VSAT is located at each remote network location to provide the interface-to-user data and voice communications equipment, transmit information to the hub station, and receive information transmitted from the hub station. These remote VSATs interface to a wide variety of user communications equipment, including LANs (local area networks), minicomputers, terminal controllers, and PBXs. This equipment also interfaces to equipment using a wide variety of disparate communications protocols, including X.25, SDLC, Token-Ring, and Ethernet®[1]. The remote VSATs typically have antennas ranging between 1.0 and 2.4 meters in diameter.

3) Network Management - The network is managed by the user if the user owns its own hub facility and by its service provider if the user receives the network as a shared hub service. In either case, the network can be managed entirely from a central location. Shared hub customers are often provided with a network management terminal to enable them to monitor and control their own locations via terminals located at their headquarters or at a remote location.

Satellite capacity is provided by the satellite providing the best coverage of the region - AsiaSat, Palapa, and AUSSAT are all carrying VSAT traffic. The network is asymmetrical, with a large outbound link supporting information transmitted from the hub location to the remotes and a number of small inbound links supporting information transmitted from remote stations to the central hub. The outbound link is shared via time division multiplexing (TDM). Information from host computers attached to the hub is transmitted to remotes as it is received by the hub. Each remote station "reads" only that data addressed to it and passes the data on to the attached user equipment.

Inbound links are also shared by a number of remote locations. The number of remotes on an inbound link is allocated by the network operator and is dependent upon the level of traffic transmitted by the user computer. The network operator can also reallocate capacity from the central network management console as changes require (e.g., addition of sites, changes in applications, or traffic levels at a site). Remotes access capacity on these inbound links upon demand (i.e., as they have data or voice traffic to send) and release this capacity for use by other locations after their transmission is complete, enabling efficient use of satellite capacity.

Mesh Networks

Mesh networks consist of two primary components, the remote VSATs and a network management center (Figure 5).

The primary difference between various mesh network architectures is the efficiency with which the satellite capacity is used. Some networks are based upon preassignment of satellite capacity whereby capacity is preassigned and dedicated to different sites in the network. These preassigned networks are cost-effective and simple to operate where there are less than four or five sites with high traffic volumes per location. For example, mesh networks using preassignment are often used for trunking applications where traffic from a number of locations or users has already been consolidated for long-haul transmission.

In recent years, mesh networks using demand assigned techniques have been developed to provide thin route connectivity. These mesh networks efficiently support networks with many locations having a low to medium level of traffic per remote as they make use of the fact that no site uses capacity 100 percent of the time. When a site does not need capacity (e.g., when the site is not involved in a call), the capacity is released for use by other locations. Remote locations are outfitted with antennas and power amplifiers that vary in size, depending upon the traffic (e.g., number of channels) that must be supported at the remote. The vast majority of sites are served with 1.8- or 2.4-meter antennas.

In addition to demand assignment, these new mesh networks often incorporate the following techniques to increase efficiency:

> Voice activation - Capacity is used only when a conversation is actually in process; it is released for use by other locations when there are pauses during speech.
>
> Voice compression - Voice is transmitted at rates as low as 9.6 kbps, minimizing the capacity required for each circuit.

A centralized network management system is used to provide full control of the network, allocating capacity when it receives call requests from remote locations, and coordinating frequency/capacity assignments between remote locations. The network management system also provides a centralized point for collecting statistics and billing information and to perform remote software downloads.

Some VSAT Users

VSATs are being used throughout the Pacific Rim by a wide variety of industries for a diverse group of applications, a few of which are profiled below.

The Salim Group

HNS Personal Earth Station™ (PES™) VSATs are being used by the Salim Group for communications between bank branches and the Salim Group headquarters location, enabling online, interactive banking transactions (Figure 6). This network is providing high quality data communications for Bank Central Asia, a subsidiary of the Salim Group, throughout Indonesia. Bank Central Asia can now provide the identical high quality data (including E-mail) and voice

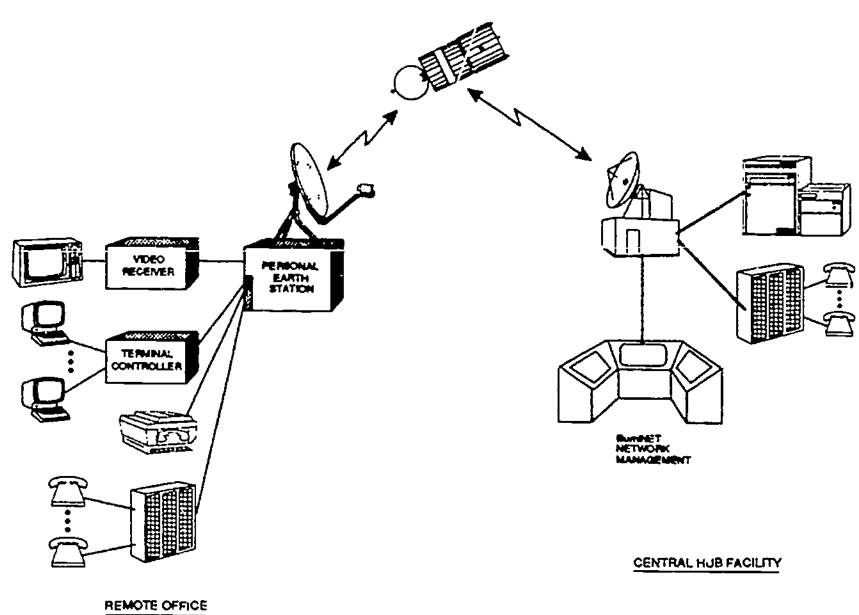

FIGURE 4. STAR NETWORK ARCHITECTURE

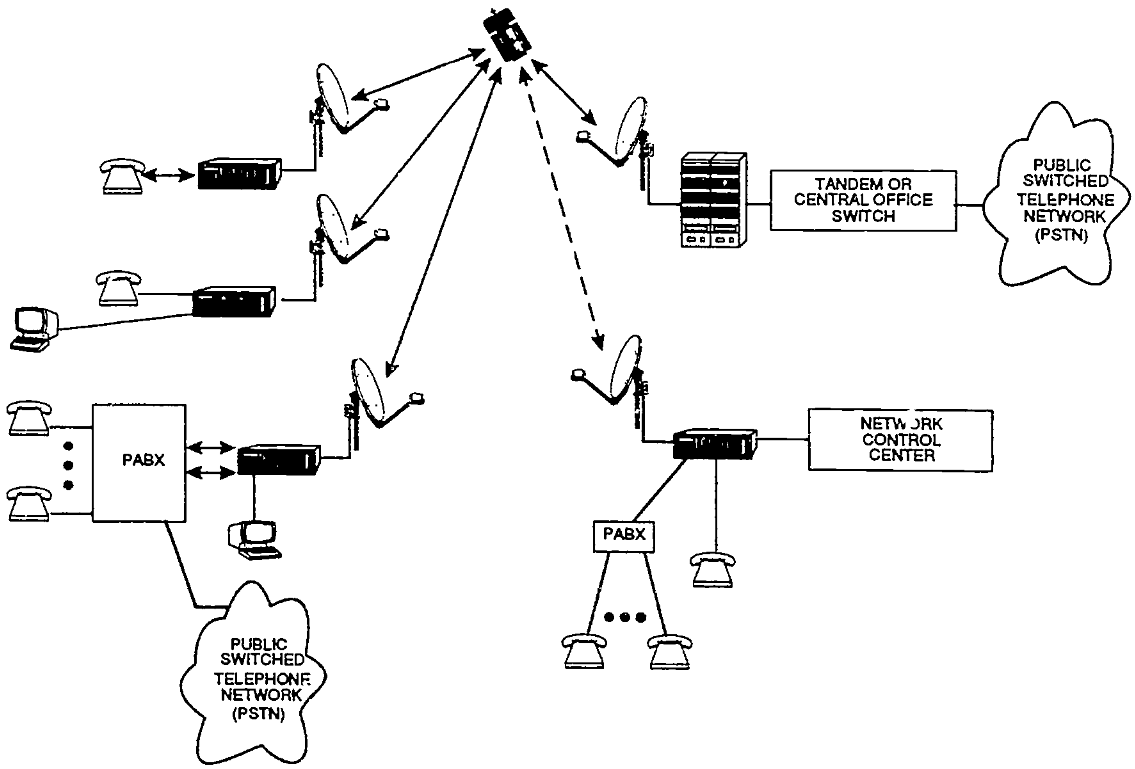

FIGURE 5. MESH NETWORK ARCHITECTURE

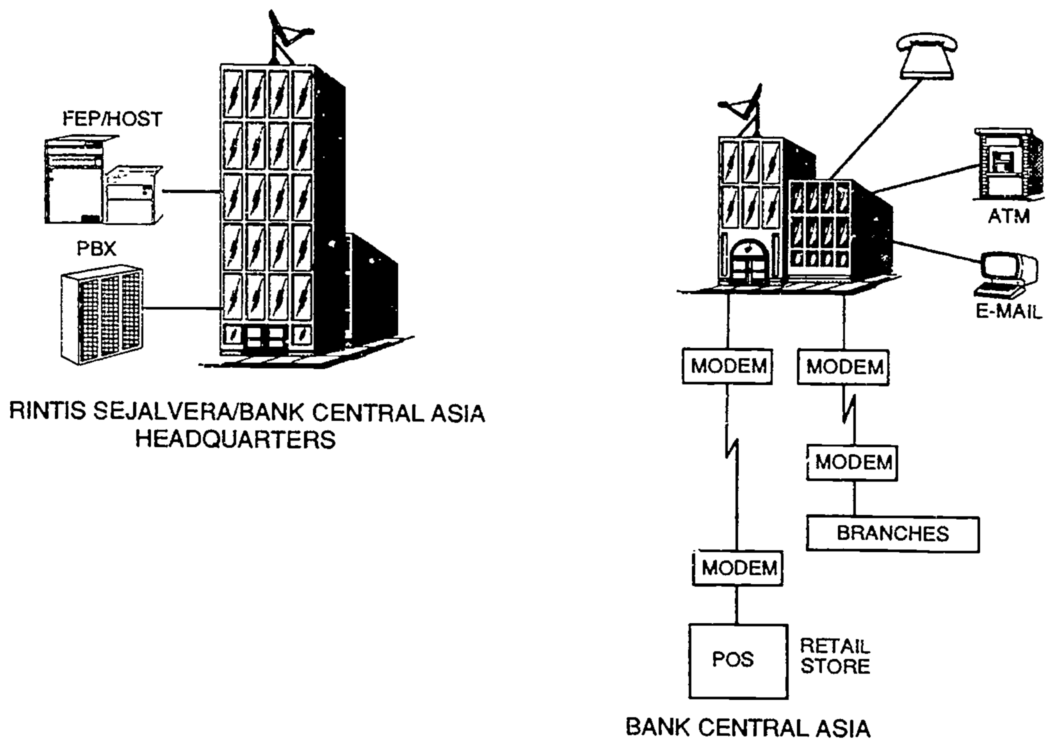

FIGURE 6. THE SALIM GROUP/BANK CENTRAL ASIA

services to 250 branches, independent of location. In addition to carrying traffic related to banking applications, the network also supports credit verification for local retailers. The retailers dial the nearest bank branch, and the credit information is transferred over the VSAT network for verification.

Bank Central Asia is also using HNS' Telephony Earth Station (TES™) to obtain full-mesh voice services among nearly 40 regional bank offices. The resulting hybrid network allows full-mesh voice and data services between all regional bank offices, and interactive data and voice services among remote bank branches, headquarters, and the regional offices.

Globe-MacKay - Data and Telephony Services

Globe-MacKay is providing telecommunications services for a wide variety of organizations within the Philippines. The hub is at Globe-MacKay's facility located in Manila and may be linked to customer data centers (or headquarters locations) via terrestrial leased lines, satellite, or microwave facilities (Figure 7). The network uses HNS' Personal Earth Station VSATs located at customer branch offices, warehouses, and other remote facilities to provide communications with the hub location.

Globe-MacKay currently has over 100 VSATs installed for applications including banking, government services, and disaster recovery. In fact, when Mount Pinatubo erupted on June 9th, several of HNS' VSATs were pressed into service to aid government relief efforts for local inhabitants and businesses. The terminals were used to transmit seismic data to geologists and to relay information used for processing the relief claims of those left homeless. The network also supported voice calls during the crisis.

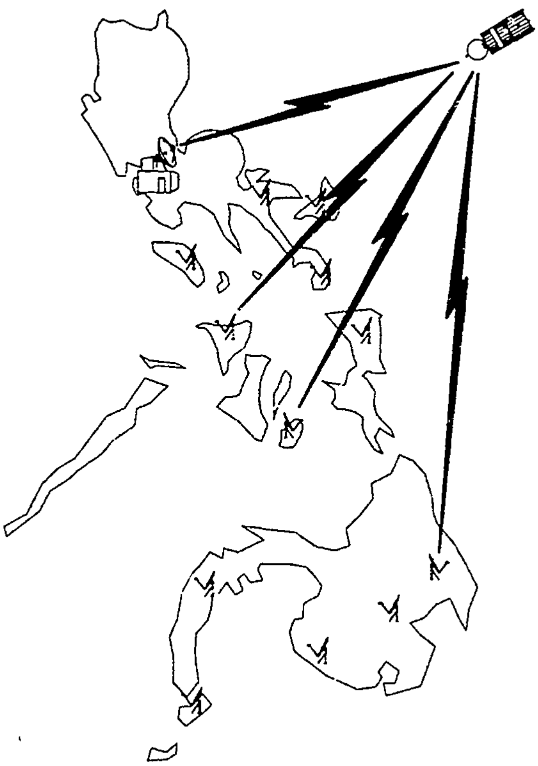

FIGURE 7. GLOBE-MACKAY VSAT NETWORK

Acumen

Acumen, located in Bangkok, Thailand, uses an HNS Personal Earth Station VSAT network to offer data communications services throughout Thailand. Targeting applications, including banking and government telecommunications, Acumen is deploying 180 PES VSATs to provide data services for its customers. Acumen also uses an HNS Telephony Earth Station VSAT network to support telephony services throughout Thailand. The TES network, which uses capacity from the Palapa B2 satellite, currently consists of 70 remote locations with 170 voice channels.

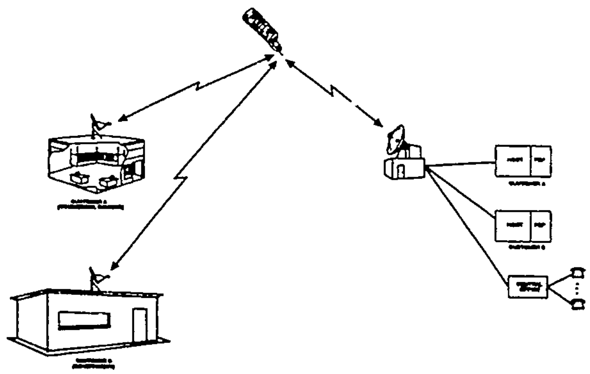

FIGURE 8. ACUMEN NETWORK SERVICES

People's Daily

People's Daily, headquartered in Beijing, uses its PES network to communicate with over 30 regional printing offices throughout the Republic of China. The network supports the printing of newspapers in remote regional printing centers, from which they are distributed to subscribers throughout the local area. People's Daily also offers printing services for other publishing organizations. Soon, a number of other organizations will be linked to People's Daily's network to enable localized printing of their publications. The People's Daily network also supports interactive voice as well as broadcast video communications.

The network also supports a return link from the printing offices to People's Daily, which indicates the status of the transfer. If a file transfer is unsuccessful, People's Daily will be notified to resend the document, and the region's news will still be delivered. In a country where telephone connections are not always available, this guaranteed file delivery capability ensures that the company will be notified if the news is not properly transferred.

The return link from the printing offices to People's Daily's headquarters will soon be carrying regional news from each region to People's Daily, assisting the organization with coverage of local interest stories within China.

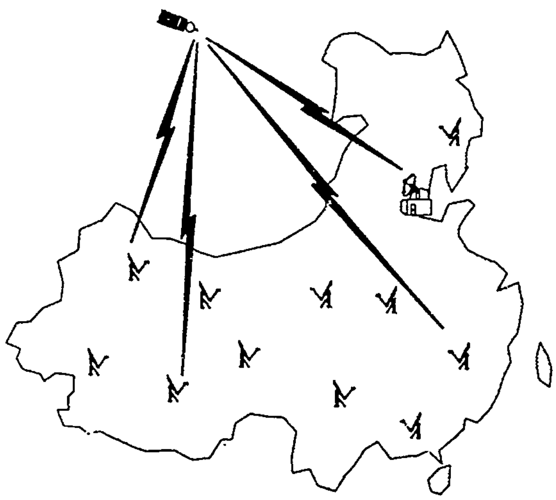

FIGURE 9. PEOPLE'S DAILY NETWORK

Conclusion

VSAT networks are assisting users in obtaining high quality, highly available communications links for network sites - especially in those locations without established telecommunications infrastructures. Even in locations with established network services, high quality VSAT links can be provided for costs below those of te. estrial networks, especially if the need is for higher rate links over large geographic areas. With the further deregulation of telecommunications markets, continued rapid growth of the business infrastructure, and continuing government investments in rural communications programs, VSAT networks will increasingly be deployed throughout the Pacific Rim.

[1] Ethernet is a registered trademark of Xerox Corporation.

VSAT in Local Administration Communication Network

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1. ABSTRACT

The Japanese market for Very Small Aperture Terminals (VSAT) is gradually expanding after the infrastructure for satellite communications was established by the launches of JASAT-1 and -2 in 1989.
This report introduces the nationwide satellite communications system for local administration and disaster prevention and outlines the technical features of the multi-media VSATs.

2. INTRODUCTION

In December, 1991, the Administrative and Anti-Disaster Satellite Communications System using VSATs was phased in under the guidance of the Japanese Government. This system will be implemented in phases under the independent responsibility of each Prefecture. 7 Prefectures have put about 400 VSATs into operation by the end of 1992. The VSAT network will link about 5000 terminals nationwide in 10 years. The major goals of this network are to:

(1) Construct multi-media administrative communications network

(2) Strengthen anti-disaster communications network

(3) Refresh local ares with information exchange

That is, this is a multi-purpose network used not only for general administration but also for collecting information from local areas by linking up systematically with existing anti-disaster administration radio networks.

3. NETWORK CONFIGURATION

3.1 Configuration of Network

Satellite - based Local Administration Communication Network is composed of Satellite, Central Control Station, Prefectural Office Station that roles Hub station for this VSAT system, and many VSATs. Figure 3.1 shows the configuration of the satellite communication network. The main roles and functions are as follows:

a. Satellite

- Ku-band Satellite : Superbird-B
- Transponder : 2 for communication
  1 for TV

b. Central Control Station

Located in Yamaguchi for main and in Hokkaido for sub.

- System Management
- DAMA Control
- Charging

c. Prefectural Office Station

Main station of a municipality located in the administrative center of each Prefecture.

- Network management
- Centralized function for VSAT network
- OMC
- Anti-disaster control
  - Broad casting (Voice and Facsimile)
  - Hot-line
  - Controlled Assignment
  - Re-routing
  - Cut -off
- Analogue/Digital TV Transmission

d. VSAT

Each VSAT has typical functions of
- Broad casting channel
- Voice/Facsimile channel
- Packet Data channel
- Analogue TV reception

In addition, mobile stations are provided to relay events, etc.

3.2 Size and Capacity of Earth Station

Table 3.1 shows the Size and capability of each earth station in one prefecture. In this case, Prefectural Office roles as Hub station. Dam, City, Town, Village and Fire depart-ment station are treated as VSAT.

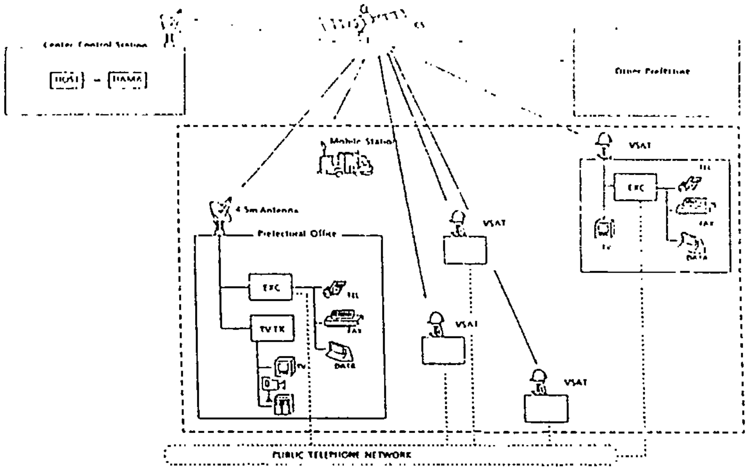

Fig. 3.1 Configuration of the satellite communication network

Table 3.1 Size and Capacity of Earth Station

Station	Number of stations	Transmission capacity						Analog TV	Antenna	PA output
		Voice/fax/still picture/data	Packet data		Digital TV (384 kbps)	Broadcasting (32 kbps)				
			32 kbps	128 kbps						
Prefectural office	1	19	4 (R)	1 (T)	1 (TR)	2		1 (TR)	4.5mφ	125W + 125W
Branch Office	9	11	1 (T)	1 (R)	1 (R)	1		1 (R)	2.4mφ	15W
Dam management station	10	2	1 (T)	1 (R)	-	1		1 (R)	1.8mφ	4W
City station	9	2	1 (T)	1 (R)	-	1		1 (R)	1.8mφ	4W
Town station	19	1	1 (T)	1 (R)	-	1		1 (R)	1.8mφ	2W
Village station	8	1	1 (T)	1 (R)	-	1		1 (R)	1.8mφ	2W
Fire department station	22	1	1 (T)	1 (R)	-	1		1 (R)	1.8mφ	2W
Satellite mobile station	1	1	-	-	1 (T)	1		1 (TR)	1.4mφ	125W

3.3 Services and Quality

The features of this network are multi-media communication in daily base which can handle various customers request and broadcasting/controlled communication facilities in disaster or emergency.

Table 3.2 shows the design target for this network.

Main services are as follows;

1) Voice services

- Operated in SCPC -DAMA (Mesh - system)
- High-quality 32kbps ADPCM with FEC
- Hot line in pre-assigned
- Facsimile (G-3)
- Data up to 9.6kbps

2) Packet data services

- Star configuration, Prefectural Office as Hub station.
- Out bound (Hub→VSAT) 128kbps ×1 TDM
  Inbound (VSAT→Hub) 32kbps×4 Slotted ALOHA

3) Broadcasting Services (Voice and Facsimile)

- 1CH pre-assigned for government to prefectural office.
- 1CH pre-assigned for prefectural office to VSATs.
- Verification for receipt
- Whole party or Group calling
- Asking to prefectural office when VSAT want to do.
- Voice/Facsimile storage equipment.

4) Analogue TV Services

- Half-or Full-transponder
- FM transmission
- NTSC/PCM Audio (Japanese BS Standard)
- Descrambler/Tuner equipped in each VSAT
- TV sent from prefectural office station or mobile station.

5) Digital Video Services

- Transmission speed 384kbps
- Video sent from prefectural office station or mobile station.

6) Facsimile mail services

- Store and broadcast to specified stations
- CCITT G3 standard.

7) Still-picture transmission services

- Uses voice channel

8) Video conferencing services

- Transmission speed 64kbps or 384kbps.

Table 3.2 Design Target

Service	Target Value
Voice / FAX	BER . 10^{-5} or less at Eb / No = 5 dB
Packet data	Same as above
Analog TV	S/N of full transponder: 45 dB or more S/N of half transponder: 42 dB or more
Availability Voice / FAX Packet data Analogue TV	 99.95% per year or wore 99.90% per year or wore 99.90% per year or wore

Table 4.2 Technical Data on Analog TV Tra emission

Item		TV transmission system	
		Full transponder transmission	Half transponder transmission
Occupied bandwidth	(MHz)	30 0	17 5
Equivalent noise bandwidth	(MHz)	30 0	15 75
Maximum modulation frequency	(MHz)	4 5	4 5
Maximum frequency deviation	(MHzp-p)	21 5	13 5
Over deviation	(dB)	0	6 0
FM improvement factor	(dB)	23 4	16 7
Emphasis factor	(dB) *	3 0	3 0
Weighting factor	(dB) **	11 2	11 2
S/N to C/N conversion factor	(dB)	37 6	30 9
Dispersal	(MHzp-p)	3 0	1 0

* Emphasis characteristic according to CCIR Rec 405, Curve A.
** Weighting factor according to CCIR Rec 637-3

4. SATELLITE LINK BUDGET

This network is required to be high reliability and high availability from that purpose. In other hand VSATs are expected as small as possible from the economic reason.
The satellite link is designed considering the most of traffic in this network is generated between Prefectural Office and VSAT.

Table 4.1 lists the technical data on Super bird - B satellite used in link calculation.

Table 4.2 lists the link calculation between VSAT and VSAT (worst case) for digital circuit.

Table 4.3 lists the technical parameters for Analog TV transmission.

Figure 4.1 shows the satellite coverage.

Table 4 3 Link Calculation (VSAT→VSAT , 32kbps)

	Description	Unit	Clear Sky	Uplink Rain	Downlink Rain
Uplink	VSAT EIRP	dBW	39 8	40.9	39 8
	Antenna pointing Error	dB	0 3		
	Free Space Loss	dB	207 0		
	Absorption Loss	dB	0 1		
	Rain Attenuation	dB	--	6 4	—
	Satellite Antenna Gain	dBi	39 9		
	Satellite Receiving Power	dBW	-127 7	-133 0	-127 7
	System Noise Power	dBW	-153 0		
	Uplink C/N	dB	25 3	20 1	25 3
Downlink	Satellite EIRP	dBW	19 6	14.3	19 6
	Output Back off	dB	-33 6	-38 9	-33 6
	Free Space Loss	dB	205 9		
	Absorption Loss	dB	0 1		
	Rain Attenuation	dB	—	—	6 8
	Noise Degradation by Rain	dB	—	—	2 7
	Antenna Pointing Error	dB	0 2		
	VSAT Antenna Gain	dBi	44 8		
	VSAT Receiving Power	dBW	-141 8	-147 1	151 3
	System Noise Power	dBW	-158 2		
	Downlink C/N	dB	16 4	11 1	5 9
Total	Satellite C/IM	dB	18 0	12 7	18 0
	Total C/N + IM	dB	13 8	8 5	6 5
	Total C/I	dB	14 7	9 4	14 7
	Total C/N + IM + I	dB	11 2	5.9	5 9
	Required C/N + IM + I	dB	5 9		
	Threshold Margin	dB	5 3	0 0	0 0

Table 4 1 Technical Data on Satellite

Frequency band	Ku band 14.0-14.5GHz / 12 25 -12 75GHz
Polarization	Horizontal (Uplink) Vertical (Downlink)
EIRP / G/T / SFD	Refer to Fig2.2
Input/output backoff	Digital circuit TIBO 8 4 dB TOBO 5 0 dB Analog TV circuit TIBO 5 3 dB TOBO 2 0 dB
Carrier-to-intermodulation noise ratio (C/IM)	Digital circuit 18 0 dB Analog TV circuit [illegible]
Noise allocation	Digital circuit Thermal noise and intermodulation noise 55% Others 45% Analog TV Thermal noise and intermodulation noise 70% Others 30%

TIOB Total Input Backoff TOBO Total Output Backoff

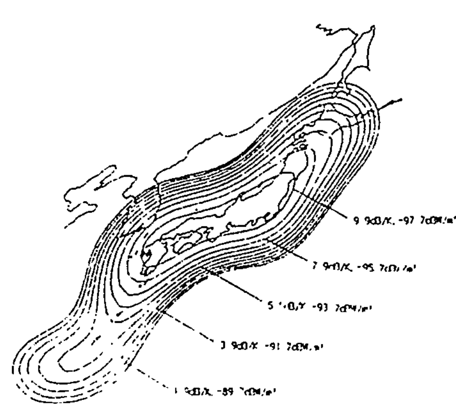

Fig 4 1 Ku Band G/T and SFD(at maximum gain) Contour(Vertically Polarized Wave)

5. COMMUNICATION FACILITIES

5.1 VSAT

Figure 5.1 shows photograph of typical VSAT and Figure 5.2 shows the simplified electrical blockdiagram.
Specifications for VSAT are as follows:

a. ODU (Out Door Unit)

- Antenna — 1.8mφ offset
- Antenna gain
  - Transmitting — 48.6 dBi or more
  - Receiving — 47.7 dBi or more
- Cross polarization discrimination — 32 dB or more
- Frequency range
  - Transmitting — 14.00 - 14.50 GHz
  - Receiving — 12.25 - 12.75 GHz
- Transmission frequency stability — Within ±1 kHz/year
- SSPA — 4W (nominal)
- Receiver's equivalent noise temperature — Lower than 180 deg.K at +25 deg.C
- IF frequency — TX 140 MHz +/- 36 MHz, RX 950 ~ 1450 MHz

b. IDU (In Door Unit)

- IF freuency — TX 140 MHz +/-36 MHz, RX 950 ~ 1450 MHz
- Modulation — Absolute 4-phase modulation (QPSK)
- Modulation speed — 35k symbols/sec.
- Demodulation — Synchronous detection
- Carrier spacing — 50 kHz
- Error correction — Convolutional code
  - Coding rate — 1/2
  - Constraint L — 7
- Error correction decoding — 3-bit soft-decision Viterbi decoding
- Base band signals
  - Voice signal — 32kbps ADPCM
  - Facsimile — G3 facsimile signals at 9.6 kbps transmitted in voice signal band
  - Data — Up to 9.6 kbps

c. Packet Data Transmission Facilities

- Outbound: — TDM
- Inbound: — RA (Slotted ALOHA)
- Modulation — QPSK - Burst
- Data Speed
  - Out bound — 140kbps
  - In bound — 35kbps
- FEC — Convolutional code 1/2 Soft-decision Viterbi decoding

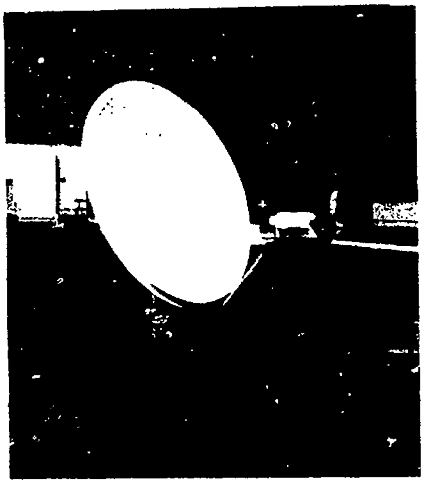

Figure 5.1 a) Antenna/ODU

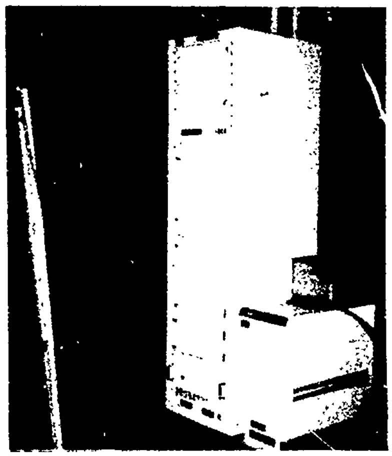

Figure 5.1 b) IDU

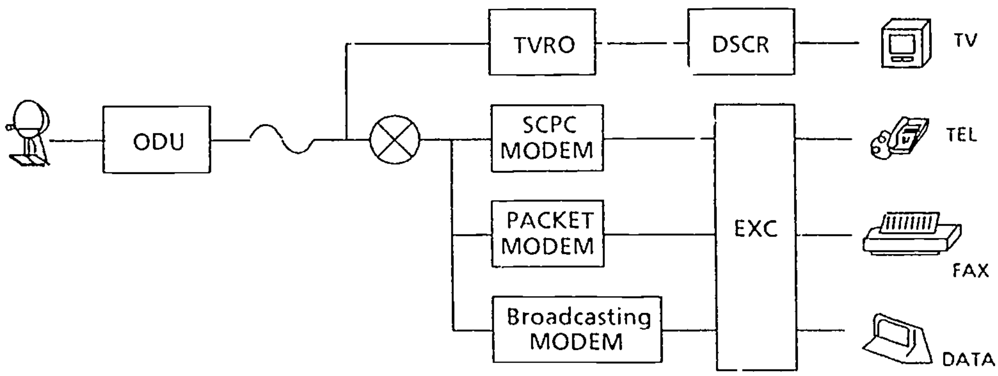

Fig.5.2 Simplified electrical blockdiagram

5.2 DAMA

DAMA control is performed in nation-wide base by Central Control Station.
The DAMA scheme uses an algorithm in which each subscriber requests a connection through Common Signalling Channel (CSC).
As the electrical parameter between CSC and digital voice channel is same, slave-DAMA for VSAT is equipped on each SCPC board.
Every SCPC channel is hearing the CSC channel transmitted from Central Control Station and responds to it (Health check).
Once the assignment comes to certain channel, then he goes to specified frequency and returns to CSC channel after finishing the communication.
In this way, channel capacity of VSAT is made high.
Main parameters as follows:

Outbound	:	TDM 35kbps Information Rate
Inbound	:	Slotted-ALOHA 35kbps Information Rate

5.3 OMC (Operation Maintenance Center)

OMC is placed in Prefectural Office, and performs monitoring, controling and status data collection for VSAT network.
Necessary data from VSAT is collected via Packet Data channel or Broad-casting channel.

- Monitor
  - To monitor the operation status of the satellite communication facilities, satellite end office equipment, and packet switching equipment.
  - To take up the monitoring data collected by the monitor and control equipment.
  - To monitor the volume of traffic on packet data circuits.
- Control
  - To give control indications to the satellite communication equipment and satellite end office equipment.
- Major display items
  - Block diagram for full system
  - Block diagram for station equipment
  - Station definitions
  - Frequency allocation
  - Current data on monitor items
  - Abnormality judgment record
  - Traffic data
  - Operation record (Chronological)
  - Logical error record

6. ELECTRICAL CHARACTERISTICS

6.1 Antenna

Antenna used in VSAT is a type of offset parabola in order to obtain high-gain, low-sidelobe characteristics and ease of installation.
In northern area in Japan, De-icing detector and heater are attached to the antenna.
Antenna noise temperature is shown in Figure 6.1 and typical sidelobe pattern in Figure 6.2.

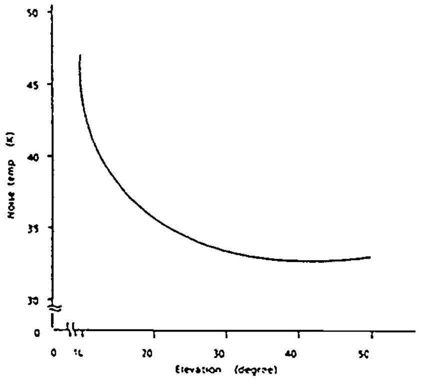

Fig 6 1 Antenna noise temperature

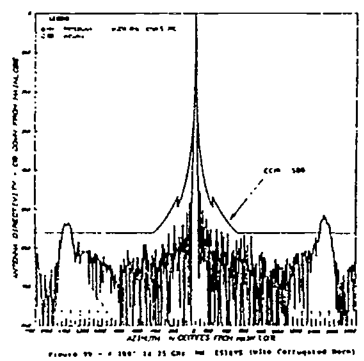
Fig 6 2 Typical sidelobe pattern

6.2 ODU (Out Door Unit)

ODU includes primary horn, orthomode coupler, filters, solid state amplifier (SSPA), low noise amplifier, synthesized dual-converter and is housed in a water-proof cannon bullet.
Figure 6.3 shows electrical blockdiagram of ODU.
Figure 6.4 shows photograph of ODU.
Figure 6.5 shows Frequency Response of ODU.
Figure 6.6 shows Input/Output characteristics of ODU.

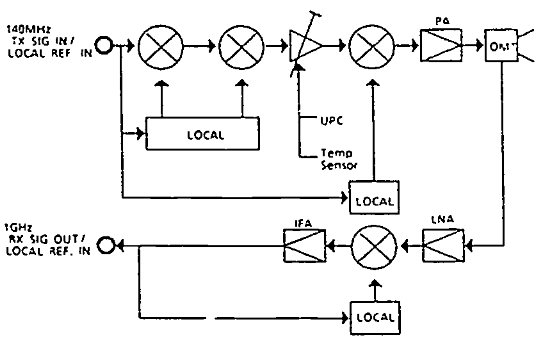

Fig.6.3 ODU electrical blockdiagram

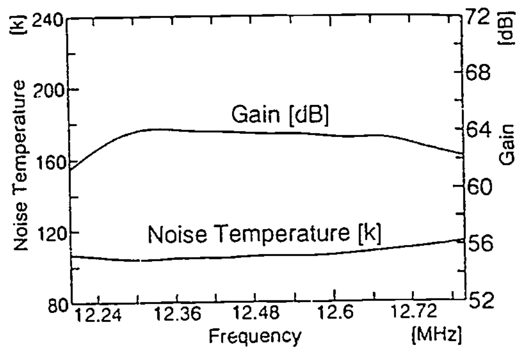

Fig6.5 Frequency Response of ODU (RX)

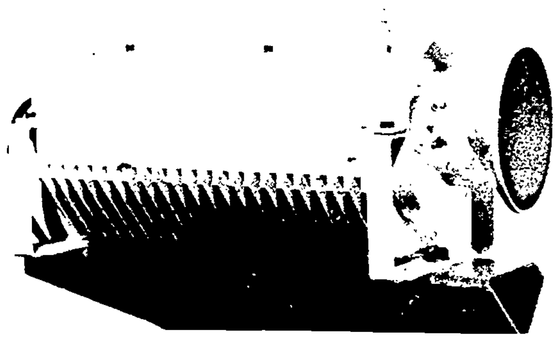

Figure 6.4 VSAT ODU

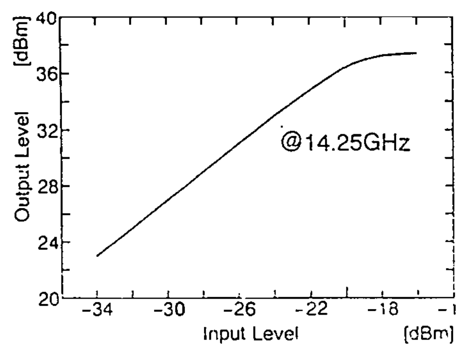

Fig6.6 Input/Output Characteristics of ODU

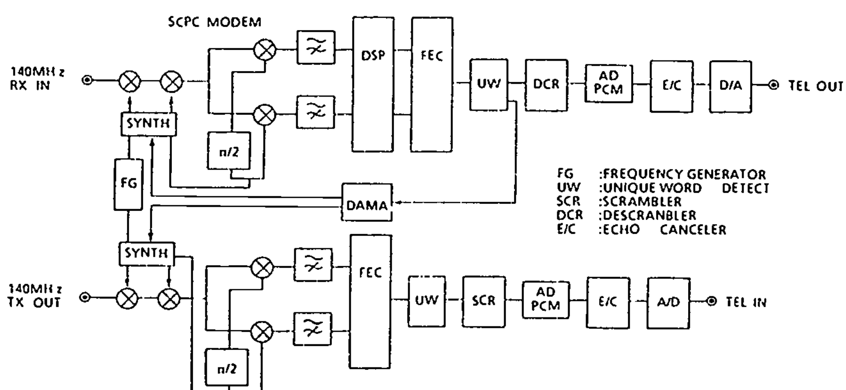

Figure6 7 Detail of SCPC Modem

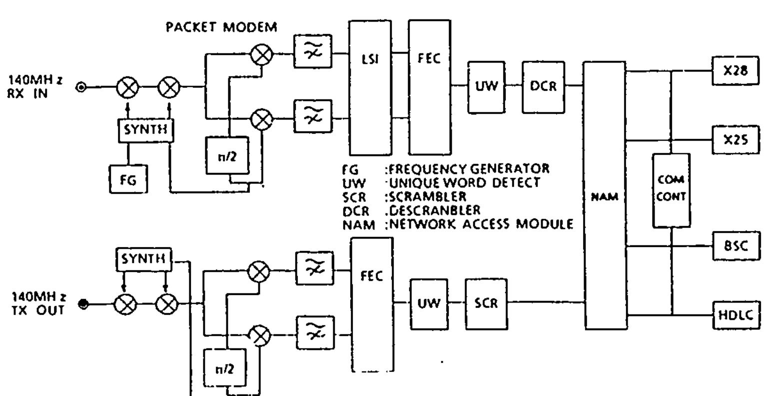

Figure6 9 Detail of PACKET Transmission MODEM

6.3 IDU (In Door Unit)

Typical IDU for VSAT is composed of Hybrid/combiner, SCPC Modems, Packet Transimission Modems, Broadcasting Modems. TV tuner with Descrambler, Link Re-routing Equipment and others.
The key devices, SCPC Modem and Packet transmission Modem are described in detail below.

(1) SCPC Modem
SCPC modem is composed 3 PC boards, modulator, demodulator and interface board. Modulator includes channel synthesizer for 2 transponder, authogonal modulator, digital filter, signal processor and others.
Demodulator includes similar functions with modulator.
Interface includes Unique Word/Carrier Detector, 32 kbps ADPCM in which G3 Facsimile can be handled, Echo Cancellor and others.
Fig 6.7 shows the electrical blockdiagram of SCPC Moedm.
Fig 6.8 shows input C/N versus Bit Error Rate characteristics.

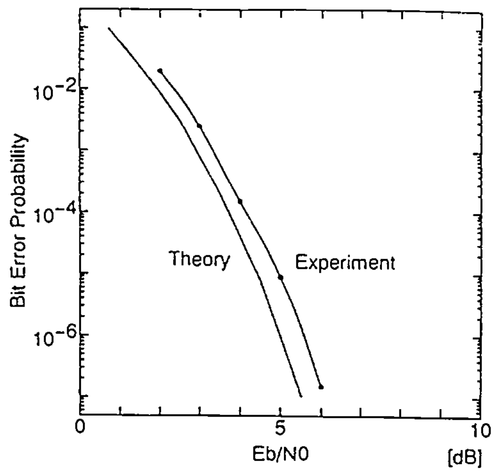

Fig 6.8 Bit Error Rate Characteristics

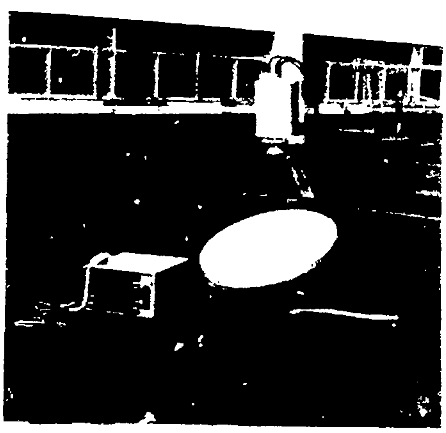

Figure 7.1 75 cm USAT

(2) Packet Transmission Modem
The difference between SCPC Modem and Packet Transmission Modem is very small, ex LSI high speed demodulator for 128 kbps Outbound TDM and base-band processor for slotted ALOHA 32kbps Inbound modulator.
Packetize and De-packetize is performed in Network Access Module.
Figure 6.9 shows the electrical blockdiagram of Packet Transmisson Modem.

7. CONCLUSION

In addition to the JCSAT1 and JCSAT2 commercial satellite launched in 1989, Japan launched Super Bird-B in February 1992.
She further plans to launch and Super Bird -A in December 1992. Satellite Japan and NTT plan to launch NSTAR in 1994 to 1995.
As mentioned in this paper, Japan has just started to develop VSAT systems under federal initiative.

Since the licensing standards of the Ministry of Posts and Telecommunications were relaxed for VSATs, the regulations for the following points are significantly relaxed in the VSAT technical compatibility test system:

- Antenna gain less than 50 dBi
- Output of less than 10 watts
- Services of less than 3.3 Mbps

From the viewpoint of hardware, full-menu media conceivable today are prepared.
The remaining problems are miniaturization of VSATs, etc.
Recently Ultra Small Aperture Terminal (USAT) which has 75cm antenna is developed and used in another system, as shown in Figure 6.1.

Whether or not the VSAT market expands in Japan depends on the progress of application software development, therefore both government and private developers are studying this carefully.

Finally, I would like to thank you all, both institutes and personnel, that have given me the opportunity for this presentation.

References

1. JAPAN LOCAL AUTHORITIES SATELLITE COMMUNICATIONS ORGANIZATION
"BASIC DESIGN OF TOTAL SYSTEM FOR LOCAL SATELLITE COMMUNICATIONS"
·· Issued August 1991

Television in Papua New Guinea:
Policies and Practice

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ABSTRACT

This paper traces the development of broadcasting policy and the events leading up to the introduction of commercial television in Papua New Guinea. Content analysis of programming will be used as the basis for comparison between policy and practice, and for a discussion of its social impact on its citizens. Alternative models of tel. vision broadcasting adopted by other developing countries will be cited briefly in analysing policy options for broadcasting decision-makers.

1. INTRODUCTION

Television was introduced into Papua New Guinea in an uneventful incremental fashion that circumvented the law and pre-empted policy -making. Neighbourhood sharing of satellite equipment led to commercial cable operations in the early 1980s which remain unregulated today. The application for licenses to operate commercial broadcast television led to a parliamentary attempt to ban or at least postpone its introduction, but this was over-ruled by the judiciary. Of the two commercial stations that entered the market, only one survives today However its programming practices do not reflect the broadcasting policies of the PNG government, as encapsulated in the reports of its commissions of inquiry on television.

2. COUNTRY BACKGROUND

2.1 Geography

Papua New Guinea (PNG) lies between the north of Australia and the equator. To its west is Indonesia and to its east is the island-dotted Pacific Ocean. PNG comprises the eastern half of the island of New Guinea, the world's second largest, and a number of smaller islands. The mainland makes up 85% of its territory. The total population of the country is estimated to be 2.5 million.

The geography of PNG explains some of its cultural diversity and limited socio-economic development. The central spine of the mainland is a mountainous region, the Highlands, with peaks over 4,000 metres. The terrain restricted movement and resulted in the existence of over 700 distinct language groups, many still retaining their traditional animosity or, at least, mistrust.

2.2 Modern history

In the late 19th centuury, the British colonised the south-eastern quarter of the island, known as Papua, the Germans the north-eastern quarter, known as New Guinea, and the Dutch the western half, known as West Irian. In the First World War, the German territory was captured by the Australians, which in turn lost it to the Japanese in the Second. After that War, both Papua and New Guinea were administered as a joint territory by Australia under a UN trusteeship (Hoadley, 1992).

A UN visiting mission in 1962 was critical of the lack of progress towards self-government in PNG and this resulted in the formation of an assembly and political parties. This led eventually to independence in 1975, though continuing to have the Queen of England as head of state. A year after independence, as a concession to regional rivalries and successionist movements, the constitution was amended to provide for 19 provincial governments. Due to the multiplicity of political parties in unstable coalitions, PNG has seen rapid changes of government, though power seems to be rotated among the same group of four men.

2.3 Economy

Approximately half of the the population aged 10 years and above are involved in farming and fishing, and only 10% have a wage-earning job. The average per capita income is US$520. Still, agriculture, fishery and forestry resources are relatively untapped (Census, 1980).

Though the world's largest copper mine in the province of Bouganville is closed due to a successionist rebellion, discoveries of gold, silver and oil made in the late 1980s and are beginning to come on-stream. PNG is expected to be the 6th largest gold-producing nation in the world.

According to World Bank estimates, government revenues from minerals will rise to US$751 million by 1993. Thus in comparison to other developing nations, PNG has great potential for development. But it must overcome a growing breakdown of law-and-order due in part to the growing disparity between the urban 'haves' and the rural 'have-nots'.

2.4 Media

The mass media of PNG comprises 3 newspapers, 2 national radio networks, a number of regional radio services and one commercial television station. Only one newspaper, the Post-Courier, is a daily, published on weekdays and in English. With a circulation of 39,000 and a pass-on rate averaging 5.5, it has a readership of 215,000 or less than 10% of the population. The two other papers are weeklies, one published in English and the other in Pidgin.

The two national radio networks are both owned by the government and run by its National Broadcasting Corporation. One is Radio Karai, the public service which does not accept advertising, and the other Radio Kalang, an FM station run as a commercial station. According to NBC marketing materials its potential listenership is estimated at 1.5 million or 83% of the population of the semi-urban areas.

Television is the most recent entrant to the media scene. EMTV is the sole survivor of two station that entered PNG in 1987. It is transmitted by microwave to urban centres, mostly around the provincial capitals where electricity is available. There are plans to expand TV reception to rural areas via satellite transmission (Post-Courier, 1990). Proprietary market research estimates the potential viewership of EMTV at 300,000 (Taylor, 1990).

3. COMMISSIONS OF INQUIRY

Various commissions of inquiry were covened from as early as the 1960s in anticipation of the introduction of television. These commissions envisaged the establishment of a broadcasting tribunal, comprehensive legislation, a public broadcasting/educational channel, and PNG-majority owned commercial stations.

3.1 The 1966 Inquiry

Although the terms of this commission included mass communication and entertainment, its primary focus was on television as an educational medium (Broadbent, 1966). It saw television as a means of supplementing teaching in primary and secondary schools, especially given the teacher shortage and inadequate facilities. Health education was also given priority, particularly preventative medicine such as child-care and sanitation.

In the view of the then colonial administration an additional category of extra-mural and enrichment education needed to be emphasised. Its aims were to overcome any cargo-cult mentality, illiteracy, political ignorance and lack of craft skills. The 1966 commission perceived as important the counteracting of the offerings of commercial cinema.

The commission did not look into appropriate legislation as it was informed that the acts governing Australian broadcasting would apply to this territory, as it was then. But the commission did recommend the establishment of a single territory-based television authority overseeing broadcasting, with input on programming from the departments of education, health and agriculture.

3.2 The 1978 Advisory Committee

Recognising that television would be just one of many media used for public communication, this committee recommended the establishment of a media development council. Its aims would be to co-ordinate private and government bodies in the more integrated use of television in attaining national development objectives. It would do so largely through the telecasting of national/ provincial extension activities, community development programs and formal/non-formal education.

The committee saw the existing radio-based National Broadcasting Corporation (NBC) as the sole provider of a national television service. It also recommended satellite systems as the best means of providing a truly nation-wide service. It urged the government to ensure that the majority of programmes are locally produced and that imported programmes are appropriate to PNG society, without being culturally isolationist (TV Advisory Committee, 1978).

3.3 The 1987 Board of Inquiry

The Kalo inquiry of 1987 was convened soon after the government's abortive attempt to prohibit commercial television stations from gaining licenses. Its extensive terms of reference incorporated legislation, ownership, licensing, programming and advertising. This commission noted the inadequacies of existing legislation and the need for comprehensive new legislation to take into account both the new technology and the likely participation of commercial operators. A broadcast tribunal was suggested as a body for licensing ownership, including that of cable networks, and for controlling programming.

Strong emphasis was placed on the preservation of PNG's multi-cultures through their reflection in the broadcast media. Nothing was mentioned specifically about restricting for ign programmes, though. The television medium was anticipated to play a large educational role both in disciplines such as agriculture and health, and in the development of balanced programmes in news, religion and sports. It is the policy recommendations of this last inquiry which will be compared with the actual practice of commercial television broadcasting in PNG.

4. ARRIVAL OF COMMERCIAL TELEVISION

4.1 Unregulated systems

Prior to the establishment of local commercial television networks, urban areas in PNG had access to foreign television via subscriber clubs using illegal satellite dishes and cable systems, which proliferated due to the lack of legislation to govern them. In one remote capital alone, there were 13 clubs and their subscribers had a choice of Australian Broadcasting Corporation, American Armed Forces, Malaysian TV as well as 2 video channels (Kalo, 1986).

4.2 Early negotiations

As early as 1984, NBN of Australia lodged a formal application with the PNG Post and Telecommunications Corporation (PTC), which sought guidance from the National Broadcasting Corporation, which agreed to the application. PTC then sought policy direction from the National Executive Council of the government, which convened inter-department committee to make recommendations. However, the NEC rejected those recommendations for the setting up of a tribunal and formed instead a state negotiating team for the introduction of commercial television (Kalo, 1987).

Under the direction of the government, PTC issued licenses in December 1984 to Niugini Television Network (NTN), 90% Australian-owned and a subsidiary NBN. In 1985, Media Niugini, 50% owned by Publishing & Broadcasting Ltd (PBL), later Bond Media, made a submission to the government (Stewart, 1991). Media Niugini had been a Port Moresby-based video operation since 1984 and was seeking to extend its 'marketplace television' to Lae, Goroka and Mount Hagen, the larger provincial capitals on the mainland (Madden and White, 1987).

4.3 Regulation debacle

In November 1985, the government of Michael Somare was replaced by one led by Paius Wingti. When the new government reaffirmed that it would honour the agreement with NTN, PTC issued new licenses to both NTN and Media Niugini in March 1986. But in July the Prime Minister requested NTN not to commence broadcasting as scheduled the same month, the Radiocommunication Act was amended to prohibit TV broadcasting and a board of iniquiry convened (Kalo, 1987).

In August 1986, after NTN mounted a court challenge to the prohibition of television, the government passed new legislation, the Television (Control and Prohibition) Act which sought to delay the introduction of television to 31 January 1988. However, the Supreme Court ruled in favour of NTN and the latter began broadcasting in January 1987, followed by Media Niugini's EMTV in August the same year.

The commission of inquiry reported its findings in January 1987, too late to influence policy or practice of television broadcasting. NTN ceased broadcasting in February 1988, due to the financial problems of its corporate parent. EMTV continues as the sole broadcaster and its programming is analysed in this paper in comparison to the 1987 commission's iniquiry's recommendations.

5. ANALYSIS OF PROGRAMMING

5.1 Channels and hours

Citing the dangers of a monopoly in television broadcasting and the necessity of a public service, the commission recommended that two commercial channels be introduced from the start, followed as soon as practicable by a public broadcasting channel. In its opinion, no more commercial channels should be licensed till that public channel was firmly established. Aware of the temptation for commercial broadcasters to use cheap imported material for more expensive local productions, the commission recommended that they be limited to 5 hours programming per day, presumably per channel. It recommended further that ownership of the stations by non-PNG interests not exceed 49% and that the majority of senior management be Papua New Guineans (Kalo, 1987).

With NTN ceasing to broadcast in February 1988, after just over a year's operations, EMTV remains the sole television broadcaster. No public broadcasting service has been set up, nor even seriously proposed. The NBC continues to operate solely as a radio service and faces financial constraints in maintaining that alone. No broadcasting tribunal was ever set up despite consistent recommendations to that effect by the various commissions of inquiry. EMTV has moved subtly to position itself as the national television service, through the nomenclature of its programmes and lyrics of its signature tune. EMTV broadcasts an average of 60 hours per week, usually from 3:00pm to 11:30pm (8.5 hours) daily, which is approximately 42% more than the commission envisaged. The senior management of EMTV has been totally expatriate, a situation explained by them as the lack of local television expertise.

5.2 Programmes by category

All inquiries into broadcasting in PNG have emphasised cultural and educational purposes to which the television medium ought to put. The 1987 commission specifically mentioned documentaries relevant to PNG cultural, commercial, agricultural, health and religious needs. It urged the Education Department and tertiary education institutions to produce educational programmes, either on their own or in conjunction with broadcasters.

Analysis of a week's programming from each of 6 months over the period 1990-91, reveals a situation quite opposite to that recommended by the commission (Table 1). The highest proportion of programmes were situation comedies and soap operas, totalling 21.5% of programming. Crime and westerns comprise the second highest category at 20.8% of total programming and are a controversial issue, given the law-and-order problems of the country.

Children's shows and cartoons come next at 18.8%, though it must be conceded that the 11.4 hours of this category includes 5 hours of Sesame Street which may be classified as 'educational'. But it should also be mentioned that much of the remaining children's programmes are of a highly commercial nature. Movies, averaging four in number per week, and the periodic drama mini-series add up to 14.7%, while musical shows, game shows and other light entertainment are an addtional 3.0%. While sports programmes are surprisingly low for a sports-loving country at 3.8%, they are a regular and extended feature in news programmes.

By contrast, programmes of a non-entertainment character occupy a much smaller proportion of programming. News and news magazine-style programmes head the list at 14.0%, but are generally not of an indepth or investigative nature. Educational and documentary programmes amount to only 2.5% of total programming, or an average of 1.5 hours per week, a quite different scenario to that proposed by the policy-makers.

With the possible exception of two programmes, EMTV has not addressed the educational needs of PNG. The first is 'Tingim Helt', a public health programme produced by a government department, and aired at a late hour such as 11:00pm when it is watched by about 28% of the potential audience (Taylor, 1990). The other was 'Yumi', billed as PNG's first locally-produced drama though not produced by EMTV itself but by the local Lutheran church. It dealt with social issues with a moral undertone and was aired at prime-time, though it was on for only a limited season.

Religious programming constitutes 1.0% of programming, and that only because a Billy Graham crusade elsewhere was being shown live in November during one of the weeks researched. This is a particularly significant anomaly in PNG where over 95% of the population would consider themselves Christian and the constitution proclaims the nation to be a Christian one. In a specific section on religion, the 1987 commission recommended that the broadcasting tribunal give adequate emphasis to religious programming. But in 1990-91, religious broadcasting was confined to a 3-minute epilogue at closing time each night, which failed to register in the research count. In its defence, the management of EMTV claim to have offered air-time gratis, but that the churches have been reluctant to undertake their own production (Taylor, 1990).

5.3 Programming by country-of-origin

As might be expected of most countries, especially a developing and English-speaking one, the USA heads the list as the source of over half of all programmes (Table 2). Almost all of the crime/western programmes, and movies/drama mini-series, as well as the majority of children's programmes/cartoons and soap operas/sitcoms are of US origin. They are often of at least a decade's vintage and thus of quite minimal cost. The domination by US-exported programes of programming worldwide is well documented and analysed (Hoskins and Mirus, 1988; Mattelart, 1983).

Australia, as PNG's nearest developed-nation neighbour, former colonial ruler and country of permanent residence of most broadcast executives and expatriate viewers, features quite naturally as the runner-up. But at 25.0% it adds up to less than half of the US share. Britain is an even more distant third at 3.2%. The classification 'international' refers to programmes which are a montage of clips from various countries including the US, Autralia and Britain, and/or from countries other than those in the categories above. It amounts to only 2.6%, the smallest proportion, and it should be noted that it does not include programming from any other developing, non-western country. Although there is a growing cultural industry in Latin America which is exporting programming to other Spanish-speaking regions (Sinclair, 1991), no equivalent trend is evident among English-speaking countries.

TABLE 1: EMTV PROGRAMMING BY PROGRAM CATEGORY, 1990/91							
Program category	**Aug**	**Sep**	**Oct**	**Nov**	**Jan**	**Feb**	**Ave. hrs per week**
SitCom/Soap	11.0	11.0	14.0	14.5	14.0	14.0	**13.1**
Crime/Western	14.0	12.0	13.0	13.5	14.0	9.5	**12.7**
Children/Cartoons	12.5	13.5	12.0	8.5	11.0	11.0	**11.4**
Movie,Drama,etc	8.5	11.0	9.0	6.5	7.5	11.0	**8.9**
News/Magazine	7.0	4.0	10.0	6.5	10.0	13.5	**8.5**
Sports	3.0	4.0	3.5	0.5	0.5	2.5	**2.3**
Gameshows/Music	1.5	2.0	2.0	2.0	1.0	2.5	**1.8**
Documentary/Educ	2.0	2.0	1.0	1.0	1.5	1.5	**1.5**
Religion	0.0	0.0	0.0	3.5	0.0	0.0	**0.6**
Totals	**59.5**	**59.5**	**64.5**	**56.5**	**59.5**	**65.5**	**60.8**

TABLE 2: EMTV PROGRAMMING BY COUNTRY-OF-ORIGIN, 1990/91							
Country of origin	**Aug**	**Sep**	**Oct**	**Nov**	**Jan**	**Feb**	**Ave. hrs per week**
USA	39.0	35.5	30.0	33.0	30.5	29.5	32.9
Australia	7.5	9.0	24.5	13.5	14.5	21.0	15.0
Britain	2.5	3.5	2.0	0.0	3.5	0.0	1.9
International	1.0	2.0	0.0	2.5	1.0	3.0	1.6
Papua New Guinea	9.5	9.5	8.0	7.5	10.0	12.0	9.4
Totals	59.5	59.5	64.5	56.5	59.5	65.5	60.8

Ostensibly, programmes of PNG origin are a significant proportion at 15.5% for a developing country. However, the figures are deceptive on 2 counts. Firstly, although programmes such as news, sports, children and music are produced locally, they are collations of both local and foreign material, the latter usually far exceeding the former which may be simply the use of local anchor persons. Secondly, many programmes of local origin are repeated frequently unlike those of foreign origin, thus misrepresenting its proportion of total programming (Stewart, 1991).

5.4 <u>Social impact</u>

The 1987 commission raised concerns about the erosion of PNG's rich cultural traditions by unregulated television broadcasting. No formal research on its social impact has been carried out. However, research on viewership conducted for EMTV in 1989 indicates that approximately 60% of homes having television have it on between 7:00pm and 10pm, with approximately 40% in the 2 hours preceeding and 1 hour following this extended prime-time (Taylor, 1990). Given the high proportion of foreign, particularly U.S., programming depicting western lifestyles (movies, sitcoms and soap operas) and violence (crime, westerns) all of which enjoy viewership rates in the high 60% bracket, one might reasonably infer that there is some significant effect. One of the difficulties of social impact research in separating the effect of television from that of other economic development. It would be reasonable to suggest that television is at least a partial cause of PNG's social problems such as the decline of traditional social control mechanisms, urban drift and consequent unemployment, and crime.

A special concern of the 1987 commission was of the amount of violence then on the illegal cable systems and pre-recorded videotapes, and anticipated to be on broadcast television. While acknowledging that depiction of violence may have a legitimate place in dramatic productions, the commission was persuaded of the New Zealand Royal Commission on Broadcasting findings of community perception of a link between television portrayal of violence and the incidence of violence in society, despite the equivocal findings of formal social research (Kalo, 1987).

Anecdotal evidence from both expatriates and nationals, as well as content analysis of newspapers indicates a significant rise of the incidence of crime from the mid-1980s, coinciding approximately with the introduction of private cable systems. Managements of the two television stations counter that impression by stating that television has actually reduced the incidence of crime by keeping people off the streets at night (Stewart, 1991). One senior executive suggested to this author that Papua New Guineans have a predilection for 'action' programmes, but are able to discern make-believe and exagerration in violent programmes. In the light of increasing criticism of its violent programmes in a society in which there has been a tradition of violent confrontation between tribes, the commercial stations appear determined to defend their highest-rating and profitable programmes.

6. ALTERNATIVE MODELS

Papua New Guinea is a relative latecomer to television broadcasting and might have benefitted from the experience of other developing countries, especially those of the Asia-Pacific region. This section seeks to survey the historical development of television broadcasting in a select group of countries which may have relevance to PNG.

6.1 <u>American Samoa</u>

Television was introduced in American Samoa in 1964, the first of the Pacific islands to have the service for the ambitious purpose of upgrading school-level education to the standard of the U.S. Conflicts between state governors and the educational broadcasters over the next decade resulted in the dramatic scaling down of the project.

A secondary agenda was the provision of information on health, agriculture, news and children's entertainment through broadcasting to homes after school hours. Conceived initially as a government funded station it initially broadcast primarily PBS programmes, then began purchasing programmes from US commercial networks (complete with US advertising) and grew to 6 channels before being cut back to 3. In 1978-79, only 14 hours of programming per week were of local origin compared with 174 hours imported (Schramm *et al*, 1981). With the decline of educational television, entertainment came to predominate American Samoa television.

In 1977 a study conducted 5 years earlier on cultural values was replicated and it found that American Samoa teenagers had become more westernised in that period. They were also found to be more westernised than Western Samoan teenagers researched concurrently in 1977, who had experienced a much lower exposure to television. A similar result would probably be obtained if the research were to be conducted in PNG periodically since the introduction of television. Quite simply, the American Samoan experience is one that the PNG policy-makers may not have wished to emulate, but have done so by policy default. In contrast to American Samoa, television in PNG began as a commercial operation with only a token committment to educational objectives. This ought to have signalled the policy-makers that their educational objectives were even less likely to be fulfilled than American Samoa's.

6.2 Indonesia

In 1976 government-sponsored satellite television was introduced in Indonesia in a controlled fashion to support its developmental goals in education, health, agriculture and family planning among others. Despite the fact that most programming was local and was largely informational in nature, Chu *et al* (1991) report that television viewing was popular. Television appeared to have had significant effects in promoting the consumption of advertised goods, adoption of new agricultural methods, use of health services, practice of family planning and learning of the national language.

Introduction of satellite television in Indonesia was closely associated with the implementation of numerous development projects, and it is therefore not clear what the effects of television are independent of other stimuli. While PNG policy-makers have stated the need for television to support national development objectives, no economic blue-print of how this might be accomplished was produced. Though it is of an immensely larger size and better resourced, Indonesia's approach to the provision of television across its widely spread island provinces may be instructive to Pacific island nations collectively.

6.3 Chile

Although it may seem an unusual choice of a model, Chile is a developing country on the Pacific Rim and brings a unique perspective with a Latin American flavour. Historically, television stations in the country have had an association with universities because of early trials of the technology. Through legislation, stations continued to be neither commercially or government controlled, had a mandate to offer varied programming including both education and entertainment, and were free to compete with one another. Regulation of broadcasting was by a 5-tier system in which the government, universities, the church and television industry were represented. The Pinochet regime trimmed down these representatives bodies, filled them with political appointments and paved the way, not for government propaganda so much as unfettered commercialism: entertainment programming increased while informational programming decreased (Fuenzalida, 1988).

Universities and schools in PNG have long been considered by the various commissions of inquiry to be likely major players in the provision and use of educational broadcasting, though not of general programming. Though one of the two universities has journalism and drama schools and the other engineering departments, neither have shown strong interest in developing an alternative to commercial broadcasting, nor has the government been encouraging with financial grants. The other lesson from Chile would be that governments with an interventionist broadcasting policy will not necessarily promote informational programming. They may collude with commercial broadcasters to promote programming which merely entertains as a means of discouraging political fervour. The optimal solution is that of a plural and independent tribunal overseeing the regulation of all television broadcasting.

7. CONCLUSION

This paper has chronicled the introduction of television into a developing nation in the Pacific. More specifically, the PNG experience illustrates the divergent agendas of multinational providers of commercial television and government policy-makers on broadcasting, and the dominance of the former when the latter are unprepared or lacking the political will, despite numerous commissions of inquiry or consultations, as often is the case with smaller developing countries. The paper has also looked at some other models of television broadcasting which have attained a more equitable balance, even a convergence, between commercial and national agendas.

Developing countries face a dilemma in introducing TV broadcasting. The cost of providing publicly-funded TV broadcasting to their citizens is prohibitive. Also, the local expertise is lacking and locally produced programmes do not draw the viewerhip needed to attract advertising revenue. Yet if governments allow commercial stations to operate they lose control over programming. Commercial TV stations lobby against government regulation of programming arguing that it would affect their profitability and continued operation. Though often this is done indirectly by presenting themselves as defenders of the freedom of expression and information.

UNESCO addressed these issues in its MacBride Commission (1980) report which recommended that developing countries establish and develop their own broadcast systems, including training and production facilities. It added that national production of broadcast materials is crucial to reducing over-dependency on external sources. Since many developing countries are not in a position financially to do so, an effective partnership with multinational commercial broadcasters may be the solution for achieving financially viability and development goals.

The extent to which governments can regulate is being further eroded by the advent of new technologies, particularly satellite and cable systems, which permit transborder broadcasting with impunity. Quite evidently, the political-legal structures of developing nation-states do lag behind the technological prowess and economic power of multinational broadcasters. Perhaps a better balance in negotiations and collaboration between commercial broadcasters and governments could be achieved through smaller nations, such as the Pacific islands, grouping to formulate regional television broadcasting policies.

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WEDNESDAY, January 20, 1993

Afternoon Plenary

NOTES

GLOBAL TELECOMMUNICATIONS DEVELOPMENT

- MARKET FORCES OR MULTI-LATERAL PLANNING?

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1. ABSTRACT

The Maitland Commission in 1984 formulated recommendations for the development of global telecommunications, including multi-lateral initiatives. This paper reviews progress since the Commission's report and contrasts some of the planning assumptions for telecommunications services in developed countries against those more appropriate in developing nations.

Eight years have now passed since the release of the Report of the Independent Commission for World Wide Telecommunications Development, and this Conference seems an ideal opportunity to take stock of what has been achieved, and what experience has taught us, in the course of those eight years.

The issues that Sir Donald Maitland and his distinguished Commission raised in "The Missing Link" are not only still relevant in 1992, but perhaps even more urgent and pressing than they were then.

The Maitland Report forms the context - rather than the agenda - of my contribution to this forum. What I would like to do is to follow some of the Commission's lines of thought, and avenues of inquiry, to pose some questions about the role of global telecommunications in the world today.

That path will require some questioning, not only of the specific recommendations made by Sir Donald and his fellow Commissioners, but of a couple of the assumptions that underlie "The Missing Link".

Eight years' hindsight may show that telecommunications has developed just as quickly under a regime of laissez faire and market influences as it might have under the multilateral overlay proposed by the Maitland Commission.

I will also argue that the uneven distribution of telephones around the world may not create quite so glaring a disparity as the simple ratio of telephones to populations seems to indicate, if the differences in social organisation that exist in different parts of the world is factored into the statistics.

My third theme is really a corollary of the last. Even in countries with a high telephone penetration rate, there may not be even distribution of services. It may also be argued that the current trend towards competitive service provision in mature markets, such as has recently been legislated in Australia, can potentially create new disparities in access to services.

Finally - and here I depart from the Maitland agenda - it seems to me that the evolution of technology has created the potential for solutions that could effectively jump the gap between the information-rich and information-poor. Certain advanced applications now being trialed, in Australia and elsewhere, may make the notion of telephones per person an obsolete means of measuring access to telecommunications.

At the same time, solutions that have been developed for the high end of the business market in mature networks may create short-cuts that can be adapted to provide lower-cost solutions in places where access is currently very limited.

My illustrations for these arguments will come, naturally enough, from certain experiences that Telecom Australia and OTC, respectively Australia's traditional domestic and international carriers, have been through, notably in providing telecommunications to rural and remote Australia, and to Indo-China and the Pacific Islands.

Several years ago, a senior telecommunications official from a developing nation visited Australia. We presented him with an overview of Australia's telecommunications regime, and enjoyed a mutually profitable discussion of the differences between our two countries' systems.

We inquired of him when he thought his country would reach the stage of having a telephone in every household. His response was instructive. Why," he asked, "would every household want a telephone? One in every village, maybe."

That answer made us realise how blinkered our view was. Most industrialised nations are characterised by a highly mobile populations, with families and interest groups often separated from each other by considerable distances, either permanently or for frequent short intervals. Our markets tend to be centralised, and business operates across a wide range of sites, both domestic and offshore.

Both of these features have driven our need for individual rather than collective communications, and they are still driving the way technologies are developing. PCN technology will take this tendency to its logical end.

But in a nation whose population is still overwhelmingly rural, where generations have remained and still remain within the same relatively small geographic area, where local, decentralised markets carry the bulk of commerce, the idea of individual telephone access is a nonsense.

To put it another way, the fashionable idea of "appropriate technologies" should not just refer to the technical nature of the network infrastructure, but - more importantly - to the social and economic needs that the network will be required to support which are more various than many of us in the information-dependent countries are often prepared to recognise.

In Australia - which is at once one of the most urbanised countries in the world, and at the same time characterised by a vast and sparsely populated land mass, with widely divergent climates and terrains - the challenge of providing universal telecommunications services has recently been met.

Telecom's Australia's Rural and Remote Area Programme (RRAP) began in 1984, with three objectives: (1) to convert the last 26,000 manual services in Australia to automatic; (2) to replace over 10,000 privately erected lines with Telecom provided and maintained automatic services; and (3) to provide 7,700 new services in areas not previously serviced.

In June 1992, the RRAP was successfully finalised, at a cost in 1989/90 of $AUD530M - an average cost per service of $12,000. In the most remote areas, the average installation cost was $28,000. A mix of technologies was employed, including certain solutions developed specifically to meet special circumstances: our Digital Radio Concentrator System and solar-powered payphones, for instance.

We are proud of this achievement. But it must be admitted that Australia has achieved universal service for its people - 95% in the centres of population, 93% in remote areas - at a very high capital cost, which can never be redeemed in profits from the traffic generated. It is a relatively rich nation's solution to the need to communicate.

Just as the RRAP was drawing to a conclusion, competition began on the Australian network. A second carrier, Optus Communications, was licensed to compete against Telecom and OTC in all carriage markets, domestic, international and mobile. (A third mobile licence is to be issued in 1993; the network will become openly competitive in 1997, according to the current legislation.)

Competition has been introduced in such a way as to speed the market penetration of the new entrant, which has full access to the established network at a very favourable interconnect rate.

While Optus will share the cost of our Universal Service Obligations - the duty to provide the Standard Telephone Service, including Payphones, to all Australians - on a pro rate basis, it is under no compulsion to provide competitive services in low margin areas of the business.

Our competitor will build its revenue stream in the heavy traffic, high margin traffic routes, as any rational commercial operator would do. But the effect will be limited competition with possible discounts being offered between major population centres and internationally, while local services and rural customers will miss out.

Some degree of inequality is therefore inevitable - just as the whole population has achieved equitable access to the standard service. This sketch does not apply exclusively in Australia, of course. It is becoming increasingly characteristic of mature markets around the world - yet it is a disparity entirely masked by the yardstick of telephones per head of population.

I have gone into this situation in some detail because it seems to me to provide an analogy to the way telecommunications services are being introduced in developing nations. Access is following business - and that means it is gravitating to the cities, and it may be contributing to the urban drift that appears to be accelerating in places like Mexico City, Calcutta and Rio de Janeiro.

Ironically, the creation of these mega-cities is occurring at the same time as the possibilities of telecommunications-based decentralisation are beginning to be realised in countries like Australia.

Tele-cottages and tele-working from home are just beginning to emerge as real possibilities for us, as the disadvantages of commuting are being realised by workers, and the high cost of central city offices is affecting the business sector, in the wake of a severe recession in Australia.

Yet, as often happens in a world where (as I think it was Voltaire who said) "systems offend reason", solutions are being developed in and for places where the problems they address are least pressing, while commercial considerations increase the tendency towards urban agglomeration in developing nations.

These ironies suggest a possible solution - or rather a range of solutions, based on the specific and particular needs of countries or regions, looking for the multiplier effect of communications infrastructure on their economies.

My main point of divergence from the Maitland Commission's approach lies here. The flexibility needed to solve for the wide range of different needs and priorities in different countries and regions is virtually impossible to solve on a multi-lateral basis.

Bi-lateral solutions developed between neighbours at unequal levels of telecommunications sophistication can generate results more quickly, more sensitively and more appropriately. To strive for a global solution, especially in a world where trade competition is becoming so intense, risks achieving nothing, albeit in a very high-minded and well intentioned manner.

PACT is a thin-route regional niche service developed by OTC Australia in consultation with the member countries of the South Pacific Forum to complement the local networks of member countries, with a demand assigned multiple access satellite link operated from our Sydney earth station.

PACT is small - currently less than 1/4 of a transponder - and ideal both for domestic communications between isolated island communities and for international calls between Forum Island Countries.

Eleven nations are now PACT signatories, though the Solomon Islands, Fiji and Papua New Guinea are still awaiting equipment installation, which should be in service in March 1993. The central idea behind PACT's design - the small earth station/village telephone - is yet to be realised, but several exciting applications are already emerging from the technology.

The enhanced services already developed for PACT include Demand Data Services to allow banking, airline bookings and credit card validation at a cost 60% lower than a conventional system. The service is under active consideration for monitoring commercial fishing in the region, for ground to air use in aviation, for air traffic control and for the University of the South Pacific as a low cost satellite teaching network.

We have learnt a great deal from the process of establishing PACT successfully. One key is consultation, with Government as well as local carriers; a second crucial issue is pricing (we have recently negotiated a rebalanced and much more attractive domestic/international pricing regime); and the third is the need to create applications which overlay the existing systems, and enhance rather than duplicate what is currently available.

The situation in Indo-China - another area where OTC Australia has concentrated its attention - was and is quite different. Telecommunications infrastructure has been virtually non-existent. Tourism, which leads to a net inflow of hard currency from outside for local carriers, has been restricted to very small numbers of the intrepid traveller type.

The political history of the region has not encouraged the inflow of foreign capital for development, and the reconstruction of social and economic life has been slow and painful.

So far, OTC Australia has built one International Telecommunications Centre in Ho Chi Minh City and a second in Hanoi, under a ten year contract to assist in the development and management of Vietnam's international network. The same contract provides for exactly what the Maitland Commission recommended - a substantial programme of technical and managerial training to create a strong indigenous base for longer term development.

OTC has also provided Cambodia's first IDD service, through INTELSAT, and has signed a five year agreement to provide international telecommunications for the Laos People's Republic, increasing the number of international circuits to Vientiane from 8 to 30, and reconfiguring the telephone exchange for IDD.

OTC's aims and intentions in Indo-China very closely follow what you might call the "Maitland line": to facilitate the growth of each nation's social and commercial links with the world, to serve commercial, diplomatic and administrative needs, and to provide a mechanism for outside investment in the region.

These examples are not designed to paint us either as brilliant operators or as generous, caring benefactors. My point is that we have followed the prescription recommended in "The Missing Link", but on a bilateral basis, rather than under some global umbrella or system. It seems to be working, and it seems to hold out real potential for the future.

Sir Donald Maitland and his fellow Commissioners handed all of us a political hot potato in 1984. In terms of the recommendations made in that Report, we have probably failed, as a group, to grasp the opportunities or to meet the obligations identified there.

However, the results that the Maitland Commission envisaged might be achieved nevertheless.

TECHNOLOGY TRANSFER IN THE ASIA PACIFIC REGION

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ABSTRACT

The goal of telecommunications policy in developing countries in the Asia-Pacific region seems to stimulate economic growth, since it is believed that economic growth cannot be sustained unless the economy's supporting infrastructures including telecommunications grows at a greater rate. Beside increasing the telecommunication facilities, some governments in the Asia Pacific Region also put the development of telecommunication manufacturing industry as the priority in developing telecommunications sector. An important issue in this process is **transfer of technology**. Some experiences of transfer of technology in the Asia Pacific region such as Indonesia, Korea and India especially in the telephone switching industries will be presented briefly. These experiences show that transfer of technology involves many challenges, in human resources as well as financial matters.

INTRODUCTION

It is well accepted that telecommunications is a very important means in developing the economy. Countries in the Asia Pacific region - particularly developing countries - put telecommunications into priority to create this necessary infrastructure.

The steady economic growth in the Asia Pacific region has attracted many developed countries to invest in the telecommunications business in this region. As a result, there has been interactions, among the governments, companies and other constituencies. And one of the important things in the interactions is technology transfer.

Transfer of technology happens in many forms. There is simple forms such as seminar, training, documentation etc. Another form is the physical relocation of production system to local production facilities, as *technology may be embodied in the form of capital goods, such as machinery, equipment, and physical structures* (Dicken, 1988, p. 361).

But the most effective way of transferring the technology is undoubtedly the execution of R&D program. This program is getting its popularity worldwide and it is known as the globalization of R&D activity. However it has been organized mainly, if not merely between advanced countries or industries for the sake of efficiency and economy.

Joint R&D program should be encouraged to happen also between developed and developing countries and among the developing countries. There are fortunately some 'success story' which can be referred such as software development industries in India (for varieties of software products) and New Zealand (for NEAX NEC digital switching software). The prerequisite for the joint R&D program to successfully take place is actually R&D management capability of the concerned parties. R&D management is a unique branch of management where creativity, intellectual activities, and great funding and risks are the main elements.

The process of transfer of technology in developing countries in the Asia-Pacific Region becomes a concern of governments and industries, because there are some expectations and opportunities to be gained from this high-tech industry. Generally, governments support local industries in some ways that is unique to each country in the region.

This paper presents particularly Indonesian, Korean, and Indian experiences in telecommunication technology transfer as samples in the Asia Pacific region. The emphasis will be on the search for suitable and appropriate technology transfer specially in the switching system industry.

INDONESIA

It is rather difficult to imagine, how big and spread is Indonesia. Indonesia is the largest archipelago country in the world with more than 13,667 islands extending for some 3000 km from North-West coast of Sumatra to the Papua New Guinea border. If the Indonesian map is superimposed with that of USA, it will stretch from the west coast to the east coast of the USA.

Although Indonesia is rich with mineral and natural resources, the development of telecommunications infrastructure remains very low. There was only 1.1 phones for 100 people, which Stephen McClelland (1991) said comparable to a country such as Bangladesh. But now Indonesia is trying to catch up. Indonesia, now the fourth most populous country in the world, through its government policy plays an important role to stimulate the local production facilities in return to one of the biggest telecommunications market in the region.

Based on the average growth of GDP by 5 % and the expectation on telecommunications to increase the GDP by 1.5 per cent to 1.8 per cent and net foreign exchange by between US $525 million to US $675 million (McClelland, 1991), since the end of 1980s the face of telecommunications has been changed dramatically. Indonesia plans to add some 2.1 millions telephone lines on the top of about one million in the fifth 5-year plan 1989-1994. The government will further increase this number further by extra 5 million subscriber in the sixth 5-year plan (1994-1998) bringing the number of 3.7 phones per 100 people.

The new telecommunications law, introduced in 1989, allows private sector participation in providing basic services in cooperation with telecommunications authority (PT. Telkom). Some 30 foreign companies have expressed interest last year in partnerships with PT. Telkom for revenue sharing arrangement. In this scheme, the private sector partner having invested in telephone network is entitled to 70 % of revenue in a set period (approximately 7-9 years) and after that the facilities will be transferred to PT. Telkom.

Equipment Manufacturing

The Maitland Report recommended that developing countries should consider the possibilities of local or regional manufacture. This will reduce foreign exchange problems and dependence on the TNCs. Moreover, beside some obvious benefits such as job opportunity and domestic value added, equipment and spare parts which are no longer available can be produced continuously.

In 1984 INTI (Indonesian Telecommunication Industry), a state owned telecommunications industry was awarded a contract to produce the 'flagship' of telecommunications products : digital switching system. Under the licence from Siemens Germany, the Electronic Digital Switching System (EWSD) has been manufactured from the initial production of 11,000 line units in 1984 to 150,000 in 1988 and it has grown to 400,000 line units last year. In 1990, AT&T and NEC were each awarded for 350,000 lines.

Indonesia's aims of the equipment manufacturing capability are:

- The capability to operate or utilise the production machines/facilities.
- The capability to understand the design.
- The capability to select and to find the substitution components through multi-sourcing program.
- The capability to achieve the level of efficiency in the production.
- The establishment of work discipline, corporate culture, and standard application.

However it is understood that to master the technology, the need is not only to *know-how (production engineering)* but also to *know why (basic design, research and development)*. Due to the fact that relatively little R&D has been relocated to developing countries, strategies for technology transfer must be developed.

Telecommunications Technology Transfer

Since Prof Dr. B.J. Habibie has been the Minister of Research and Technology, the task of technology transfer in Indonesia is better structured and well organized. He was formerly a vice president of the German aircraft company, Messerschmitt Bolkow-Bloehm (MBB) in Munich.

Dr. Habibie, also chairman of the Agency for Assessment and Application of Technology, has laid down the principles of technology transfer. His philosophy is *'to start from the end and to end at the beginning'*. In other words, Indonesia should be capable first in the final products and finish by mastering the initial components.

The process of technology transformation, which becomes a standard for developing 'strategic industries' in Indonesia, has four stages:

-Technology transfer through licence production ,i.e., the use of existing production and management technologies to produce goods already in the market;

- Technology integration, i.e., the use of existing technologies in the design and production of completely new products;

- technology development, i.e., the further development of existing technologies and investment in new technologies; and

- large scale basic research to support the first three stages and to defend the technological superiority already attained

A popular example is the development of the IPTN aircraft company in Bandung, Java. In the first stage, IPTN had been licensed to produce commuter aircraft C-212 Aviocar from Spain. In the second stage, IPTN developed together with CASA Spain a new aircraft for 35 passengers called CN-235 (1984). And at this time, in the third stage, IPTN is working on its own aircraft, a 50-passenger N-250.

However in the public switching industry, it is almost impossible to develop a new large switching system and compete in the world market. Muskens (1988) predicted that each manufacturer should have at least 16 % of world market share in order to exist, because of high Research and Development cost. In other words, if the world market would be a single market, there might only be six manufacturers left.

Therefore, another approach to transfer of technology should be worked out. One possible answer is to focus the transfer only in the software area. With this strategy, INTI for example with its own initiatives had sent 20 engineers to Germany to work in Siemens environment for around two years. They worked, together with Siemens engineers on how to develop, integrate and maintain the EWSD software.

It was realised, from the first months, that EWSD software is very extensive. EWSD, as a telephone exchange, must operate 24 hours without attendance and without failure. If there were errors, the system must be capable of self correction. Another point is that the basic EWSD software is completed. The variations of the software are only in the national projects (e.g., for Indonesia, Columbia, Pakistan). So, there was no sense in concentrating on studying the 'core' software (operating system, data-base, etc.)

Because of that EWSD software structure, INTI concluded that the possible development was to 'adapt' EWSD peripheral software and 'modify' it to the national telecommunications environment. This type of development is often called 'Software Adaptation.' With this capability, in the future INTI will be responsible for software adaptation for Indonesia (or even in the Asia Pacific Region).

Although INTI wants to develop its software development towards the higher level of R&D laboratory (i.e., to develop local products) through joint or independent development, INTI argues that the other possibility for the telecommunications industry in Indonesia is to search and develop small-scale products, which such large TNCs will never interested. The market for this product is also very encouraging. In this case INTI is now having a small public exchange up to 1000 subscribers called STDI-K (Small Digital Telephone Exchange).

The development of STDI-K begun in 1987 when there is a need from PT. Telkom to provide rural areas of Indonesia with small exchanges. We know that with the scattered and vast rural areas, the big EWSD is not so effective to supply lines under 1000. Therefore a new small switching system is necessary.

STDI-K was jointly developed based on the EWSD digital concentrator, by installing special control modules which makes this concentrator becomes intelligent. To control the exchange, STDI-K just needs a common IBM compatible personal computer STDI-K does also not require air conditioning facility and special raised floor as large exchanges. All of these reduce development time needed if INTI develops from 'scratch.' A trial run in Kamal, 1988

(Madura Island, East Java), proved to be successful. Now STDI-K is 'everywhere' in Indonesia, and INTI is still developing by enhancing the capability of STDI-K by adding some new features, such as OSS (Operator Services System).

Transfer of Technology in Telecom Operating Company

People do not talk so much transfer of technology in the telecommunications service providers. Indeed, as users of telecommunications products the transfer of technology is some what different. In PT. Telkom's view, transfer of technology should not be focused only in products but also operation, set-up and business arrangement.

Therefore at least three types of transfer of technology are possible between:
- Supplier - Operator *(equipment technology)*
- Overseas operator - Local operator *(network administration)*, and
- Standardization body - Operator *(techniques and philosopy)*

In developing countries, focus has so far been directed to transfer from the equipment supplier to the operator. Here, the technology transferred has everything to do with the product but very minor attention has been given to the technology as how to provide the service by utilizing the product. This is part of the reason why telecommunication the service in developing countries is usually substandard.

To improve the situations, telecom operating company in developing countries should seek for better partnership with developed operating companies and therefore better opportunity in transfer of technology. This is in fact a two way interest since standard quality of global telecommunications service will improve the number of calls crossing the nations borders. The technology which is transferred is different than the equipment oriented one, it is more to the technology of service provisioning. Technically it could mean the networking sense of different elements (products) and the arrangement as how to operate the network and interact with external entities such as the investors, suppliers, traders and customers.

Participation of telecom operating companies in the international standardization activities is one of the key strategies to be always up to date with the growing technology, the concepts and the technology behind. From the experience, this kind of technology transfer will most effectively occurs when operating companies are actively involved in standardization meetings of international agencies.

Telecom operating company in developing country can play a very important role in directing and coordinating the local equipment manufacturers to cooperate and to design their R&D program towards a national long term R&D achievement. Korea is a good case to refer (see the Korea section). As the user of products resulted from the R&D program of the manufacturers, telecom operating company has a very unique and potential position to foster the transfer of technology to happen in the country from overseas donor as well as to organize the local manufacturer R&D program to focus on a long term and strategical goal.

In any case the unsuccessful transfer of technology to the developing countries operating company may result in an unacceptable quality of the telecommunication infrastructure and service and in turn this will hamper the growth of it in terms of capacity and technology. In turn this will affect the opportunity that the donor country should have to contribute.

KOREA

Korea, one of the advanced developing countries in Asia, is already successful in developing its own switching industry, after some years of TNCs presence. Backed with the rapid growth of economy and the massive increasing demands of telecommunications service, Korea is now able to produce and export various indigenous digital switching called TDX series from the range of 10,000 to 100,000 subscribers.

From 1985 until 1992, there are already 5,885,000 lines have been supplied to the Korean Telecommunications Authority. There has been export too to countries such as Philippine (1990, 6,150 lines), Nicaragua (1991, 5,500 lines) and Iran (1991, 19,000 lines).

How did Korea create its own research, development and manufacturing in the switching system industry ? The answer is in the research institute called ETRI (Electronics & Telecommunications Research Institute). ETRI had conducted a basic research since 1978 and in 1981, a laboratory model was completed and put into a field trial in a rural area of Korea. The result is a production model TDX-1 with the maximum capacity of 10,000 lines.

It can be said that ETRI acts as an 'architect'. ETRI set-up the system architecture, hardware devices, and software needed for call processing, maintenance, and administration. With full support of the government through the funds provided by Korean Telecom, ETRI was able to transfer the know-how to four local manufacturers i.e. GoldStar Information and Communications, DaeWoo Telecommunications, Oriental Communications, and SamSung Electronics.

The success of TDX-1 had encouraged Korea to continue with new product in 1987: TDX-10 (maximum of 100,000 lines). Again Korean Telecom and ETRI play a major role. This collaboration, KT as a project coordinator in term of funds, user requirement, qualification test / commercial service and ETRI as designer, development control and system integration and test proved to be appropriate.

Lee and Bahk of ETRI (1988) describes some transfers of documents (system design, functional block design, unit design and others) and supporting systems for design and production to the local manufacturers (software development system, CAD environment, automatic test environment, dimensioning system, traffic analysis packages). In addition Lee said that people from manufacturers were sent to ETRI and have worked together. This transfer of technology' shows the 'true' complete transfer of technology.

Manufacturers, with its expertise in production and technology development put the laboratory model into mass production. Specially in this TDX-10 development, the role of universities and other research institutes come up with the support of development environment, future directions and basic research.

Hun Lee and Hang Gu Bahk said in an Asian ISDN Council (AIC) meeting, Manila 1988 that what Korea has done is a concerted effort to build the necessary infrastructure to achieve a self-reliant telecommunications technology base. The effort is such that the accumulation of resources including well educated engineers at ETRI and other organisation is necessary.

The development of indigenous switching system will reduce the dependence on major international firm. It clear cuts the difficulties that might happen if Korea had developed the system from the existing one. Nevertheless the former analysis remain, could Korea sustain the development of digital switch after it fulfil the domestic market ?

INDIA

India is a special case. A quote from Pitroda from C-DOT (Centre for Development of Telematics) may reflect the Indian policy on technology: "Even since independence, India has been emphasising indigenous development and self-reliance in several major technologies for basic necessities such as agriculture, transportation and communication. India, with strong industrial base and scientific manpower, impressive in quality and range of skills, just cannot rely on imported technologies and products to build her infrastructure to leap frog into the future."

With those philosophy, India does everything with their own, however sometimes with old technologies they acquired in the past. An example is their main exchanges (above 2000 lines) factories. There are still 4 factories set up by ITI (Indian Telephone Industries Limited) that use Strowger technology from 1948 and Crossbar technology from 1965. Until 1987, 90% of Indian telephone lines are still using these type of technologies (Nair, 1989)

The problem emerged as the Indian Telephone Industries tries to replace those main exchanges with the Alcatel E-10B switches. But "...nearly 12,000 persons are becoming surplus', said Nair. As a result the Indian Government reserved the market for ITI for main exchanges (more than 2000 lines) until such time that all the manpower and infrastructure are utilised.

However for switching system which has the capacity under 2000 lines, India has its own indigenous products. Started in 1984 under a centre called C-DOT (Centre for Development of Telematics), India was able to produce 128 port PABX and rural exchange. There is also 512 port version. ITI has also produced exchanges called 'ILT' (Integrated Local Trunk Switches) with the configuration from 1000 to 2000 lines.

The development of C-DOT exchanges started when Sarin committee was appointed in 1980 to analyse the telecommunications problems in India. He came up with recommendation of digital technology for the future switching and transmission facilities. In line with this, it was decided to develop new digital switching system indigenously.

Again, the same as Korea, the government of India accumulates the resources in two and half years, and agrees to spend some Rs. 35 crores to develop a family of digital switches in 36 months with 300 engineers. A new company was set up in August 25, 1984 : Centre for Development of Telematics (C-DOT) (Pitroda). The task was not only to design but also to produce in a complete production line. C-DOT rural exchange with 128 port was exhibited at Africa Telecom 1986. The commercial production is due by the end of 1987.

CONCLUSION

We have seen examples from Indonesia, Korea and India in technology transfer, especially in the switching system industry in the Asia Pacific Region. In Indonesia, INTI develops small digital exchange in addition to support laboratory or even locally integrated research and development laboratory.

Korea, backed with a strong economy, has already set-up a good manufacturing base of switching system industry. Korea made this happen with the concerted effort and strong commitment of Korean Government through its Korean Telecom, ETRI /Universities, other research institutes and manufacturers.

India started to develop its own digital switch after looking that 90% of it telephone were from old technologies. With the philosophy of self-reliance, India produces switching system by setting up a centre called C-DOT (Centre for Development of Telematics).

We can see that the challenges of technology transfer require commitments in human resources, financial support and of course, reliable research and development organisation. Technology transfer must be acquired with efforts from the industry itself as well as the government through its policies. Moreover, industry should also have the capability to translate the development of technology into development of manufacturing as recommended by the Maitland Report.

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COOPERATION TASKS OF TELECOMMUNICATIONS IN THE ASIA-PACIFIC REGION

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1. Introduction

The telecommunications were largely dependent on the telephone and telegraph in the past but today, their services are fast expanding thanks to the rapid development of technology, the advent of versatile computers and the linked usage of telecommunications and computers.

Accordingly, the telecommunications have become more essential in today's economic activities. In fact, telecommunication services enable enterprises to be internationalized by overcoming the geographical barriers and thus expand their production and trades by exchanging information faster.

The information network will play the pivotal role in exchanging and distributing information, which is so essential in commerce and industry.

As the technologies for telecommunication and information are further developed, their role will be more crucial in industries and eventually they will lead us to an information society.

In particular, the necessity of the information network is even greater in the Asia-Pacific region and suggest some cooperative activities deemed necessary among the countries in the region.

2. The telecommunication environment in the Asia-Pacific region and the present status in Korea.

The countries in the Asia-Pacific region can be classified into four groups in view of the structure of the telecommunication providers and the services.

Included in the first group are China, Thailand, Indonesia, Taiwan, etc. whose telecommunication services are being provided exclusively by the government or public enterprises. The second group embraces those countries which have privatized the telecommunication service providers but the service is still a monopoly. Hong Kong, telecommunication service providers but the service is still a monopoly. Hong Kong, Singapore and Malaysia belong to this group. The third group includes such countries as Korea, Japan, Australia, etc., where competition is partly introduced and the carriers are almost privatized. In countries falling into the fourth group, telecommunication services are fully transferred to private domain and competition is widely in practice. In this group are such countries as USA, Canada, Philippines and New Zealand.

Generally speaking, however, the countries in the Asia-Pacific region follow on a similar pattern in reforming their telecommunication structures in that, at the beginning stage, the service is provided by a government body and then it is provided by a public enterprise and at last the service is privatized while competition is introduced.

Contrary to the trend in basic telecommunication services mentioned above, however, the mobile service has been developed in a different style. As the mobile service was regarded as a special type of alternative service rather than a kind of public service like telephone and was also thought to be somewhat confined in the use for a restricted group of customers, the participation of private corporations was allowed from the initial stage.

Apart from privatization and liberalization, another important aspect in the telecommunication field is internalization. As you are well aware, such multi-national negotiations as Uruguay Round are frequently held in this telecommunication business. In the long term view, it seems to be inevitable to open the telecommunication market internationally and in this respect, the Asia Pacific countries should make renovations in their telecommunication structure or service so as to cope effectively with such internationalization trend.

In terms of facilities, Asia-Pacific countries can be divided into two groups; the first one has such countries as USA, Canada, Japan, Hong Kong, Singapore, Taiwan, Korea, Australia and New Zealand whose telephone supply has already exceeded the demands. On the other hand, the countries in the second group could not provide the public with sufficient telephone facilities yet, hence it is not easy for ordinary customers to gain access to telephone services.

The former group now have to pay their attention to providing a variety of new services and the enhancement of the service quality, while the latter group should accelerate the expansion of facilities in the first place.

From the point of view of industrialized countries, the fact that there exists considerable gap in the degree of facility installation among the Asia Pacific countries would seem to be an attractive telecommunication equipment market. In reality, however, it would give a bad effect to that region in respect to the promotion of commerce and evolution of the industries due to the lack of fast and sufficient communications among the countries.

In the case of Korea, continuous investments have been made year after year in expanding the total scale of national telecommunication capabilities since last decade. As a result, the demand for basic telecommunication service has been fulfilled to some extent. In addition, we have achieved a great goal for the technology level-up. For example, Korea has developed a full-digital exchange, named TDX, thus ranking itself among the top ten countries in the world.

As the facilities are enriched and the service is diversified, it becomes no longer suitable to remain a monopoly. Moreover the pressure for opening the telecommunications market is getting stronger from outside. Hence it is almost inevitable to reform the telecommunication structure including the regulatory aspects as well as the service categories. In this connection, the area of value-added services was brought into competition to a far extent already and even the telephone service stands in competition partly. In the case of mobile telecommunication service, new competitors are expected to be opening in the near future.

Despite the dramatic development in the basic telecommunication service area in Korea, other specific services are still poor in its scale of facilities and penetration into day-to-day life of the public. The sum of mobile telecommunication service and other value-added services accounts for a mere twelve percent of the total telecommunication market of Korea at present.

In respect to technology, such areas as digital mobile communication, portable phones, satellite communication and data communications are still underdeveloped. In addition, the key technologies required for the forthcoming integrated telecommunication service era in the 21st Century, including fibre optic transmission, high speed/broad band transmission and intelligent network are still to be upgraded.

3. The necessity for telecommunication cooperation in the Asia-Pacific region and current status

From the position of Korea, the necessity for telecommunication cooperation with Asia Pacific countries is viewed as follows.

First, out of the total international telecommunication traffic, the segment of the Asia Pacific region accounts for 69 percent and 73 percent for outgoing and incoming respectively so that the Asia-Pacific region is of vital importance to us. Second, the potential of the Asia-Pacific area is great enough to give us some motivations for the development of data communication service in view of the demand for not only the data communication service itself but also the commercial utilization of it.

Third, Asia Pacific countries can achieve the technology development and transfer with less effort and cost through cooperative ties among them.

We think, such cooperative efforts are still needed for other countries as well, for it will cause the total volume of telecommunication utility to be increased and in turn, enhance the economy in the region as a whole.

In order to attain such objectives, the countries' mutual cooperation is required especially in the following activities.

First, the establishment of a global data communication network with a view to ensuring diverse and free exchange of information. It means not only the expansion of the network itself but the upgrade of the service quality.

Second, in order to utilize data communication freely, all the technological and regulatory environment should be reshaped or broadened.

Third, to set up telecommunication standards commonly applicable to any country in the region so as to ensure effective interconnectivity of the data communication networks between countries. Viewed in this light, we need systemized tools in the region.

Fourth, in view of the balanced development of telecommunications, every country should cultivate human resources, especially for the areas of relatively less developed technologies. This is the area in which the regional cooperation system is most required.

There already exists several regional cooperative organizations in operation in the Asia Pacific. And I understand some of other economic organizations are also developing several programs to boost the telecommunication industries of the region.

In the former, there are such bodies as the Asia Pacific Telecommunity, the Pacific Telecommunications Council and the Asia ISDN Council. The latter includes the telecommunication development program of APEC, the Triple T project of PECC and the committee activities of ESCAP.

4. Tasks of Cooperation in Telecommunications in the Asia-Pacific region

4.1 Exchange of information in the telecommunication sector.

The first thing to do in the Asia-Pacific region is to exchange information on each country's current status of telecommunications.

In the latter part of the 20th Century, the technological advances have been accelerated year after year. Keeping pace with this, the circumstance of telecommunication services and regulations are being restructured in each country. Such variations are shown to us as the privatization, competition and deregulation.

In order to keep abreast with such circumstantial changes, every country should modify or reform its telecommunication structure regarding both technical issues and regulatory matters. In doing this, we really need to know of other countries' experiences and applications.

At present, some regional organizations are running specific programs for gathering database of each country's telecommunications environment. APEC and PECC have completed their respective information gathering and APT is also going through this process.

APEC's committee for telecommunication has launched a project named Data Compilation through which APEC member countries are exchanging information related to telecommunications. Under this project, materials are gathered from all the member countries such as telecom regulations, investment plans, conditions for penetration into telecom market, education programs and facilities. It plans to draw a master plan on telecommunication cooperation policy on the basis of the data compiled.

On the other hand, PECC's Committee for Telecommunications, Transportation and Tourism has conducted a rather broad survey on these three areas under the title of Triple T Survey. PECC's survey is unique in that it includes opinions from experts in the field.

This information gathering and distributing work is an on-going project and is expected to be carried out in the future, even more actively and quickly for the purpose of achieving real cooperation in the region.

4.2 Establishment of a Data Communications Network in Asia Pacific

As the economic structure is transforming itself into the service oriented one, the need for information as well as data communication is on the rise in proportion but present PSTN cannot fully support such complex communications.

Therefore it is urgently required to set up a renewed data communication network as an economic infrastructure in the region which links all the countries in the Asia Pacific together, comprising such facilities as exchange and transmission systems, and software like EDI or E-mail as well.

In relation to the theme "Establishment of Data Communication Network in Asia Pacific Region", Teleport plan was drawn up and has been carried out by APEC. And another project named "Triple T Port for Developing Economies" is underway in PECC.

APEC's Teleport plan is drawn up in two directions; one is to establish the concept that Teleport plays an important role as a center of telecommunications to regional economy development and, the other is to discuss the items to be investigated or examined preliminarily prior to the installation of the network. APEC's Teleport plan is progressing comparatively slowly because there are various opinions in regard to the pattern and scale of the teleport system which should reflect such factors as the degree of facility deployment, communication demand and regulatory circumstance.

PECC has come up with a teleport model as reviewing the construction plans of telecommunication infrastructure in Indonesia, Malaysia and Thailand which have the construction plans of "Industrial Parks".

The viewpoints from the countries involved in the Teleport project have shown a conflict of interest. Industrialized countries are interested in providing equipment required for the construction of Teleport network, while underdeveloped countries look for receiving technical and financial support through this Teleport project.

For the successful establishment of data communication network in the Asia Pacific region, these two aspects should be harmonized smoothly.

4.3 Utilization of Data Communication Network

Another important thing in regard to the establishment of data communication network in Asia Pacific region is how to utilize the network well.

The services to be thought of on the first hand are EDI, E-mail, Videotex, Audiotex, etc.. In particular, EDI is expected to be utilized extensively in trade and commerce and other economic activities as a whole.

As a utility program of the international data communication network in Asia Pacific, "EDI plan" of APEC and "Pacific Communication Network" of PECC have been drawn up. Of these, EDI plan of APEC is in progress in two ways, one is to provide EDI education program to member countries and to draw their attention by doing so and, the other is a demonstration program which shows the real benefits from using EDI. On the other hand, PECC's interest is on electronic mail and bulletin service.

EDI itself is, of course, to be welcomed for both industrialized countries and under-developed countries in consideration of its usefulness, but the situation of the countries are not all the same. It is because EDI or data communication is closely related to service industries such as finance, insurance, advertisement, tourism and that if utilization of the network is wide-spread, it makes easier to penetrate into the service market of developing countries by developed countries.

In the circumstances, USA, Canada, Australia, New Zealand, Japan, Singapore, Hong Kong, etc., are emphasizing the earlier implementation of EDI, whereas other countries which do not have sufficient technical or service capability are rather passive in this regard. Accordingly, the matter of introduction and utilization of the data communication network in Asia Pacific area should be preceded by deep considerations on the harmonious combinations of above two seemingly conflicting standpoints.

4.4 Development of Human Resources

As the cycles of new technologies are getting shortened due to renovations in services and relevant technologies, it becomes the key task to develop and obtain sufficient professional manpower possessing upgraded skills.

Even in this matter of data communication network build-up and subsequent use of it in Asia Pacific, human resources development is very crucial and therefore requires substantial cooperation and supports.

Such cooperation in Asia Pacific region can be achieved in two ways; more convenient way is the technology transfer in the course of telecom equipment imports, which is a rather private and bilateral method between the vendor and vendee. The other approach is to promote cooperation through international organizations.

As you are well aware, APT and APEC are conducting training program. APT's program is focused on the technical training for the people from developing countries, while APEC's program has been targeting the management class of the service providers.

When it comes to organizing the training program, the field of interest is contingent on the situation of each country. In the case of less developed countries, whose priority is to expand the telecommunication facilities and services, the training is focused on cultivating the general technical man-power capable of installation, operation and maintenance of the equipment and facilities. Compared with this, newly industrialized countries such as Korea, Hong Kong, Singapore and Taiwan need professional engineers for state-of-the-art technologies as they already have enough human resources for handling other general areas and besides, they can cultivate the required technicians by themselves to some extent. On the other hand, advanced countries are not interested in the training itself, but in other benefits derived from such training programs. They are in a position to provide other countries with their own developed education systems and so, they may expect the increase of demands for their manufactured telecommunication facilities in connection with the training courses.

4.5 Standardization

Needless to say, communications are possible only when the terminals and associated facilities' in both sides satisfy required technical specifications.

In the countries of the Asia Pacific region, both old and new systems with updated technical standard are commonly used and yet, some countries are using the materials of their own standard.

It could be easily seen that if each country is producing and using its own type of facilities, it will give disadvantages to international telecommunications on a global scale and this is especially true of data communications.

In order to absorb rapidly upgrading technologies with less effort, it shall be emphasized to produce an environment for setting up telecommunication standards on a regional basis.

I understand there is no regional organization for telecommunication standards in Asia Pacific like ETSI in Europe yet. Though there exists such organizations as PTC and APT, they are not directly related to the matter of standardization.

PTC is open to any issue concerned with telecommunications including the standardization matters, but is rather oriented to the exchange of information and APT's role is focused on the balanced development of all the countries in the Asia Pacific region, the standardization is left out in the dead angle.

The subject of standardization includes not only technical aspects but economic points. As the standardization of materials are being treated as non-tariff trade barriers, this matter is very sensitive to trade and commerce also.

Due to such economic concerns of each country, setting up a regional standard organization is a very difficult task. However, considering the fact that our primary purpose in this telecommunication business is to maximize the fulfillment of communication needs in keeping with the development of all the industries, it still seems to be necessary to establish a standardization body in the Asia Pacific area so as to come up with useful standards commonly applicable to all the countries. Support and cooperation are badly needed in this regard.

5. Closing Remarks

The telecommunication cooperation in the Asia-Pacific region should be progressed toward the direction that the technology renovations in the field of telecommunications are being reflected to a maximum extent in improving the social and economic standard in the region.

It is in this context that I have mentioned some tasks of cooperation for the telecommunications in the Asia-Pacific region. They are; Exchange of Information sector, Establishment and utilization of Data Communication Network, Development of Human Resources and Standardization.

As PTC has played an important role so far in promoting a free exchange of information in regard to telecommunications, I count on the PTC to continue to carry out such functions in the future so that it will contribute a lot to the development of the Asia Pacific society.

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