DOCUMENT RESUME

ED 187 341 IR 008 461

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TITLE Educational Telecommunications Delivery Systems.
INSTITUTION American Society for Engineering Education, Washington, D.C.
PUB DATE 79
NOTE 152p.

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Cable Television; Communications Satellites; *Delivery Systems; Educational Equipment; Educational Radio; *Educational Technology; Educational Television; *Educational Trends; Public Television; *Telecommunications; Teleconferencing

ABSTRACT

This monograph is a single volume reference manual providing an overall review of the current status and likely near future application of six major educational telecommunications delivery technologies. The introduction provides an overview to the usage and potential for these systems in the context of the major educational issues involved. Each article is written by an expert in that field, and provided with commentary by an acknowledged professional in educational telecommunications critiques. These papers are as follows: (1) Public Broadcasting and Education: A Look at the Record; (2) Instructional Television Fixed Services: A Most Valuable Educational Resource; (3) Teleconferencing + Telewriting = Continuing Engineering Education in Wisconsin; (4) How to Establish and Operate a Radio Reading Service via SCA; (5) Radio Reading Service: The Minnesota Experience; (6) Cable Television: A Useful Tool for the Delivery of Education and Social Services?; and (7) Communications Satellites for Education and Training: Past, Present, and Future. (RAA)

ED187341

Educational Telecommunications Delivery Systems

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Editors

IR008461

$7.00

Library of Congress Catalog Card Number: 79-53685

American Society for Engineering Education
One Dupont Circle, Suite 400
Washington, D.C. 20036

ISBN 087823-105-6

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Introduction

Two years ago, after determining that there was available no reference manual describing the major types of educational telecommunications systems, and after evaluating the potential usefulness of such a volume to educators in engineering, as well as those in other fields, the Publications Committee of the American Society for Engineering Education chose *Educational Telecommunications Delivery Systems* to be the subject of an ASEE monograph.

As a guide to compiling the monograph, the monograph editors selected as a working definition of America's educational goals one submitted to the National Academy of Engineering in 1972.[1] This specification stated that the nation's educational processes should:

1) Provide students the knowledge necessary to understand themselves, their environment, and their relationships with others, so they can effectively manage their lives;
2) Give students sufficient training and expertise (be it in shoe shining or in people management) to enable them to obtain their basic needs;
3) Develop within students the ability to adapt effectively to the varying requirements of a constantly changing world; and
4) Generate within students sufficient motivation to enable them to use their capabilities in ways that are constructive both for themselves and for the society in which they live.

It has taken 371 years (from the founding of Jamestown) and a number of far-sighted legislative acts and judicial decisions to create our nationally comprehensive

2000	
1978	
1962	The Golden Age: Progress in the Democratization of America's Educational System
1954	Supreme Court Outlaws Racial Segretation
1900	
1890	Federal Funds for Land Grant Colleges
1862	Morrill Act--Land Grant College Act
1852	Massachusetts Compulsory Attendance Law
1834	Pennsylvania Public School Law
1821	First Public High School, Boston, Massachusetts
1800	
1795	First State University Opens
1700	
1639	First School Supported Directly by Taxation—Boston, Massachusetts
1635	Founding of Harvard University, Cambridge, Massachusetts
1620	Landing of Pilgrims, Plymouth Rock, Massachusetts
1607	Jamestown, Virginia, Founded

Figure 1. Landmarks in American education.

educational system (see figure 1), and to come nearer to meeting our far-sighted egalitarian educational standards. We still have far to go, however, to realize our national educational goals. Further, costs of education continue to spiral upwards, and voluntary support of public education is decreasing as these costs rise. Without more effective use of its educational resources, the nation may be unable to continue its long struggle for equal access to education for all its citizens.

Threats to the Economic Viability and Public Support of Our Educational Processes

Factor One: *Failure of educators to control the critically spiraling costs of their services*

The following taken from the April 1977 issue of *Educational and Industrial Television* clearly supports this critical assessment.[2]

> In dollars adjusted to reflect true buying power, the average per-pupil cost of America's public school system in 1947 was $406; in 1957-58, $733; in 1973-74, $1,364. In brief, America's per-pupil cost has been doubling (in *adjusted* dollars) every ten years, and is still spiraling. Does the increased quality and quantity of school-level education justify this out-of-control factor? American voters apparently don't think so, for whereas in 1965 they approved 74.7% of the school bond issues submitted to referendum, in 1975, they approved only 46.3%.

Factor Two: *Education's ever-expanding responsibilities*

America's is a technology-based society, and its educational processes are expected to keep up with the needs of a dynamic, fast-changing democratic society. New socio-economic factors and ever-expanding technological information continue to increase the depth, number and types of educational requirements. Lifelong education, computer power distribution and education of the handicapped are but three of the many new responsibilities of our educational processes. New responsibilities, as well as inflation, are contributing to the spiraling (and, to the public, alarming) rise in the cost of education.

Factor Three: *Educators are not meeting consumer requirements*

Time and geography still shackle our educational processes. Those who wish to learn usually must go to a certain place at a specific time for the education they need to get a job in the first place, and the continuing education needed to keep it.

America has, indeed, spent billions of dollars during the last quarter century to develop teaching expertise and materials, but has spent very little to develop more efficient ways to meet the third dimension of its education processes: distribution.

This failure has contributed substantially, many believe, to the frightening rise in educational costs and has restricted the "consumer" use of America's educational processes.

Table 1, (see next page) published in *Engineering Education* and based on data prepared for the National Academy of Engineering's Advisory Committee on Issues in Educational Technology, indicates the significance of our unfilled educational needs.

Factor Four: *Educators have failed to make intensive use of modern technologies*

According to statistics from the National Center for Education Statistics, three of every ten of America's 214 million persons are currently direct participants in the nation's educational processes--62.3 million, including 58.9 million students, 3.1 million teachers and 300,000 administrators and staff employees. Further, the current annual cost of our educational system is running in excess of $180 billion. Thus, our educational systems are the nation's third largest industry, exceeded only by petroleum and retailing. During 1975, education represented 7.8 per cent of the total national product. Yet in terms of per-employee production, education is probably the lowest of the country's top ten producers. (See figure 2.)

Many critics believe that education is the only major American industry which does not yet make intensive use of modern technologies to reduce its costs and to increase the scope of its services.

Innovative Capabilities and the "Crisis in the Classroom"

There is reason to expect greater use of technology in the future in our educational processes. Since 1954, for instance, educators have been effectively but slowly trying to develop new ways to stem the rising tide of per-student costs.

One of the most promising ways to increase the geographic scope and effectiveness of America's educational processes appears to be the use of modern telecommunications technologies.

There are currently six major telecommunications methodologies delivering

Table 1. America's Potential Student Body.

	Total by Category	Those Now Being Served	Those Not Being Served	% Not Served
1) Pre-school young (no curriculum, no communications links)	11,424,000	3,949,000	7,475,000	65.4%
2) Physically handicapped & homebound (no communications links, no accomodation of the curriculum)	389,500	191,946	197,554	50.7%
3) Lower economic classes (unable to afford direct or indirect costs)	16,[illegible],000	7,000,000	9,000,000	56.3%
4) Communicatively disordered – deaf, blind, dyslexic (system presupposes entering behaviors which these people lack)	2,934,500	1,493,672	1,440,828	49.1%
5) "Educationally averted" dropouts (past reinforcement from the system leads them to predict more 'failure experience')		(Elem. 4%	1,473,800)	
		(High 24%	3,552,000)	
	7,636,800	(Coll. 50%	2,611,000)	
			7,636,800	
6) Aptitudinally unique (same as # 4)	3,783,000	1,195,000	2,588,000	68.4%
7) Basic skills - deficient (same as # 4)	665,000	221,000	444,000	66.8%
8) Incarcerated – institutionalized (same as # 2, neglected & juvenile del.)	175,000	175,000	NDA*	
9) Socially-culturally different (system presupposes values which they do not have)	340,000	215,000 Migrant 125,000 Indian	NDA*	
10) Geographically remote (same as # 2)	1,500,000			
11) Temporarily out of phase (night)	1,500,000	1,500,000	NDA*	
12) Older & retired (same as # 2, poss. # 3)	275,000	25,000	250,000	90.9%
13) Spec. educ. training skills (mgmt. etc.)	13,000,000	13,000,000	—	
TOTAL	58,123,600		21,395,382**	
14) Formal Education		1970	1975	
K-12		51,600,000	51,000,000	
Undergraduate		6,662,000	8,368,000	
Graduate		946,000	1,334,000	
Noncredit		666,000	962,000	
Part-time credit		1,576,000	2,043,000	
	TOTALS	61,450,000	63,707,000	

*NDA No data available. Figures rounded to nearest 1,000 Revised 4/8/73
Source of Data: U.S. Office of Education and the Department of Commerce.)

**If drop outs are included, this figure would be 29,032,182

See Curtis, J.A., "Recommendations for a National Educational Telecommunications Network," in the *Proceedings, FIE Conference*, ASEE, 1973, and Curtis, J.A., "Needed: A National Telecommunications Network for Education," *Engineering Education*, May 1974.

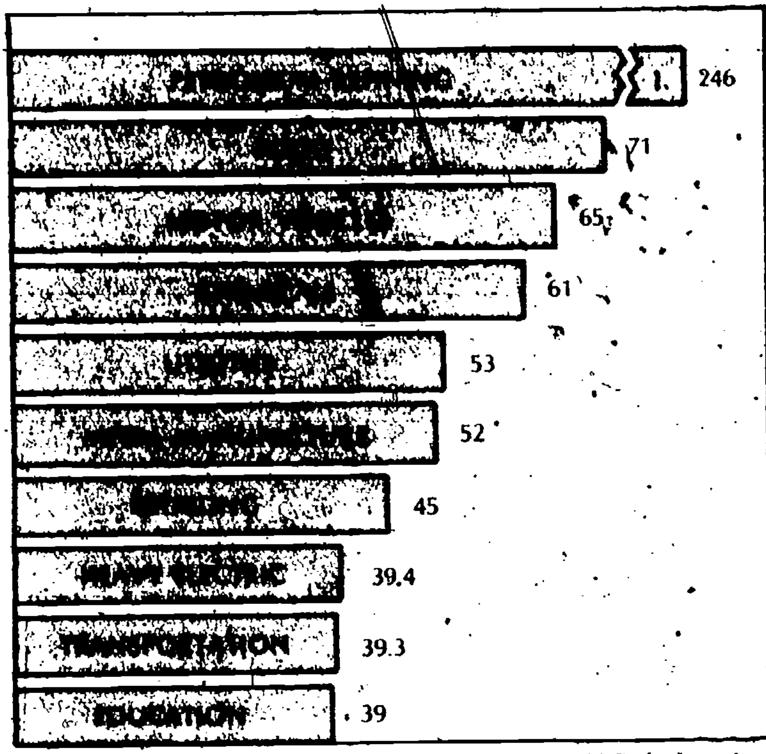


Figure 2. Revenue per employee for various U.S. industries (in thousands of dollars).[2]

educational services every day to major segments of students. Together, these methodologies have demonstrated their ability to distribute *effectively*, the "cradle-to-grave," diverse education so essential to our well-being and democratic future. So far, only one federal agency (the Federal Communications Commission, which assigns our frequency spectrum resources), and one federal bureau (the Bureau of Education for the Handicapped) have demonstrated the farsighted statesmanship essential to the proper, continuing development of this new, major educational tool.

Although very different in equipment specifications, operating procedures and cost requirements, the six major educational telecommunications delivery methodologies have one common denominator: They all have the ability to break the shackles of *geography* and *time*—factors which so drastically limit access to most educational systems. Telecommunications methodologies enable educators, for the first time, to deliver education where and when the consumers, not the manufacturers, of education want to buy and use it.

These methodologies have also demonstrated their usefulness in the area of cost control. They assist this important objective by enabling educators to:

1) Bring resource materials and teaching expertise from remote locations to supplement the teaching expertise and programmed information of the classical classroom; and to
2) Increase individual teaching productivity by enabling the instructor to teach from a central point one or more student bodies in remotely located classrooms (be they a home, a hospital, a rented store front or the conventional school or campus classroom).

Six Major Educational Telecommunications Delivery Technologies

The six major U.S. educational telecommunications methodologies are as follows:

1) Public Broadcasting (radio and TV)
2) Instructional Television Fixed Service (ITFS)
3) Teleconferencing-Telewriting (via standard telephone circuits)
4) FM-Broadcasting Station Multiplexing
5) Community Antenna Television (CATV)
6) Satellite Circuitry

In most instances, each of the six major educational telecommunications methodologies has been initiated to meet differing student body needs and delivery requirements. Each is therefore likely to have its own group of proponents. These methodologies have yet to be integrated into a coherent, coordinated educational delivery system, even on a local operating level, let alone on a statewide, regional or national level.

These differing factors make it difficult to prepare one comprehensive, in-depth analysis of current uses and costs of educational technology and identify the likely future applications and operating costs of more than one telecommunications technology. There are, however, operators/users/managers who have operated and studied one or another of these systems over a long time.

We have selected one or more such experts from each of the six educational fields of telecommunications to prepare papers regarding the particular field in which each has special knowledge.

Obviously each author is likely to be an advocate of the particular methodology in which the author has time-based confidence and experience. To balance this possibility of prejudice, we have asked Bert Cowlan, the H.L. Mencken of educational telecommunications critiquing, to cast his discerning eye and sharp wit on the contents of each contribution. The editors believe this monograph to be the first reference manual to provide in a single volume an overall review of the current status and likely near-future application of the six major educational methodologies by professional advocates of their use.

John A. Curtis
Joseph M. Biedenbach

REFERENCES

1. Written and submitted by John A. Curtis, December 1972, to the Advisory Committee on Issues in Educational Technology, National Academy of Engineering.

2. Curtis, John A. and Alan R. Blatecky, "Project TIMES–Telecommunications in Medical and Educational Services," *Educational and Industrial Television*, April 1977, pp. 35-42.

John A. Curtis is founder and chief operations officer of the Center for Excellence, Inc., in Williamsburg, Va. Joseph M. Biedenbach is director of continuing education, College of Engineering, University of South Carolina, Columbia. Dr. Biedenbach was chairman of ASEE's Publications Committee when plans for this monograph were approved.

Commentary

When John Curtis first asked me to write a series of short commentaries on the papers assembled for this volume, he described my style as "Mencken-like." Somehow, my reputation for choler must have reached John, or at least some indication that I have recently become rather short-tempered with over-blown technological promises. Not long ago, I encountered a lapel badge (conventioneer-style, and you what Mencken might have had to say, and probably did say, about conventioneers), which read, "Technology is the answer . . . but what was the question?" Perhaps that's the bias—if, indeed, it is a bias—that I bring to this volume.

Since it was a fairly strict injunction, I turned to the collection of quotations that hangs over my desk for use on occasions such as this or when other words fail me. I did find one from the Sage of Baltimore that somehow does seem suitable, "Conscience is that small voice within you that tells you someone is watching," especially since John took the trouble to notify the authors that I would be undertaking this task.

The idea of writing a set of commentaries on papers dealing with educational technology and communications is appealing. I find myself wishing, usually just after publication of my own efforts, that someone had done just that for me. (Of course, I'd prefer that it have been *before* publication, but that isn't the way this world seems to work.) One non-Mencken saying that seems appropriate to the education/communications/technology world came from Albert Einstein: "Everything has changed," he said, "except man's way of thinking." It is believed to have been said in the context of the dawn of the atomic era but, since, in the long run, education is even more dangerous than atomic energy, perhaps it should apply here as well. It certainly seems to apply to education in the sense of the old adage that *from innovation to implementation generally takes seven years, except in education where it takes forty.*

After reading through this volume, I find myself puzzled by the lack of a unified policy, the lack of a realization on the part of those who make policy that education/communications/technology constitute a *gestalt* and must be dealt with as such. The failure to deal with the problems of one area can back up, rapidly and with possibly disastrous effects, upon the others. Changes in one, without consideration to what will happen to the others, can produce the same effects. Perhaps Garret Hardin said best what I fear in the current policy vacuum:

> We can never merely do one thing because the world is a system of fantastic complexity. Nothing stands alone . . . . The stirring of a flower on Earth may not quite trouble a distant star. But it does trouble the rest of Earth to a surprising degree.

Bert Cowlan

Bert Cowlan is an independent consultant in New York City who has a long and distinguished background in the use and development of telecommunications for education and social service.

Public Broadcasting and Education: A Look at the Record

Douglas F. Bodwell
Corporation for Public Broadcasting

No book about educational telecommunications would be complete without dealing with the contributions that public radio and television have made to learners of all ages. A comprehensive study of the educational uses of public radio and television, however, could easily fill a volume by itself.

This chapter looks at the educational and instructional programs and services provided by public radio and television licensees in the United States, Guam, Puerto Rico and the Virgin Islands. Specifically excluded will be educational and instructional programs broadcast over commercial stations (such as Sunrise Semester) and closed circuit programming originated by school districts or colleges and universities.

While most programs broadcast by public radio and television licensees can be considered educative in the broad sense of the term, I will focus here primarily on those that are formally "instructional", i.e., aimed at specific instructional objectives, usually used in organized learning environments, providing credit to viewers or receiving feedback from them, and usually accompanied by learning materials.

The Corporation for Public Broadcasting (CPB) was created by the Public Broadcasting Act of 1967 to facilitate the full growth and development of non-commercial, educational radio and television nationwide. A private, non-profit corporation, CPB was funded mainly by Congressional appropriations for fiscal year 1978 in the amount of $107,150,000. CPB disburses funds by several means, among which are direct, unrestricted financial assistance to eligible public radio and television licensees in the form of Community Service Grants; programming support grants in radio and television; and contracts with the Public Broadcasting Service (PBS) and National Public Radio (NPR) for the nationwide interconnection services of public radio and television. CPB also funds training opportunities and provides other services to the stations and the industry in such areas as educational activities, audience research, system-wide information gathering and engineering research.

Origins and Growth

It should be clear that a system as involved as public broadcasting did not emerge full-blown overnight.

From the beginning, what is now public broadcasting was closely tied to education. The first noncommercial radio signals were transmitted in 1919 on an experimental basis from Madison, Wisconsin's, station 9XM, relicensed to the University of Wisconsin as WHA in 1921. From 1920 to 1930, educational institutions constructed at least 176 radio stations, of which only 35 survived the 1929 Crash. The survivors were mostly at land grant colleges, where the commitment to off-campus learning and education was mandated under the Morrill Act. These stations continued to serve through World War II, when the emergence of FM caused some educators and broadcasters to petition successfully for educational reservations on the FM spectrum.

In 1948, the membership of the National Association of Educational Broadcasters (NAEB) reached 95 educational institutions, with 50 stations in 31 states, and NAEB began to explore the use of television in education.

Meanwhile, the Federal Communications Commission announced its intention to develop a new plan for television spectrum allocation. As R. B. Hull wrote in his history of ETV, "While some educators hoped this plan would reserve channels for educational use, the Commission clearly gave no evidence of such intent. Meanwhile, the vast majority of American educators had expressed little interest or concern about this new electronic medium."* For those who did care, the next few years brought much activity, including support for educational reserved television channels by major national education organizations and the creation of the Joint Committee on Educational Television to lobby the FCC. These and other activities culminated in the FCC's decision to reserve for educational purposes channels in both UHF and VHF spectrums for a "non-commercial educational television station"--a new broadcasting entity. In 1953, the first of these, KUHT, licensed to the University of Houston, began to broadcast.

Another milestone for non-commercial educational broadcasting occurred in 1962 with President Kennedy's signing of the first federal legislation providing support for educational broadcasting facilities. By providing partial funding for the creation and expansion of educational television and radio stations, this act significantly increased the number of non-commercial educational television and radio stations. From 1963 to 1967, 161 grants totaling more than $31,971,000 were awarded.

At about the same time, the U.S. Office of Education supported some demonstration projects to look at the viability of instructional television libraries. One of these projects was later operated under the Indiana University Foundation and, by 1970, was self-supporting. This library became known as NIT or National Instructional Television. In 1973, NIT became part of the Agency for Instructional

*Richard B. Hull, p. 339, in "A Note on the History Behind ETV," at p. 334 in *Educational Television: The Next Ten Years*, USOE/HEW, U.S. GPO, 1965. (First published by the Institute for Communication Research, Stanford U. 1962.) I found this article very helpful and drew upon it for this section.

Television (AIT), affiliated with the Council of Chief State School Officers of the United States. Two other demonstrations were located at the University of Nebraska (which became the Great Plains National Instructional Television Library) and in Boston (at the Eastern Educational TV Network).

The early 1960s marked a period of rapid growth for non-commercial educational television both in terms of the number of stations on the air and of the numbers of hours those stations transmitted programming to serve their local communities. Federal facilities grants and Ford Foundation financial support were pivotal during this decade.

Late in 1964 the National Association of Educational Broadcasters, through a grant from USOE, convened station representatives and others to consider the financial future of non-commercial educational television. The conference called for a national commission to study the ways and means by which educational television could become permanently established in the United States. Douglass Cater and President Johnson were interested and so was John W. Gardner, president of the Carnegie Corporation.

The Carnegie Commission on Educational Television, led by James R. Killian, Jr., published in January of 1967 its report, *Public Television–A Program for Action*. For the Commission, educational television had two components: instructional and public. The Commission dealt with the latter, although it took a great amount of testimony on the former. It called for further study of instructional television and at the same time called for the creation of what became the Corporation for Public Broadcasting. The Public Broadcasting Act of 1967 expanded some of the Carnegie Commission's proposals to include radio, and it mandated this federally supported organization to, among other things, facilitate the full development of educational radio and television, including its uses in instruction. Title III of the legislation called for an extensive examination of all instructional media, including television and radio.

Before monies were appropriated for such a study, HEW initiated a project chaired by Sterling McMurrin, dean of the University of Utah Graduate School, which led to a study of all instructional technology, including television and radio. Commissioned under the Johnson Administration, the McMurrin Report was presented to the Nixon Administration. No action was taken on the report's recommendation to establish a National Institute of Instructional Technology.

Public broadcasting continued its growth in the 1970s with the success of *Sesame Street* and the creation of PBS and later NPR, and CPB's federal appropriation, though sometimes handicapped by continuing resolution, grew slowly but steadily from \$5 million in 1969 to \$35 million in 1972 and 1973, to \$62 million in 1975 (when the Public Broadcasting Financing Act authorized a federal match of two dollars for every five dollars of non-federal revenue, subject to a Congressionally authorized ceiling set two years in advance of appropriations).

The Current System

Public broadcasting uses two distinct media–television and radio. Although some organizations hold both a public television and public radio license, it is easier to look separately at the two sets of licensees.

Public Television

In public television, there are 253 stations licensed to 158 licensees located in all 50 states except Delaware, Montana and Wyoming. Licensees are traditionally divided into four descriptive groupings reflecting the type of organizations holding the license: community or independent organizations (59 licenses); university licensees (53); state authorities (28); and public school systems and municipal authorities (18).

Public television licensees within geographic regions have found it useful to work together for common interests, services and program sharing, and sometimes for distribution of programming. Perhaps the most well-known regional grouping of stations is the Eastern Educational Television Network (EEN), composed historically of most of the stations in the Northeast and mid-Atlantic states. EEN, unlike the other regions, has maintained its *own* interconnection system, apart from that operated by PBS. The Central Educational Network (CEN) is composed of many stations in the 11 states of the Midwest; the Southern Educational Communications Association (SECA) represents many of the stations in the southern and southwestern states. Finally, the Rocky Mountain Public Broadcasting Network and the Western Educational Network complete the regionally based collections of stations. The latter two groupings merged in the summer of 1978 as the Pacific Mountain Network. These regionals, as they are called, differ among themselves in scope, function and purpose, but they all play important roles in the life of public broadcasting. EEN, CEN and SECA, for example, provide significant instructional services.

- In fiscal year 1976, the total income of public television was about $361.4 million. The federal government contributed 27 percent, the largest single share, closely followed by state governments (24.5%). Among the remaining sources, local governments and state colleges and universities each supplied 8.1 percent.
- In 1976, the average public television station broadcast 4,542 hours of programming.
- As of January 1977, public television licensees employed 8,039 people full-time.

On the national scene, the public television licensees belong to the Public Broadcasting Service, which is at once their membership organization and the organization which operates the nationwide system of program interconnection. PBS distributed about 69.3 percent of all hours broadcast by public television stations in 1976. PBS receives programming from production agencies and stations for distribution. It does not produce programs. In addition, PBS represents the stations before Congress, federal agencies and the Corporation for Public Broadcasting.

Public Radio

As of March 1977, the public radio system consisted of 182 licensees, of which 116 were university licensees, 35 were licensed to community groups, 24 were licensed to local authorities and seven to state authorities.

- In 1975, the latest year for which data are available, an annual average of 6,446 hours were broadcast per station, and 63.5 percent of these programs were produced by the local stations.
- In fiscal year 1976, public radio had an income of $50.7 million, with the federal government providing 32.9 percent, and state colleges and universities accounting for 31.2 percent. Local government and membership subscribers, accounting for 9.8 percent and 8.4 percent respectively, represent the next largest sources of support.
- As of January 1977, there were 1,729 full-time employees in all of public radio.

At the national level, National Public Radio is the major national program production and interconnection service, and represents the public radio licensees to Congress, federal agencies and the Corporation for Public Broadcasting.

In fiscal year 1976, NPR distributed 1,935 hours of national programming to the public radio stations, about half of which was produced by NPR. Unlike PBS, NPR produces much of its own programming; like PBS, NPR distributes programming produced by its member stations and by other production entities.

Sources of Data

To provide the most complete picture of public broadcasting and its relationship to education, I have drawn in this article upon four major studies which CPB has recently undertaken. "Public Television Programming by Category: 1976," conducted by Nathan Katzman and Kenneth Wirt for CPB's Office of Communication Research and HEW's National Center for Education Statistics, depicts the programming schedule, on a sampling basis, of about 98 percent of the public television licensees in 1976.

"The School-TV Utilization Survey," (SUS), was also co-funded by CPB and the National Center for Education Statistics. Conducted by Peter Dirr for CPB's Office of Educational Activities, the survey covers the school year 1976-77. It is the first national survey of television's use in elementary and secondary education, public and private. The SUS random sample included 933 school districts, 1,850 school principals, and 3,700 classroom teachers. SUS is a statistically valid sample which, because of the high response rate, can be extrapolated with confidence to national estimates.

The third and fourth major studies are CPB's Educational Activities' first Biennial Instructional Television and Radio Services surveys conducted in the fall of 1976, and covering academic year 1975 - 76. Of 158 then-existing public television licensees, 156 responded with usable data, as did 145 of the then-existing 185 public radio licensees.

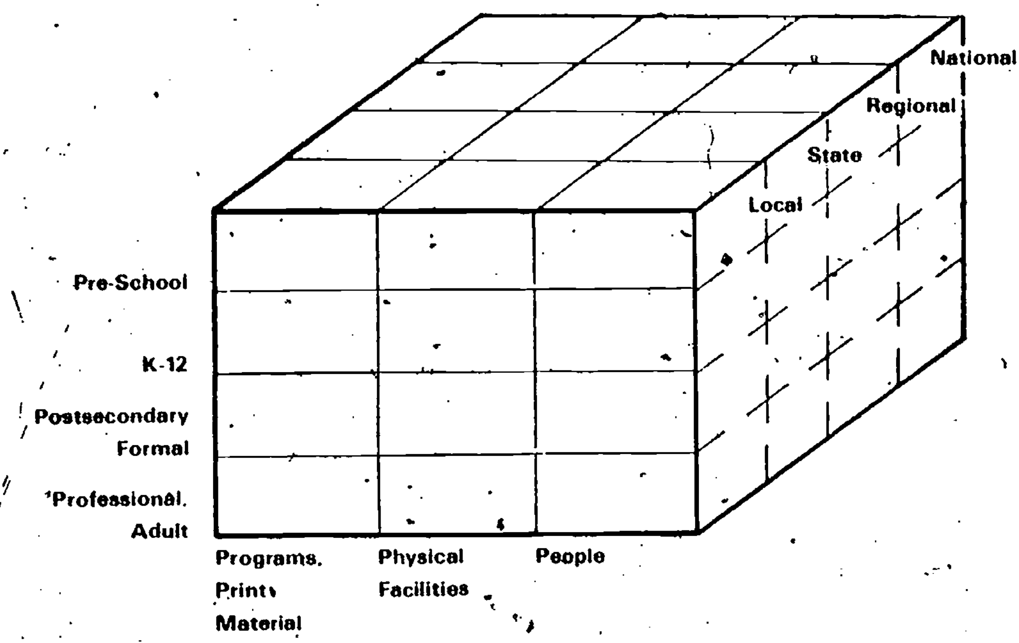
Taken together, these four surveys represent the most comprehensive data base or inventory available about the relationship between public broadcasting and education from the perspective of the stations and, in one case, from the perspective of the schools.

In the fall of 1978, the Office of Educational Activities of CPB updated its biennial instructional surveys for public radio and television licensees. The Office is also planning a comprehensive survey of college and university use of TV and radio to be implemented in the next two years.

Additional statistical information about public broadcasting was obtained from the *Status Report of Public Broadcasting, 1977* (advance edition), published by CPB and the National Center for Education Statistics (NCES).

The Dimensions of Public Broadcasting

The grid depicted in figure 1 aids in examining such richly diverse systems as public radio and television and as equally diverse and complex a system as education.



Source: Mary E. Sceiford, Educational Activities Assistant Director, CPB.

Figure 1. Analysis of radio and television for education and instruction.

The first dimension of the grid contains the essential components of public broadcasting. There are three essential components: programming, physical facilities and people. *Programming* includes the production and dissemination of radio and television programs and the related print materials that make those programs useful to learner and teacher. *Physical facilities* include the licensee's hardware necessary to produce and transmit programming and the learner's hardware necessary to receive that programming. *People* include those who design, produce and broadcast the programming and those who facilitate the use of the programming. The successful interaction of all three of these components is essential for the development and delivery of educational radio and television services in the United States.

The second dimension of the grid focuses on the four levels of education to which services are provided. Public broadcasting has a long history of providing educational programming at several levels. *Pre-school* television programming continues to be an important part of an educational service as shown by the fact that *Sesame Street* alone accounted for 564 hours of the average public broadcaster's schedule in 1976. *K-12 (elementary and secondary)* programming plays an important role for most public television stations, accounting for 80 percent of the daytime programming (8:30 a.m. to 3:30 p.m.) on days when school is in session. Increasingly, more public television stations are providing *college courses* and developing close relationships with colleges and universities in their broadcast areas. *Professional, continuing and adult* education programming is also receiving increased attention at many public television stations. Although public radio has a less extensive record of educational services, the four levels of education services provide a valid framework for examining public radio.

The third dimension of the grid displays the geographic level or scope of the educational services provided. *Local* educational services are usually limited to the immediate broadcast area of the licensee and usually involve the station and local school districts and colleges. *Statewide* services usually involve a state network and might involve a state department of education. *Regional* services involve a group of licensees, states and state departments of education (e.g., a multi-state regional interconnection service providing mechanisms for previewing, acquiring and distributing instructional programs). *National* educational services usually involve PBS and the local stations and frequently include the distribution and transmission of multiple-use programming (e.g., *The Electric Company,* which is equally suitable for in-school and home viewing). Most stations have available at least two simultaneous levels of educational service (PBS national and their own local), while many others have state and regional services also available simultaneously with their own local service.

A Look at the Numbers

In taking a close look at the current status of public broadcasting's educational services—programming, facilities and people—we find much more information available on television than on radio. Figure 2 shows the instructional services of 146 of 158 television licensees reporting such services. Figure 3 shows a quite different picture for radio.

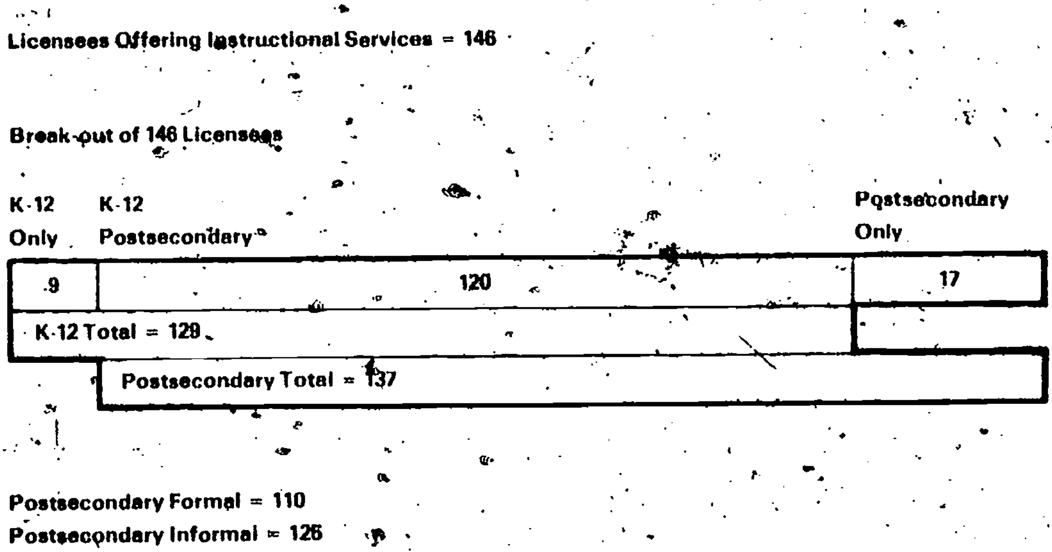


Figure 2. Public television and education, 1975-76 school year.

Stations Offering Instructional Services = 63

Break-out of 63 Stations

K-12 Only	K 12, Postsecondary	Postsecondary Only
9	11	43

K-12 Total = 20

Postsecondary Total = 54

Postsecondary Formal = 20

Postsecondary Informal = 42

Figure 3. Public radio and education, 1975-76 school year.

Programming

Availability

One of the hallmarks of public television has been its programs for pre-school children such as *Mister Rogers' Neighborhood* and *Sesame Street.* This area has been the subject of much research, and some of the impact and usefulness of the programs is well-documented. Its importance to the system cannot be overvalued. March 1977 estimates from the A.C. Nielsen National Television Index revealed that *Sesame Street* was viewed by 56.1 percent of the television viewing households with children under age six, and by 38.7 percent of the viewing households with children 6-11 years old.

It is in the equally important area of public and private, elementary and secondary education that for the first time hard data can be found on the presence of television in the nation's classrooms. According to the CPB/NCES School TV Utilization Survey, fully 71 percent of all teachers have television programming available to them for instructional purposes, and as many as 75 percent of all elementary school teachers have such programming available. Of all teachers in middle and junior high schools, 64 percent are estimated to have ITV programming available; as are about 72 percent of all teachers in senior high schools.

From the stations' perspective, 16.6 percent of their programming hours are devoted to programming specifically for use in elementary/secondary education. Even more significant is the fact that on days when school is in session, about 80.5 percent of all time between the hours of 8:30 a.m. and 3:30 p.m. is devoted to programming solely for in-school classroom use.

On the college level, 110 licensees provided 522 courses which were used by about 1,300 colleges and universities in an aggregated count for the year 1975-76. Those 110 licensees estimated an enrollment of approximately 97,000 students taking those courses for college credit that year.

For in-service programming during 1975-76, 78 licensees reported offering 284 courses in conjunction with 1,345 agencies enrolling almost 112,000 teachers for in-service education. In addition, 125 licensees offered post-secondary informal programming of about 879 courses involving 218 other organizations and agencies.

Looking at radio with the same degree of specificity is difficult because of the scarcity of data. Some information can be reported with confidence. For example, in 1975, for the first time, information was collected about the types of programming provided by public radio stations. Only 2.5 percent of all public radio programming was instructional programming ,a small percentage of the more than 6,400 annual average broadcast hours per station reported for 1975. In radio, there has been no nationally organized and distributed programming for pre-schoolers such as *Sesame Street*, and there is currently no information systematically gathered and available to CPB about pre-school radio services.

In 1975-76, 20 radio licensees provided programming for use in elementary through secondary education. Twelve of those licensees reported that they serve an estimated 900,000 students. The remaining eight licensees were not able to estimate the numbers of K-12 students they serve.

At the post-secondary level, 20 public radio licensees reported offering an aggregated number of 64 formal courses in 1975-76. Eight of these licensees account for slightly more than 73 percent of all the courses offered by public radio licensees. The licensees themselves estimate that approximately 10,700 students took college credit courses through their programming in 1975-76. A total of 132 colleges and universities offered courses in conjunction with these licensees. Moreover, five licensees offered nine courses designed for the in-service education of teachers, and 41 licensees reported offering a total of 131 informal courses for adults during the same year. It is interesting to note that school board licensees provided the most instructional programming, followed by university licensees, then state and community licensees in that order.

Public radio had no nationally distributed interconnected series adapted for in-school, elementary and secondary use during 1975 and 1976.

Production and Distribution

We know a great deal about instructional television production. Fifty-two licensees in 1976 produced programming designed specifically for K-12 use. The major ITV production sources for 1976, according to the stations which responded to the Katzman survey, were:

Local station for its own use	18%
Other public television organizations	26
Major public television producers	9
Consortia productions	11
Independent producers	23
Children's Television Workshop	7

A similar Content Survey was completed in 1974, and some comparisons with the 1976 survey are illuminating. The percentage for local production of ITV continue to drop, while consortium production continues to grow, as do independent productions.

Because of our School TV Utilization Survey, comparisons can be made between what the stations are transmitting and what the teachers are actually using.

In 1976, the programs most broadcast included:*

Reading and writing	16.4%
Literature and humanities	10.5
Science	10.1
Music, art, theatre	10.0
Social science	9.8
Health, physical education, safety	7.5

The School TV Survey estimated that programming in language arts, excluding reading, is used by an estimated 337,000 teachers; social science programming is used by an estimated 328,000 teachers; science programming by an estimated 264,000 teachers; reading by 255,000 teachers, math by 151,000 and career programming by an estimated 91,000 teachers.

Elementary/secondary ITV programming is useful at several grade levels. The 1976 Content Survey permitted respondents to identify one, two or three grade levels for each ITV program. Asked to identify the target audiences, by grade level, for ITV programming, the instructional programming station staffs responded:

Kindergarten:	18.4%	4th grade:	36.9%
1st grade:	25.8	5th grade:	32.8
2nd grade:	31.9	6th grade:	29.2
3rd grade:	31.1	7th grade:	16.4**

The percentages of ITV programming taper off from the 7th grade through the 12th grade. Only 7.3 percent of all ITV programming is designed for 12th grade student use.

Similar multiple level use may be at work for adult instructional programming, and the Content Survey reports that 3 percent of instructional programming is designed for junior or community colleges. About 5 percent is designed for college study, including upper division. About 6.7 percent is designed for adult educational purposes.

In recent years, instructional television has labored under many false assumptions and stereotypes. One that is widely known deals with the format which supposedly typifies ITV programming—the "talking head." Without debating the merits of the "talking head," (many people consider Jacob Bronowsky's *The Ascent of Man* a glorified talking head), the 1976 Content Survey reported that 34 percent of all ITV program formatting included dramatization; only 30 percent included "lectures"; 28 percent was demonstration; 15 percent was documentary; 11 percent involved symbols; followed by animation, discussion, actuality, and interview in that order. (The percentages total more than 100 percent, because responses were permitted in up to two categories for each program.)

In 1976, 86.4 percent of all ITV programs broadcast were produced in color. Although this is a lower percentage than for public television programming (94%), it represents a dramatic increase. As recently as 1972, only 24 percent of the ITV

*Percentages refer to proportions of ITV broadcast hours.

**Since most programs are targeted for more than one grade level, the percentages cited exceed 100%.

programs broadcast were in color. The School TV Survey results, however, show that color TV sets are available only to about one in every four teachers who have a set. "Colorization" in the schools has not kept pace with the increase of color programming.

Finally, closely related to programming and its use in a formal educational setting is the availability of printed material to assist teachers in its use. One hundred and eighteen licensees distribute curriculum materials for elementary/secondary programming, and 83 percent of all ITV programs are accompanied by such printed material. CPB's Office of Educational Activities estimates that 1,064,000 teachers have access to guides distributed in their school buildings, and an estimated 522,000 teachers have individual copies. Teacher materials, and in a few cases student materials, are available from licensees and from such agencies as state departments of education and school districts. Perhaps reflecting the source of funding for the programming used for instructional purposes, or the statutory authority of the licensee, guides are available with about equal frequency free of charge, or included in a regular service charge of the licensee, or for an additional user charge.

Physical Facilities—Transmission & Reception Systems

Sources that provide ITV programming to the licensees are almost as diverse as the sources of production. In 1976, the major distributors were:

AIT/NIT	21.6%
Local stations	17.7
Regional and state networks	16.1
PBS	10.1
Great Plains National Instructional Television Library	6.0
Miscellaneous sources	28.5

Of special note is the increase since 1974 of PBS-distributed programming in ITV schedules. PBS has scheduled daytime repeats of high quality evening programming that can be adapted for instructional purposes. Recognizing the importance of this service, licensees offer these programs in cooperation with their local educators.

Our School TV Survey asked teachers who use instructional television programming to list what best describes the method (or methods) by which television is available in their classrooms. Table 1 shows the results. To better understand what sources of ITV programming were available, we studied the respondents by educational level (see table 2).

Analysis of some selected variables begins to provide insight about the relative importance of geographic region, school level and training to the use and availability of ITV programming. For example, we found that Instructional Television Fixed Service (ITFS), closed circuit, cable television and commercial television are about equally available in all four geographic regions. However, region and source of availability seem to be associated in the case of public television and videotape and film (see table 3). We also looked at the availability of videotape equipment in the four regions and found that videotape equipment was available to almost two out of three teachers in the northeast and north central regions and to

Table 1. Which Best Describes the Method(s) by Which ITV Is Available in Your Classroom?

Public TV	58%
Videotape/Film	37
Commercial TV	26
Cable TV	15
Closed Circuit/MATV	12
ITFS	3

Table 2. Effect of School Level on Source of ITV Programming.

Source	*Elementary Schools*	*Middle/Jr. Hi. Schools*	*Senior High Schools*
Public TV	69%	54%	39%
Videotape/Film	18	47	71
Closed Circuit	8	21	17

Table 3. Effects of Region on Source of Availability.

Source	*Total*	*Northeast*	*North-central*	*South*	*West*
Public TV	58%	63%	50%	54%	61%
Videotape/Film	30	41	47	24	30

two out of five teachers in the south and western regions. The findings show no other major differences amont the regions in any of these variables.

Next we looked at the availability of sets to teachers. We estimate sets are available to 1.5 million teachers or 65 percent of all teachers in public and private elementary and secondary schools; 66 percent of the available sets are black-and-white and 34 percent are color. In contrast, about 77 percent of all American homes have color television sets. In elementary schools, there is on the average one TV set for every five classrooms. In middle and junior high schools, the average is one set for every 13 classrooms, and in senior high schools, one set for every 12 classrooms. About 1.6 million teachers have ITV programming available to them from whatever source, and we estimate that 100,000 teachers within that category do not have a set available.

Knowing that having a set available may mean many different things, we asked some detailed questions about where and how that set was used, and we permitted multiple answers from teachers: 440,000 teachers are estimated to have a television set in their classrooms, about one million teachers have a set brought into their classrooms when they need it, and about 300,000 teachers move school children from their classrooms to another setting to view the television programming.

In this area, too, there is only limited data available about the instructional aspects of public radio, except for CPB's 1976 Biennial Survey of Public Radio's Instructional Services. We do know, however, that 16 stations rely exclusively on their broadcast channel for distributing instructional elementary/secondary programming, that one provides an additional tape/cassette distribution service, and one station uses cable for distributing audio programming. During the time covered by the survey, no station reported using SCA* to deliver elementary/secondary programming. In spring 1977, Newark's Public Radio experimented successfully with SCA in combination with the broadcast channel for in-school programming and plans to continue serving the Newark public schools through SCA and other means.

CPB has no data at present about the use of audio/sound in schools or about equipment availability.

People

The last element of the instructional television and radio grid (figure 1, page 14) focuses on the personnel available among the licensees and some of the services they provide, and also on the people from educational institutions who avail themselves of these services, and how the groups relate to each other.

At the Licensees

Of the 129 licensees that provide an elementary/secondary type of instructional television service, 98 percent involve non-station personnel in deciding which ITV programs to broadcast, and 92 percent also involve them in decisions about when to schedule ITV programs. Only 2.3 percent of the licensees rely solely on their own staffs to make programming decisions, and only 7.8 percent to make scheduling decisions. Typically, ITV services have advisory committees composed of teachers, curriculum specialists, administrators and state or school district personnel, among others. Often each school district for which the station provides an ITV service is represented. The stations serve, on the average, 32 school districts.

In addition, 112 licensees provide utilization services to teachers and other school personnel to assist them in maximizing the usefulness of the programming. In 41 percent of these cases, the licensee staff provides utilization services directly; in 25 percent of the cases, such services are provided indirectly through other agencies. Assigned licensee and other agency staffs work jointly to provide these services in the rest of the cases.

Another service to people provided by licensees is that of technical support: seven out of every 10 licensees which provide an ITV service also provide technical consultation about the reception equipment, and one out of six of these licensees provides technical services to maintain the reception equipment in good shape.

It is clear that for the public television licensees, programming distribution involves a heavy commitment by them to serve the people who use the programming and to work directly with them in many ways.

*Subsidiary Carrier Authorization.

For radio, a similar pattern of providing services to the user and the commitment to user determination of programming is equally apparent. Of the 20 licensees providing a programming service to elementary and secondary education, 12 also provide utilization services and technical consultation; four provide technical maintenance services. All 20 involve non-licensee staff educators in programming and scheduling decisions through mechanisms similar to those employed by the television licensees.

Briefly then, instructional services are more frequently provided by television licensees than by radio licensees. K-12 instructional services are provided by 14 percent of the radio stations, but 83 percent of the PTV licensees. In the case of post-secondary services the proportions are 37 and 87 percent respectively. If we look only at those licensees which provide some K-12 services, the magnitude of the differences between radio and television is not as great but remains substantial in the areas of full-time instructional staff (20% in radio compared with 53% in television) and utilization services (65% in radio and 87% in television).

At the Schools

Certainly, the most significant research work done by CPB was the 1977 School TV Utilization Study (SUS), which provides quantities of data and, for the first time, a nationwide perspective about the nature and extent of television's use in elementary through secondary education. CPB is already exploring a similar undertaking in higher education, but discussion here is limited to the SUS information.

Superintendents, principals and teachers were asked to identify the nature of their contacts with public television stations. Almost 75 percent of the superintendents had some contact with the station, slightly less than 62 percent of the principals also reported some contact, but only 27 percent of the teachers indicated contact with the station. Of course, percentages do not tell the full story, for more than 430,000 teachers are included within that 27 percent. Quite obviously, those contacts that require the physical presence of station personnel might be reflected in higher percentages among administrators, superintendents and principals, who are far fewer in total number than teachers, and easier to identify and contact. Much work remains to be done to gain a clearer understanding of the role of superintendents and principals in passing along information from stations to teachers.

Certainly "contacts" between stations and educators are important but, for most people, the bottom line of any utilization study is how many teachers and students use ITV in their classrooms. Until last year, there was no reliable nationwide data available to answer that question. And when the SUS results were reported, they astonished many. According to estimates from this Utilization Survey, more than 1.6 million teachers, or about 72% of all the teachers in elementary and secondary education, had instructional television programming available to them in the school year 1976-77. Of that number, 945,000 teachers were estimated to have used television for instructional purposes that year and 727,000 teachers were estimated to have regularly used television in their classrooms during 1976-77. Regular use of ITV was defined in the survey question as use of approximately 75 percent of all the lessons in at least one series; 32 percent of the nation's teachers used ITV regularly in 1976-77. Furthermore, 58 percent of those regular users indicated that they used two or more series.

Even more significant, 64 percent (945,000 teachers) of all teachers who had both programming and television sets available used television for instructional purposes during 1976-77. Moreover, it is estimated that an additional 330,000 teachers used ITV, but not during that year. Only 309,000 teachers with programming available have never used ITV.

Teachers were also asked to name the series they used and to give more information about the nature and the extent of that use. Based on their responses, we now estimate that 651,000 of the 727,000 estimated regular users could identify the series and provide such additional information. The utilization survey asked those teachers who use programming regularly to indicate the number of students with whom they used each series.

Their responses did not provide an unduplicated count of students, since the same student might watch two or more series with one teacher. To estimate an unduplicated count, we first made some assumptions: a) that the 727,000 teachers who use ITV regularly use it with their entire class which we had found to be true in most cases and b) that the national pupil/teacher ratio is 20.5:1. We then were able to estimate the number of students who watch ITV regularly to be about 14,900,000. Because this estimate is so important, we developed an alternative means of estimating an unduplicated count of students. We conducted a parallel study that used a sub-sample of 375 public schools to reach students directly. That study (funded partly by the Agency for Instructional Television, CPB and NCES) found that about 35.2 percent of all the students viewed ITV at least once during the preceding four-week period. This figure converts to approximately 15,400,000 students, which falls within 2.9 percent of the estimate derived from the main teacher survey.

The actual student count is a fair indication of the use of programming in the schools, but professionals need to know more about the nature and the extent of that use, and about the attitudes of the superintendents, principals and teachers responsible for using the programming. So we asked *all* respondents (whether or not they had programming available) -superintendents, principals and teachers- a series of questions to provide an overall picture of current attitudes towards television's instructional uses. When respondents were asked to agree or disagree with nine statements (table 4), most exhibited positive attitudes towards using television for instructional purposes. Distribution of the responses was similar for superintendents, principals and teachers. It can be concluded that using television for instructional purposes is favorably regarded by a majority of teachers, principals and superintendents, while about 40 percent of the groups have yet to make up their minds.

All those surveyed were asked to respond to a list of 12 potential uses of ITV by rating each as important, unimportant or neither. Again there was remarkable agreement among the three types of respondents. Table 5, which shows the response from teachers, reveals that they clearly saw ITV as an important means to extend the range of experiences available to students, to present subject matter where there is not a special teacher available (in music or a foreign language, for example), and to permit individualization of instruction. It is interesting that 44 percent saw television as important to individualizing instruction, although most teachers do not use television to permit individualization. Preliminary data about characteristic viewing arrangements for television's use in classrooms indicate that the entire class views programs together in almost 63 to 69 percent of the

Table 4. Attitudes of Teachers Towards the Use of ITV.

	Agree	Disagree	Neither
1) ITV shows great possibilities for stimulating teacher creativity.	1,207,000	155,000	913,000
2) Teachers, when using instructional television, lose some of their importance in the classroom setting.	182,000	1,436,000	657,000
3) The personal relationship between student and teacher is lost when instructional television is used.	283,000	1,234,000	757,000
4) The development of more instructional television programs is a waste of time.	55,000	1,756,000	464,000
5) Teachers don't make enough use of instructional television.	1,119,000	164,000	991,000
6) The use of instructional television makes any subject matter more interesting.	1,145,000	246,000	883,000
7) Instructional television inspires students to greater curiosity and learning.	1,091,000	128,000	1,056,000
8) Instructional television is all right but I feel it has been over emphasized.	277,000	867,000	1,131,000
9) Children watch enough television at home; they don't need to watch more in school.	226,000	1,173,000	876,000

Table 5. Teacher Ratings of the Importance of Various ITV Uses.

	Important	Unimportant	Neither
1) To extend the range of experiences available to students.	1,723,000	47,000	505,000
2) To present new materials.	1,694,000	98,000	482,000
3) To provide different approaches for presenting material.	1,870,000	43,000	363,000
4) To reinforce material taught in other lessons.	1,797,000	80,000	398,000
5) To bring new resources and/or persons into the classroom.	1,833,000	79,000	362,000
6) To motivate students' interest in a subject.	1,749,000	85,000	442,000
7) To lighten the teaching load.	539,000	898,000	837,000
8) To allow the teacher to observe the students.	778,000	649,000	847,000
9) To allow teacher and/or students a brief time to relax.	542,000	961,000	771,000
10) To permit individualization of instruction.	1,010,000	403,000	862,000
11) To present subject matter where there is not a special teacher (e.g. music, foreign language).	1,226,000	335,000	713,000
12) To serve as a suitable teaching alternative in emergency situations (e.g. school closings, long-term teacher absences.)	776,000	707,000	793,000

elementary, middle and high school viewing situations. In 32 percent of the elementary schools involved, more than one class views at a time. Only in 3 percent of the cases are children assigned individual television viewing in elementary schools. There is slightly more individual viewing in junior and senior high schools.

Television is then by-and-large used for group viewing in elementary schools, where the set is brought into the classroom for the largest number of teachers, and in junior and senior high schools, where the class is more commonly moved to a central location.

When teachers were asked to identify types of students for which they felt ITV is most useful, they overwhelmingly indicated that it was equally useful for all types of students--below average, average and above average. The teachers also indicated that most who use ITV programs spend time preparing their classes for and/or following up on those programs, with most spending more time after viewing than before.

The survey also looked at the training the three groups had received. Eighteen percent of the teachers had received some training in the use of television for instruction, while 28 percent of the principals and 31 percent of the superintendents reported such training. We are in the process now of determining to what extent training is related to ITV availability and use. (For example, the survey indicated that 86 percent of the teachers who have been trained in the use of ITV report that ITV programming is available to them, while only 69 percent of those without training reported its availability.) Teachers with training tended to be more positive and less neutral in their attitudes towards televisions' use for instructional purposes and the same can be said about principals. At this point, we know training is an important factor and we hope to learn more from further analyses. The survey clearly shows that most of the teachers, including most of those using ITV, have not received training, and that most of the principals and superintendents also lack training in use of ITV. There is a big job to be done in assisting teachers and administrators to make better use of television for instructional purposes.

Conclusion

Although broadcast and nonbroadcast radio and television have been used in education for many years, and individual applications have been well-documented, until recently national data had not been gathered systematically. Recent efforts of CPB's educational activities office have made a good beginning.

The available data reveals that instructional television has become a more integral part of elementary and secondary education than many would have thought. At the postsecondary level, television has often been used to provide educational services to adult learners nationwide. At each level, successful use has involved a close working relationship between personnel from public television and education.

Public radio's impact on education is harder to assess, given the relative scarcity of data. If one can judge the future based on the enthusiasm of a few of the current laborers in the field and from the recent decision of National Public Radio to establish an educational services function, it would seem that public radio's application to education will soon experience a period of new growth and vigor.

For too long, the application of telecommunications to education has been overstated by some of its more vocal proponents and under-appreciated by its more zealous critics. New applications of telecommunications to education are being implemented constantly. Some will succeed, others will fail. All should be carefully monitored and evaluated, and the results shared widely.

Many of us in the field believe--and the Carnegie Commission on the Future of Public Broadcasting confirmed--that telecommunications is on the threshold of more significant service to the educational future of the nation. The 730 or so people who labor full-time for public broadcasting in education are eager to work with others who share that conviction.

Douglas F. Bodwell is director of the Office of Educational Activities at the Corporation for Public Broadcasting. He has served the American Council on Education as assistant director of the Academic Administration Internship Program and as staff associate for the Office of Academic Affairs, and was assistant to the president of Fisk University. In his current position, Bodwell is responsible for guiding the growth of CPB's instructional services at the pre-school, elementary/secondary and post-secondary levels. A member of the District of Columbia Bar, he received the J.D. from Georgetown University and the A.B. from Columbia.

Bert Cowlan comments:

Since the author has confined himself to formal instructional programs, I am left without the opportunity to say anything Mencken-esque about the increasing use of public television as a vehicle for Britain's best or as an advertising medium for multinationals--oil or other. Nor do I wish to enter into the old argument about which was the oldest station in the United States; the claimants to the title have been known to deal harshly (at NAEB meetings and other such academic enclaves) with authors who take the wrong view. Any view is apt to be wrong.

I can offer one comment from personal experience. Mr. Bodwell refers to the Public Broadcasting Act of 1967. That Act was originally proposed as the Public *Television* Act of 1967, and it was not by accident (indeed, by the dint of much hard work, a Ford Foundation grant, a few conferences and some old-fashioned lobbying–though it was not referred to as that) that the name was changed to *Broadcasting*, and, for the first time, federal money (one out of ten million dollars) was allocated for educational radio. Since I and some good friends and colleagues devoted a year of our lives to this effort, the opportunity to mention it here is irresistible.

Reverting to the Mencken-mode, I must confess I do not understand the analytical framework the three dimensional grid system - used by Bodwell. I am sure there are people to whom it will be a treasure trove of substance, but to me it seems a bit of overkill to develop a matrix that says that programs, physical facilities and people are essential to produce proper programs.

I would also challenge the implication that public radio has a less extensive record of educational services than public television. As one who entered this business of education/communications and technology via WNYE-FM about forty years ago, I think the facts might bear me out. I would like to see some; those given in this chapter do not have a reference point. How many stations responded out of those queried? The author says there is little data available on public radio.

The "success" of *Sesame Street* is taken a little too blithely for this commentator's taste. I won't embark upon the argument; it is well-known that there are some other views.

The point about "colorization in the schools" not having kept pace with color programming makes me wonder. Is it possible that teachers do not view this issue with the same sense of necessity and urgency as do public television administrators? CPB's (or perhaps PBS's) insistence on certain technical standards (and NPR's reach towards octaphonic sound) has always puzzled me. In this, as in many other areas, technology is clearly in the saddle; the public has yet to buck.*

That CPB has no data at present about the use of audio communications in schools or about equipment availability borders on total irresponsibility, in my view, especially considering the comparative costs for programming radio vs. video and the recent Schramm findings to the effect that it does not seem to matter which media you use for education, it is *how* you use the media. One might expect the glamor of television to bedazzle the public; it seems that those in public *broadcasting* ought not to be so susceptible. (Or, perhaps we need a new "Corporation for *Educational* Broadcasting"?)

Bodwell's survey interpretations and mine might differ. He finds teachers strongly in favor of ITV, but if one adds up the "disagree" and "neither" columns in table 4, a different picture emerges. What does "neither" mean in the context of these questions?

Bodwell's point that "there is a big job to be done in assisting teachers and administrators to make better use of television for instructional purposes" is well taken and strongly endorsed. —*B.C.*

*Indeed, I remember an episode that occurred during the first Alaskan satellite educational broadcast. The engineers were talking of signal strengths and color tones in the master control room. From a small village north of the Arctic Circle came the plea: "Help. This thing isn't working." From engineering central in far off Fairbanks: "Go away, Alakaket, we're busy." I was only a visitor but fired two technicians on the spot - mentally, not, regrettably, in fact.

Instructional Television Fixed Service: A Most Valuable Educational Resource

John A. Curtis
Center for Excellence, Inc.

In 1961, the Federal Communications Commission (FCC) issued the Plainedge School System (Plainedge, L.I., New York) an experimental license to initiate what is believed to be the FCC's first authorization to use television circuits in the then relatively uncrowded 2000-megacycle frequency range to distribute *structured, curricula-integrated* programming.[1]

Plainedge's pioneering not only helped to stimulate the subsequent appropriate Congressional and FCC actions, but also caused FCC Commissioner Robert E. Lee, long the Commission's most knowledgeable educational TV exponent, to say, after viewing the Plainedge installation in 1963, "It may well be that Plainedge, New York, will be to education what Kitty Hawk, North Carolina, was to the aircraft industry."[2]

In May of 1962, the U.S. Congress, recognizing the educational potential of television, amended its Communications Act of 1934. This amendment provides for "Grants for Educational Television Broadcasting Facilities" (PL 87-447, 87th Congress).

The FCC, itself a Congressionally mandated and monitored regulatory body, constructively reacted to this Congressional action by setting aside, in July 1963, the 2500-2690 megahertz band to provide 31 six-megahertz channels—on a *non-exclusive* basis—for the then-new Instructional Television Fixed Services (ITFS).

When recognition of the educational significance of ITFS became more widespread and when solid-state equipment became available, the usefulness of the ITFS spectrum became increasingly significant. Soon commercial, as well as educational non-profit services, began to petition the FCC for use of ITFS channels.

After holding hearings, the FCC, in June 1971, reduced from 31 to 28 the number of ITFS six-megahertz channels, but ordered that the 28 channels be exclusively for use in America's *non-profit* educational processes. The FCC further established operating rules and authorities to make the spectrum easy for educators to provide effective, low-cost distribution for most types of educational expertise and materials. Current FCC ITFS regulations, for instance, permit the distribution of audio-video (TV) programs and hard-copy materials, as well as relay networking. Their operating flexibility even makes possible, on an experimental licensing basis, the use of education's most effective teaching methodology—direct two-way

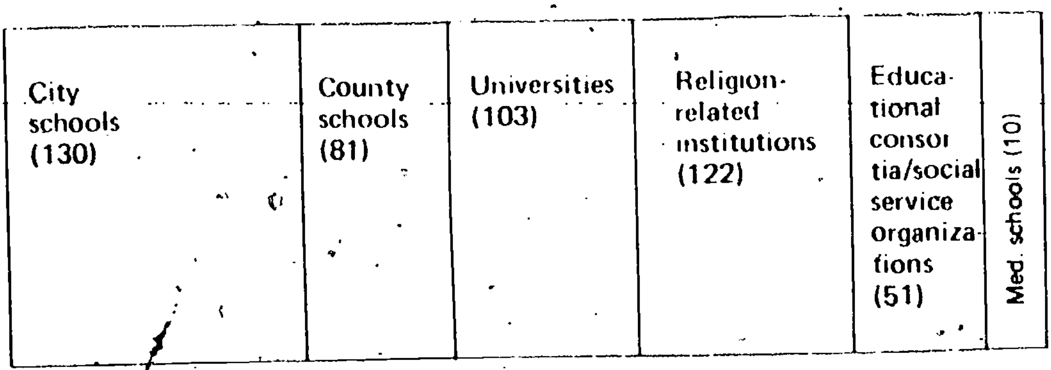


*Figure 1. What educational services today extensively use ITFS channels as basic components of their educational processes**

audio/video contact between the instructor and the student. Today, therefore, for the first time in history, an instructor is able to 1) teach students in one or more geographically remote classrooms on the basis of direct face-to-face relationships; 2) deliver "written" materials to remote locations from a central point; and 3) has low-cost digital circuits available to access, control and distribute remote computational power and data bank information.

Without question, the 1971 FCC decision and its associated operating rules rank in educational importance and potential with the Land-Grant College Acts of 1862 and 1890, the post-World War II G.I. Bill, and with the social rights legislation and court decisions of the 1960s and 1970s.

America's educators have been given the means to break the shackles of both time and geography–restrictions which have heretofore not only limited access to America's two-way educational processes, but which have also restricted the net productivity of its practicing instructor to the student body of a single classroom or lecture hall.

During 1975-76, the Center for Excellence, Inc. (CenTeX)** conducted a survey called Project TIMES–Telecommunications in Medical and Educational Services–among a national sample of 63 ITFS operations. As a group, these operations represented a national statistical matrix of the then existing 90-odd ITFS system operators.

During 1977-78, CenTeX researchers followed up with face-to-face, system-operations inspections of 23 of the 63 school, college and university ITFS operations included in the original survey. This national matrix was used to determine where and how ITFS was being used, and where and why it had gained or lost educational significance during the two years since the 1975-76 survey.[3]

The restudy found that ITFS systems are making major contributions to four major areas of America's educational processes and are beginning to make major contributions in two others. These six areas are: 1) public schools, 2) private schools, 3) graduate schools, 4) medical schools, 5) social services, and 6) rural educational and medical services (see figure 1). Survey findings regarding each of the six areas will be summarized.

*Many of the graphs in this paper were developed by Alan R. Blatecky, Director, Telecommunications Operations, CenTeX.

**An IRS-recognized, non-profit, Virginia-chartered, educational/medical/social services research and resource development corporation centered in Williamsburg, Virginia.

I—ITFS in Public School

CenTeX restudied 11 public-school ITFS systems of the total of 26 surveyed two years earlier. The restudied school systems are in Newburgh and Fredonia, New York; Altoona, Pennsylvania; Birmingham and Jefferson County, Alabama (one system each); Broward County, Florida; Richardson County, Texas; Long Beach, Anaheim, and Fresno, California; and Milwaukee, Wisconsin. The major findings of the restudy program for this sector of ITFS users are as follows:

1) All but one of the 11 operations studied have been functioning for eight or more years—some for as many as 13 years.
2) As a group, the operators expanded their systems by 12.1 percent during 1977. This compares with an expansion of 12.3 percent projected by the original CenTeX study.
3) One of the 11 restudied operations is—for all practical purposes—off the air. This represents an attrition rate of 6.06 percent; a 6 percent rate had been projected by the original study. (This off-the-air system is scheduled to go back on the air.)
4) On the other hand, the restudied school ITFS stations expanded their channel capacity by 12.1 percent during 1977. As a group, therefore, they had a net growth of 5.5 percent.
5) This net growth was financed by *non*-federal sources on the basis of the usefulness of the services delivered to the school children of the systems' constituencies. This 5.5 percent growth rate *does not include new ITFS school-installations* by new-to-ITFS school managements. (These are discussed later.)
6) As a group, the 11 restudied school operators plan a 24.24 percent expansion during the next two-year period.
7) The school managements believe ITFS enables them to provide educational services which could not otherwise be made available to their student bodies. Their thinking in this regard is specific and may be summarized as follows:

• *ITFS can provide the multi-channel services which school telecommunications systems need.* Three of the 11 school managements had access to public broadcasting channels at the time they did their initial studies on the feasibility of ITFS and made the decision to use it. All three gave these reasons for their need to switch from one television methodology to the other:

1) To serve simultaneously more than one level of an educational system requires the use of more than one or two channels. Limited channel capacity creates intolerable restrictions on program diversity and also makes for critical scheduling problems. (*Four*-channel systems appear to provide adequate capacity except for operations involving multi-service, consortia-type operations.)
2) Even the same educational levels have different materials and scheduling requirements at different school locations operating under different teacher requirements.
3) Only a multiple-channel, school-operated system can be made into an integral and basically important part of the school educational and

administrative processes. (ITFS operating rules and its low-power requirements combine to make it easy for school systems to operate ITFS systems.)

• *ITFS supplements teacher capabilities.* The idea that television replaces the teacher is a myth. ITFS service does, however, enable the teacher to do a better job. Few teachers can possibly teach all the things they must teach equally well. For example, with writing skills, a teacher may have difficulty demonstrating the correct form of a letter but, via ITFS, the proper graphic presentation can be effectively demonstrated.

• *ITFS adds teaching services and expertise as required.* Consider the slow learner in a normal classroom. No teacher can turn her or his back on the teaching needs of 20 or more pupils to give the special attention needed by the "exceptional" child. With ITFS, the slow learner can be provided with supplementary instruction and (by using a headset) this instruction can take place in the pupil's regular classroom during the regular class hours. In this way, for instance, ITFS can deliver special reading or math instruction, tailored to meet individual pupil requirements, to the below-grade-level student without embarrassing the pupil.

This same methodology can also be used to provide challenging special programs for the gifted and high-achiever who finishes lessons faster than the average pupil.

• *ITFS can be an effective communications--as well as teaching medium.* School administrations can use ITFS systems as communications links between themselves and teaching faculties. Each school in a system develops its own corps of teacher-leaders, its own personnel problems, and its own barrage of questions. Administrators can invite faculty representatives from the local schools to meet with the superintendent and his or her staff, and such meetings can be broadcast via ITFS back to the faculty groups who have gathered for the purpose in their remotely-located school rooms or auditoriums.

• *ITFS circuits protect privacy.* ITFS is privacy-protected and, by virtue of its specialized equipment, closed-circuit. Thus, representatives can present locally-generated questions and concerns, and only those authorized to do so can be invited to hear the answers and discussions regarding them. (Under the privacy provisions of the 1934 Communications Act, unauthorized listening in on ITFS circuits is likely to be a felony.) In similar fashion, ITFS can make practical the use of this same communications methodology for administration/student body liaison for one or all of the schools within a given school district.

• *ITFS makes possible the specialized daily-living curricula which students need but which would otherwise not be available.* Many school-aged pupils need down-to-earth special courses, such as How to Open and Use a Bank Account, What You Should Know about Nutrition, How to Apply for a Job, How to Fill Out an Income Tax Form, or How to Use the School's Guidance Department Effectively. Curricula in such subject areas must usually be developed by outside curriculum personnel. They often even require teaching expertise by non-school personnel, and usually require one-of-a-kind course materials for which preparation and teaching dollars are hard to find, but which may be made available by public benefactors outside the school system.

ITFS enables school curriculum managers to acquire and deliver from outside sources specialized, but perhaps critically needed, individual, "how-to-live" courses.

• *ITFS encourages pupils to be creative.* Telecommunications make possible innovative development programs which would otherwise never be initiated. Because young people feel at home with TV, and because TV holds a high level of credibility with them, teenagers are quick to use ITFS to develop their own programs (and creative talents).

• *ITFS is a dynamic teaching tool in the classroom.* TV moves effectively and adds efficiency to the classroom teaching process. Curriculum content can be carefully prepared and tested before being regularly used.

• *ITFS serves the homebound pupil more effectively and at lower cost than other methodologies.* An ITFS system can be used to instruct the homebound by increasing the amount of teacher expertise that can be delivered and by decreasing the teacher's travel time. For instance, a teacher can present a lesson from a remote location instead of travelling to the homebound student's location and can simultaneously teach students at two or more remotely located homes or "special" institutions.

• *ITFS can be used to eliminate fear of tests.* By enabling a pupil to take typical quizzes on his own, ITFS can be used effectively to prepare the pupil for testing situations--both those met during the school educational process and those that must be faced in adulthood.

• *ITFS is an effective in-service teacher training tool.* One good instructor can simultaneously teach remotely located groups of teachers. Teacher representatives from local schools can meet, exchange experiences and share real-life teaching experiences with their remotely-located colleagues. For this type of application, ITFS systems have no peer.

• *ITFS lets pupils use their "open" time constructively.* If a pupil arrives early or stays late for non-school reasons, he or she can go to the auditorium for special enrichment programs. Pupils can also view ITFS programs during lunch or other recess periods, or when they have completed their lessons ahead of schedule. Thus, an ITFS system provides a means to increase the constructive use of "open" in-school time.

• *ITFS systems have a long life expectancy.* With proper maintenance, even tube-type ITFS systems can provide ten or more years of active, full-time daily service. When technological obsolescence or equipment redesign occurs, however, replacement parts become hard to get and maintenance is more difficult to perform.

• *ITFS puts the control of education in the teacher's hands.* Because of its multi-channel capabilities, ITFS systems put the control of the teaching process where it belongs--with the teacher, not with some schedule arbiter. Teachers therefore can use the system to meet *their* specific requirements and the needs of their individual pupils on a "when, where and what's needed" basis.

• *ITFS-delivered school curricula.* As illustrated by table 1, ITFS school systems are being used to distribute programs pertinent to the teaching of varying, across-the-board curricula--reading and science; literature and health sciences;

Table 1. Categorical Summary of Curricula Distributed by 35 ITFS School Systems.

Subjects/ Curricula	*% of 35 schools using ITFS to deliver specific subjects*	*Subjects/ Curricula*	*% of 35 schools using ITFS to deliver specific subjects*
Arts and Crafts	74	Literature	89
Business Admin.	--	Mathematics	80
Business Education	29	Music	80
Community	3	Nursing/Pharmacy	14
Computer Science	3	Psychology	23
Engineering	--	Public Affairs	40
Foreign Language	51	Reading	80
Guidance	71	Religion	26
Health/Physical Ed.	74	Science	86
History	60	Social Sciences	83
		Teacher Training	51

mathematics and music--and are especially useful in the teaching of the "basics" of school education as well as the arts, personal guidance, hygiene and the sciences.

• *Even four-channel ITFS systems operate during every school day.* The 35 initially surveyed school systems--even those which are four-channel systems--operate each of their channels *40-44 hours per week,* or more.

What Makes Public School ITFS Operations Productive and Successful?

The ITFS systems of the Birmingham, Alabama, City School System and Jefferson County (adjacent to Birmingham) began operations at about the same time over ten years ago. Each had four channels; each served similar numbers of school-aged children. After approximately ten years of operation, one system is still going strong; the other went off the air last year. Why? What are the requirements for successful operation of an ITFS system that serves education in the public schools?

CenTeX posed these questions to Robert E. Dod of the Birmingham school. Here are some of the reasons he supplied for Birmingham's successful ITFS record:

1) The top administrators must be behind the project that pioneers ITFS use. From the beginning, Birmingham's school management wanted to make use of any ITFS capabilities likely to improve the quality of their school system's teaching processes.
2) From the very beginning, a team of technically and academically capable people must be formed to fuse the thinking and experience of their normally unassociated disciplines.
3) From the beginning, grass-roots knowledge of individual pupil and teacher needs must be meshed into the development and operational use of ITFS. Birmingham has a special office to maintain the needed liaison (two academicians, one director trained in the use of ITV programming, and an

experienced broadcast engineer). The librarian in each school is the appointed representative of this office, so that the ITFS management has its own "field commanders at the front lines" to keep communications open in both directions. This results in *needs-based* services and *prompt reaction* thereto. Further, keeping in close touch with teachers and pupils at the ground-level stimulates their interest; their thinking is promptly and accurately evaluated, and (to the extent of their capabilities) their vigorous participation can be encouraged and utilized effectively.

4) Those involved must keep abreast of technological changes and be prepared for them when they become practical. For instance, while most programming in the Birmingham school system in 1969 was live or on film, now as improved tape technology has become available 75 to 80 percent of the programming is on tape. Initially only black-and-white cameras were used; now 80 to 90 percent of production is in color, and three new color cameras have been purchased.

Two years ago, when CenTeX, Inc., did its first in-depth ITFS survey, the Birmingham school system was producing 49 percent of its needed curricula. It now produces more than 60 percent, and another 25 percent of its curricula requirements are acquired by swapping arrangements with other Alabama school systems. Only 10 percent of the required curricula are now purchased, and 5 percent come from PBS.

ITFS School System Costs

What does it cost to build and operate an ITFS system for public school use? The 11 public schools participating in the ITFS update study have made available their fiscal data. These may be summarized as:

• *Capital Equipment Requirements.* Initial capital equipment costs (exclusive of building costs) average approximately *$275,000* per system. As a system builds its population and school-site coverage, however, system capital equipment and installation costs of serving 50,000 to 100,000 students can rise to approximately *$900,000.* When public school systems are expanded to serve 150,000 or more students, in one instance, at least, capital investment (including building facilities) increased to *$3 million.* The capital investment of the 11 restudied school ITFS systems average *$791,721* for a *four-channel* system.

• *Annual Operating Costs.* Annual operating costs of the 11 restudied school systems ranged from a low of *$44,258* to a high of *$738,100,* depending on: 1) the number of channels provided, 2) the number of school sites included in the system, 3) the number of pupils served, 4) the geography of the distribution area, and 5) the amount of self-generated materials used by the particular system. The *average* annual operating cost of the 11 systems studied is *$219,000.*

• *Per-Pupil Costs.* The teaching effectiveness of ITFS has been very carefully documented by all of the managements of the 11 schools studied, as have equipment life and maintenance costs. All but one of the operators of the restudied ITFS systems believe (and most have themselves demonstrated) that even tube-type ITFS systems have a useful life span of ten years. Using this experience as a statistical base, the average annual per-pupil cost of the 11 restudied systems is *$1.35* for capital equipment amortization, and *$3.77* for operating and teaching materials costs. This makes a *total annual ITFS per-pupil cost of $5.12*, a figure which includes equipment amortization, all material preparation costs, and all ITFS distribution system operating and maintenance costs.

II—ITFS in Private Schools

Private-school ITFS systems have been limited almost exclusively to Catholic archdiocesan systems operated in large cities. Four of these systems came within the CenTeX restudy matrix: the well-managed Instructional Television System of the Archdiocese of New York, initiated in 1964; the system of the Archidocese of Milwaukee, which began operations in 1967; the technologically-progressive system of the Archdiocese of San Francisco, started in 1968; and the newest of these systems, which went on the air in 1976 and which is operated by the Archdiocese of Chicago.

Like the nonsectarian ITFS operations of the public schools, the Catholic ITFS systems serve school children. They also seek to serve the spiritual and social needs of their respective diocesan areas. For example, the magnificently equipped, comprehensive CTN/C system in Chicago reports that, in addition to serving 143,542 school children, it also provides programming to 2,200,000 people in community parishes and to 40,000 senior citizens, for a total non-school viewer population of 2,240,000.

Unfortunately, the management of the Chicago system was not willing to make the requested fiscal operating costs available. It did, however, provide its capital investment figures, and all requested data were provided by the other archdioceses. On the basis of the figures from New York, Milwaukee and San Francisco, these systems are obviously as well-managed as they are comprehensive in matters of geographic coverage and services offered.

Capital investment costs of the restudied diocesan systems are reported to run from *$650,000* to *$4,000,000*. The average capital investment is *$1,970,000*. The per-person-served costs of the Catholic ITFS systems are, indeed, the lowest of any similar, major ITFS operation in the nation—*$.33* for capital investment and *$3.98* for annual operating costs, for a total of *$4.32* per person, per year.

III—ITFS in Graduate Schools

For the most part, the use of ITFS at the graduate school level is directly related to dollars and cents and to the educational needs of American industry. Perhaps that is why ITFS systems operated for this level are primarily concerned with the delivery of courses in engineering and business administration, either for credit or for employee improvement.

CenTeX restudied in 1977-78 four graduate-level systems: TAGER in Dallas, which began operation in 1969 and now serves approximately 1,000 persons; Stanford University in Palo Alto, California, begun in late 1968 and serving about 5,400; the University of Southern California in Los Angeles, which serves about 1,328 and went on air in 1969, and IHETS (Indiana Higher Education TV System), begun in 1976 and serving a statewide population of 15,440. The total number of graduate students served is 23,168. From the restudy, CenTeX noted these salient facts:

1) At the graduate-school level, ITFS services are paid for either by the student or by his employer. Unless, in the opinion of these two tuition-paying sources, the service is worth the price, the tuition income stops and the ITFS system that distributes this type of educational service ceases to function. All four of the restudied systems are producing sufficient income to be considered economically viable.
2) Since these systems are dependent on tuition-type income, the privacy protection clauses in the 1934 Communications Act are, indeed, a basic factor to their economic survivability.
3) Graduate school ITFS systems usually have longer "working hours" than do, for example, public school systems. Both have heavy morning schedules, but public school systems usually stop program distribution in the late afternoon. Graduate school systems, in contrast, continue their services until 9:00 or 10:00 p.m., and their normal daily schedules begin at 8:00 a.m.—five days a week.
4) Though most graduate school systems limit their programming to the engineering and business instruction needed by industry, the system operators surveyed, however, are beginning to distribute other educational courses. For example, USC broadcasts personnel-improvement courses that viewers in remote industrial classrooms can watch during lunch hours on week days.

   IHETS (Indiana) goes the whole way. It is currently building itself into a statewide ITFS system, unassisted by satellite circuits. It is already distributing courseware in many graduate disciplines, including medicine, nursing, pharmacy, engineering and audiology. It offers continuing education courses, including curricula in mass transportation, labor relations and nursing home administration.
5) With the increased insistence by many states for continuing education programs to upgrade professional skills in such fields as law, engineering and education, the graduate school ITFS system is likely to become more widely used in the near future. Currently, however, its use is limited primarily to the states of Indiana, Texas and California.

The fiscal data developed by CenTeX in the restudy indicate the following per-student costs for graduate level systems: 1) annual per-student cost of capital investment—*$34.08;* 2) annual per-student operating cost—*$79.05;* 3) total annual per-student cost—*$113.13.*

IV—ITFS in Medical Schools

One of the fastest-growing uses of ITFS distribution systems is in the medical field. State regulatory agencies have become more concerned with the continuing education of medical and allied health professionals. In fact, 14 states reportedly now have requirements for updating professional skills and knowledge for both doctors and nurses. Many professional societies now require their members to take continuing educational programs periodically.

With or without state or professional association requirements, and given the fast-changing information in the medical fields, health care professionals must have continuing education if they are to remain effective. ITFS systems can enable health care practitioners in all disciplines to receive such education during their "open" hours in the office, at the hospital, or at home and the privacy-protection inherent in ITFS systems can be used to make practical the delivery of medical programming, including actual clinical observations, to only those authorized to receive them.

The restudy project included personal interviews with the directors of four medical ITFS systems: the one operated by Emory University in Atlanta, Georgia, which serves approximately 9,000 medical personnel; the University of Alabama-Birmingham system serving 900 medical personnel; the Cleveland Metropolitan ITFS system, serving approximately 10,000 medical professionals; and the Indiana University Medical Network, believed to be America's first, comprehensive, statewide medical telecommunications system.

The nation's first ITFS medical network went on the air in 1969 in Atlanta, Georgia. The pioneering operation was initiated by the Pinkerton-Fulton-DeKalb Hospital Authority; was initially funded by the National Medical Audio Visual Center at the National Center for Disease Control (also in Atlanta); and is very ably managed by the Medical School of Emory University under the name Georgia Regional Medical Television Network (GRMTN).

When, at the end of 1971, the National Center for Disease Control reclaimed its funded equipment, the P-F-D Hospital Authority and Emory raised the dollars to replace it. Today, GRMTN not only makes substantial contributions daily to the medical capabilities of the Atlanta area, but the educational impact of its circulating medical library (with more than 700 titles) today is making educational contributions through the contiguous 48 states and Canada.

In Atlanta, GRMTN daily delivers medical educational programming to 31 medical institutions located within a 25-mile radius of the Emory Medical School central station. The daily programming averages not less than three hours a day, five days a week (Monday-Friday). In addition, several times each year, GRMTN broadcasts to its ITFS institutional subscribers an entire, coherent postgraduate course on a specific subject of timely medical concern.

Because both Emory, one of the nation's better known medical schools, and the National Center for Disease Control induce visits by many of the country's most capable medical practitioners to the Atlanta area, the quality and up-to-date accuracy of Emory's medical lecturers are likely to have wide, as well as timely, professional appeal and significance. To make these lectures available to Georgia's rural doctors, and to facilitate their reuse, GRMTN early began to record its lectures and to seek "subscribers" for its videocassette circulating library.

Thus, GRMTN, believed to be America's first ITFS and the nation's first developer of a medical cassette circulating library, has become a nationally effective, economically viable and ever-growing factor in North American medical educational processes. Further, both its telecommunications and library networks have been targeted and managed to provide effective educational services to all levels of the medical professions (students, interns, residents and practitioners) whether in urban Atlanta, rural Georgia or elsewhere in the North American continent. The following should also be noted: although federal funding first enabled Atlanta medicos to assess the educational usefulness of an ITFS medical distribution system, *no federal funding has contributed either to the capital investment* (to date more than

$347,000) *or to the annual operating costs* (more than $92,000 a year) of the GRMTN since the National Center for Disease Control withdrew its equipment in 1971.

Another ITFS medical network also requires special recognition. Whereas GRMTN is exclusively a privately-funded, *single-city* ITFS delivery operation using conventional delivery services to make videocassettes available to those home-state, city and rural areas not served by its Atlanta-based ITFS network, Indiana has built a *statewide* ITFS system, which today serves 38 health care institutions in 19 cities strategically located in all parts of the state. Like GRMTN, the Indiana network is managed by a medical school (the Indiana University School of Medicine in Indianapolis—I.U.), and its avowed major educational thrust is continuing medical education for its home state's physicians and allied health professionals. It is also important to note that, like Emory, I.U. serves both privately, as well as publicly supported institutions. Like Emory, too, I.U. is building a cassette library available for purchase by both in and out-of-state medical practitioners. Although the I.U. medical network made its first use of ITFS late in 1969 (shortly after Emory first began its ITFS operation), its circulating cassette library has not yet attained the scope of Emory's library operation. During 1976, for instance, 33 of the I.U. catalogued medical cassettes were distributed to 26 institutions outside Indiana.

The I.U. ITFS medical network, however, includes a talk-back circuit from the 38 remote locations served by the system. This operating feature has enabled I.U. to provide first-year medical training at seven regional centers. It is reported that this system feature has been a contributing factor in the 30 percent increase in the annual enrollment for I.U.'s Bloomington Campus pre-med student body.

Study of the capital investment and annual operating costs of the four studied medical networks (Emory, University of Alabama at Birmingham, Cleveland TV Association and I.U.) indicates that average annual cost per professional served (including both capital equipment amortization and operating expense) is *$13.16*—a very low per-person cost for the delivery of critically needed continuing education and professional consultation to a highly technical and specialized field.

V—ITFS in Rural Education

In Chautauqua County, New York, a microwave system is used to establish a resource-center connection between the New York State University campus at Fredonia and the program production center of the Chautauqua County Board of Cooperative Educational Services. From the latter control, ITFS delivers programs to ten previously established, remotely-located translater installations which, in turn, regurgitate the ITFS-delivered programs to the rural service areas for which they were established. It is interesting to note that the translators were initially installed to extend to rural areas the public broadcasting programs of station WNED, operating on Channel 17, but whose signal can not be received in many of the valleyed rural and urban areas of the county. Thus, the translators perform a dual purpose: they distribute both the ITFS- and PBS-delivered programming at different hours of the day.

In Fresno, California, the county-managed school authority uses its ITFS system to deliver structured curricula to schools with single teacher or limited staffs who teach at more than one class level. Since their students are often located in mountainous, low-population areas, Fresno's pioneering ITFS system, in operation since 1967, adds the necessary multi-level teaching capabilities which such populations need but cannot afford and therefore seldom get.

In the Tidewater area of Virginia, the Center for Excellence, Inc., is developing an all-ITFS system to serve the rural areas of the upper and middle Tidewater Peninsulas; the Virginia Eastern Shore (the Commonwealth's most poverty-restricted area) and Virginia's rural, eastern southern-tier county area.

Unlike the Chautauqua system, the CenTeX Virginia system has been designed to deliver simultaneously two or more programs, and has the additional advantages of system-wide circuit protection of privacy and return-circuit communication. Thus, the system being built by CenTeX in Virginia can serve as a distributing network for many rural requirements, such as medical services, as well as those of structured, two-way teaching and special education.

Since an ITFS circuit requires one-fifth (or less) of the dollars and spectrum space needed for the use of satellite circuits, the CenTeX system, like that in Fresno, is being built "from the ground up rather than from the sky down." Consideration of satellite-circuit use is limited to "long-line" circuit requirements, which operating requirements and common-carrier tariff levels may subsequently combine to justify.

VI—ITFS in Social Services

In the Chicago area, the Archdiocese, as has been previously noted, is using its ITFS system to deliver spiritual instruction and diocesan information to an estimated 2,200,000 parishioners. The same system is also used to provide special programs to more than 40,000 senior citizens.

In California's Bay area, the technically proficient Archdiocese of San Francisco uses its ITFS system to provide hospital patients with helpful information regarding their illnesses.

In the Peninsula area of Virginia, the Bureau of Education for the Handicapped (BEH) of the U.S. Office of Education (together with the Special Education Division of Virginia's Department of Education) is funding what may turn out to be one of ITFS's most dramatic and meritorious contributions to social services education.

Known as Project SETT-UP, this program recognizes the immediate need to upgrade all public school teachers in the area of special education. Under U.S. Public Law 94-142, public school systems receiving federal dollars (and most such systems directly or indirectly depend on federal dollars for a substantial portion of their funding) must provide instructional services to all handicapped children "in the least restrictive environment." To meet these new federal regulations, most educators believe that all general as well as special education teachers must be given structured, inservice teacher training in the highly specialized field of services to special children, including the physically and mentally handicapped and the emotionally disturbed.

Under the direction of BEH's Herman L. Saettler, CenTeX's Project SETT-

UP enables a *single* inservice, special education expert to deliver simultaneously the training necessitated by PL 94-142 to *ten remote school locations* via CenTeX's two-way telecommunications delivery system. Evaluation of first-year results from the use of this system caused James T. Micklem, director of the State Division of Special Education, to remark, "The CenTeX system may be the only way we can meet our obligations under PL 94-142 on a timely and economically practical basis."

Basic System Specifications

CenTeX's Project TIMES included intensive and extensive analyses of education's telecommunications needs. The study procedure featured personal interviews with administrators and teachers from all educational levels to determine their needs-based thinking regarding the potential usefulness of telecommunications. The study also made engineering analyses of all telecommunications methodologies available to meet the educator-stated telecommunications needs.

This component of the study clearly indicated the following are basic specification requirements for a comprehensively useful educational telecommunications system:

Analog and Digital Circuits. Educational requirements necessitate the use of digital as well as the more conventional analog circuits. Analog transmission is required for TV (audio-video) signals; digital circuits are needed for efficient, low time-and-dollar costs for hard-copy transmission and for accurate access to and retrieval from remotely located computer power and memory banks.

Real-Time Capability. Live (question-and-answer) interchange between instructor and students is essential for the effectiveness of many types of structured curriculum delivery.

Easy User Access. Quick, easy communication between instructors and students significantly improves the effectiveness of most types of structured curricula. Quick, easy instructor access to program production systems facilitates the efficient development of effective curricula. Putting tools directly in the hands of the user (be it a carpenter's hammer, a secretary's typewriter, or a teacher's telecommunications-delivery or curriculum-production "tool") usually significantly improves end-product capabilities and reduces end-product costs.

24-hour Availability. Only by distributing structured educational curricula, at least between the hours of 6:00 a.m. and 10:00 p.m., can many of America's unfilled educational needs be met, and the per-student costs of telecommunications delivery systems reduced to viable economic levels. Further, some post-graduate and craft-skill educational processes (such as medical and blue-collar industrial upgrading programs) require multi-shift (or round-the-clock) delivery capabilities.

Multi-Channel Availability. The curricular requirements and schedules of different student bodies—especially at the pre-school, primary, elementary and secondary levels—usually vary. An effective educational delivery system must therefore have multi-channel delivery capabilities to meet simultaneously the varying, teacher-dictated needs of different student bodies—even those located in the same geographic or operational jurisdiction.

One-Way Audio-Video plus Audio-Return Capability. In some instances, such as engineering and business administration education, although audio-video circuitry is required from the instructor to the student, only a voice-return circuit is essential from the student back to the instructor.

Two-Way Audio-Video Capability (in special cases). Learning and use results have clearly demonstrated that *two*-way audio-video circuitry is essential to the effective teaching of some medical subjects, to the making of diagnostic/prescriptive medical and psychological analyses, and to distribution of laboratory or clinical courseware and skill training. Further, in many instances, cost-effectiveness, as well as teaching efficiency, justify the added costs of *two*-way *both*-way educational delivery systems.

Privacy-Protection Availability. The Educational Broadcasting Branch of the Federal Communications Commission has stated in writing that it believes that the privacy-restriction and penalty provisions of the 1934 Communications Act apply to the information transmitted by ITFS systems. Under these provisions, just "listening in" on ITFS systems constitutes a felony.

Circuit-privacy protection is essential to the use of telecommunications for the distribution of many educational services, such as those based on tuition fees (to protect the tuition-paying requirements essential to their economic viability) and those for which privacy is essential, such as psychiatric treatment.

The Economic Practicability Factor. To be economically practical, educational telecommunications systems must either increase student access to educational processes or increase instructor capability to the extent necessary to pay for their costs and to justify the efficient use of available spectrum space.

The Usefulness Rating Factor. Even though an educational telecommunications system may be justified by its use and economic viability factors, a subjective evaluation or judgment must answer one over-all question: *Just how well and how deeply can an educational telecommunications system be integrated into a given educational process?*

The importance of the last question is emphasized by Helen L. Clower, who helped pioneer one of America's first comprehensive and operations-integrated ITFS systems the Anaheim, California, City Elementary School District ITFS system. Anaheim has had 13 years to evaluate its ITFS system; based on results, the Anaheim television system has been allocated 4.2 percent of the 1977-78 instructional dollar. Three key points contributed to its success:

- The Anaheim ITFS system management first made grass-roots studies to determine their communications needs.
- Based on a definition determined by both teachers and administrators of the school system's major communication needs, the ITFS system management developed and published specific communication system goals.
- Based on these clearly defined needs and succinctly stated goals, the Anaheim ITFS system management proceeded to establish specific procedures to implement its objectives.

Anaheim's fact-based operations research and fact-based decisions have undoubtedly been among the key factors which have made its ITFS system an integral part of the school system's operation. Further, because the ITFS system is integrated into the school academic program, its usefulness can be regularly and accurately evaluated and its position as a budget-line item can be made clear at budget time.

Matching Telecommunications Technologies

Based on more than five years of continuing research, CenTeX analyzed all of the telecommunications methodologies today available to meet one or more of the requirements which studies have indicated as major requirements of an educational/medical telecommunications delivery system. Table 2 (pp. 44-45) lists the basic practitioner-stated system communications capabilities (11 in all) and analyzes the nine major telecommunications technologies today available to distribute educational, rehabilitative, medical and social-services programming. Technical limitations and other salient factors appear to make unnecessary any further consideration of three of these nine methodologies. Referring to table 2, these three are:

AM Broadcasting; Videocassettes (are useful to store information, but some delivery-system capability must be provided. Cassettes are not telecommunications *delivery* systems); and *Special Phone Circuits.* Without wide-band circuitry on system-wide bases, the use of common-carrier telephone company facilities for educational/medical audio-video *one*-way and *two*-way programming is economic suicide. Recent comparison of estimates for a two-way audio-video circuit for a CenTeX studio-transmitter link of about 1.4 miles showed that ITFS could supply the same circuit capability as the Bell System for approximately one-third of the phone company's quoted cost.

Each of the remaining six communications technologies in table 2, however, can effectively provide educational/medical telecommunications for *differing types of program objectives and program content.*

FM Multiplexed Circuits, Commercial and Public Radio

FCC rules currently authorize the use of a 6000-cycle spectrum component of a 30,000-cycle FM radio channel for the modulation of a subsidiary discrete channel which, in effect, "piggy-backs" on the main FM carrier. Since the use of this Subsidiary Communications Authority (SCA) channel does not noticeably deteriorate the reception of the listener of the programming on the primary station channel, FM operators are happy to make bi-product, productive use (and "sale") of the SCA channel. Special low-cost SCA receivers (selling for $55-$80) enable listeners to receive SCA-distributed programming.*

Currently, this "second" channel is being effectively used to distribute data and information, narrow-band musical programming (such as Muzak) and slow-scan television programs. Further, the SCA channel can modulate special audio receivers for the visually impaired, homebound and aged, teletype machines for the deaf, and Braille machines for the deaf and blind.

Rental of the FM subsidiary carrier circuits of 50,000-watt stations currently is running between $3,000 and $5,000 a year. In the instance of the commercial station, the rental payment is likely to take the usual format of direct-dollar payment for the SCA channel use; for the non-profit Public Radio station, the channel rental payment is likely to be made in the form of a gift.

Experience shows that the ground pattern of the SCA channel of a 50,000-watt FM station, has a 25-30 mile radius[4] or a ground coverage of approximately 1,962 miles:

The currently low SCA channel cost, the low cost of individual receivers, plus the large propagation area served by a 50,000-watt FM station combine to make this telecommunications methodology an ideal one to deliver narrow-band signals, such as those for the handicapped mentioned above.

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*Sections 73.294 and 73.319 of the FCC's rules describe the operating privileges and restrictions of SCA channel use.

Table 2. Telecommunications Technologies: Educational/

Communications Technology	Analog circ.	Digital circ.	Real-time cap.	Easy user access	24-hour availability	Multi-channel
AM Broadcast Stations	yes	no	yes	no	yes	no
FM Multi-plexed Circuits	yes	yes	yes	no	yes	no
Videocassettes/ Audiocassettes	yes	yes	no	yes	no	yes
Public Broadcasting	yes	no	yes	no	yes	no
Normal Telephone Circuits	yes	no	yes	yes	yes	yes
Special Phone Circuits	yes	yes	yes	yes	yes	yes
CATV Circuits	yes	yes	yes	yes	yes	yes
Satellite Circuits	yes	yes	yes	no	yes	yes
ITFS Circuits	yes	yes	yes	yes	yes	yes

Psychomedical Requirements vs. Capability and Cost.

2-way voice	*2-way video*	*Privacy*	*Economic practic-ability rating**	*Useful-ness rating**	*Applicability to educational, rehabilitative, medical and social services program distribution.*
no	no	no	C	D–	Meets few of the educator specified requirements for a telecommunications delivery system.
no	no	yes	B	B	Useful for some applications: such as teletype circuits for the deaf; audio circuits for the blind; slow-scan TV for educational purposes.
no	no	yes	B	C–	Useful as a storage medium; does not provide real-time access; has limited privacy; requires additional delivery system to reach student populations.
no	no	no	D	C–	useful only for general information and distribution; no privacy; excellent medium for cultural development/enrichment programs.
yes	no	yes	A	C–	No video, no digital capability; but useful for non-video distribution and student talk-back circuits in audio-video-out systems.
yes	yes	yes	D	D–	Wide-band circuits often not available; are usually costly when compared with other media circuitry.
yes	yes	yes	B	B–	Not available in many geographic areas; often does not have 2-way capabilities, which can be costly when available.
yes	yes	yes	D	C–	Equip. costly, not easy to install/operate; useful for single-channel dist. to sparsely settled areas. Req. 5-6 times other media frequency spectrum and dollars.
yes	yes	yes	A	A–	Only available methodology capable of meeting all educator-developed system specifications.

*A = Good C = Poor
B = Fair D = Not useful

Although SCA circuits cannot provide two-way capability, a telephone circuit can be rented for this purpose. It is important to note that, though protected by the privacy provisions of the 1934 Communications Act, SCA receivers are inexpensive and relatively easy to obtain and/or make. Unauthorized persons may therefore be able to eavesdrop, and the privacy of an SCA circuit is, of course, always open to all who have receivers tuned to the SCA channel serving a specific geographic area.

Public Broadcasting—TV

To assess correctly the educational usefulness of Public Broadcasting TV, the following factors regarding this telecommunications methodology must be considered.

Public TV must compete with commercial TV for the general listener's attention. Public TV station managements, therefore:

1) Must develop programming which contains a high percentage of entertainment appeal;
2) Must maintain costly studio equipment and the specialized, expensive staff able to meet the standards of competing commercial entities; and
3) Must maintain high-powered transmitters to produce the audience numbers and broad public interest essential to their survival.

Because Public TV stations are costly, high-powered operations designed to distribute programming over a wide geographic area, it is difficult to make them a "teacher's tool." In most instances, there is a substantial studio crew between the teacher and the finished educational program, and it is difficult to produce (or justify economically) the development of specific programs for use by specific student bodies.

Even when the needs-based curricula are available, Public TV cannot provide the flexible schedule required to meet the varying needs of multi-school operations and locations. For instance, high capital equipment and operating costs and available frequency spectrum have limited the number of Public TV broadcasting stations in given geographic areas to one--and sometimes two programmable channels. Educators point out that a single school district usually requires the use of more than two channels and that the geographic area served by a Public TV station usually includes *four or more* separate school system operations.

Harlan N. Levich, assistant director of the Instructional Resources Radio-TV Office, Long Beach, California Unified School District, summarized this point* as follows:

> The two-year feasibility study . . . indicated . . . the Instructional Television Fixed Service system . . . was much less expensive than a cable, VHF, or UHF system and the four channels provided four times as much flexibility in programming as any single channel. The ITFS system also gives us a privacy not otherwise available for those times when we wish to broadcast strictly for "the team."

Three other factors make it difficult for Public TV to meet the needs of America's structured-curricula educational processes:

- During evening hours, Public TV stations must use their distribution power

*In a memo to his teachers.

to deliver general-interest programs. Their services are therefore not available to educators during a time period critical to the delivery of parent and professional training.

- Public TV is a one-way audio-video system. It therefore requires an *added* system to provide either an audio or audio-video return circuit when needed.
- Public TV stations are general broadcasters, and thus the privacy provisions of the 1934 Federal Communications Act do not apply to the programming they distribute. Public TV accordingly cannot meet many of education's most critical distribution needs requiring such protection (such as psycho-medical, medical and tuition- or fee-based and special educational programs).

A recent survey by Virginia's State Department of Education appears to support the validity of the preceding assessment. During 1976, the Department surveyed approximately 6,000 (about 9.3 percent) of Virginia's total public teaching staff. Since it had been spending almost three million dollars a year to help support Virginia's five public TV stations, the Department wanted to know what its dollars were producing educationally.

Approximately 3,500 of the 6,000 teachers answered the questionnaire. Asked for *"judgments of the effect of public instructional television (Public TV broadcasting) on student learning,"* the percentage of responses to the seven questions asked were as follows:

Improved it greatly	7%
Improved it somewhat	27
Improved it slightly	18
Had no effect on it	10
Had a slight negative effect on it	0
Had a substantial negative effect on it	0
I do not know	38
	100%

In other words, only 7 percent of the respondees considered public broadcasting an important factor in student learning, and only 34 percent believed public TV broadcasting is an even "somewhat" effective teaching tool.

As a distributor of *general*, cultural and educational programming (rather than structured, needs-based educational programming), however, public TV broadcasting probably has no equal in the educational TV field.

Normal Telephone Circuits

The senior citizen of audio telecommunications, the normal telephone circuit, which is almost universally available, and its more recently developed offspring, teleconferencing methodologies, are probably the most underpublicized of all available educationally-useful telecommunications delivery tools.

All over the nation telephone circuits are being used by educators for talk-back purposes (from student to remotely-located instructor). Depending on many factors, including distance, the use of common-carrier telephone company circuits for talk-back purposes (provided audio-only communications is required) is both effective and practical.

In at least one instance, the lowly standard telephone circuit is actually being used by a state-wide, out-going, educational delivery system. The University of Wisconsin's Educational Telephone Network (ETN) is a system that supplies an instant and personalized educational channel to more than 120 Wisconsin communities. Wisconsin's Lorne A. Packer reports that during the 1976-77 academic year, ETN served approximately 30,000 people enrolled in more than 100 different courses at average per-student contact-hour cost of 25 cents.

Using telephone company circuits, Wisconsin has also developed a system which provides the means to transmit simultaneously both audio and visual materials. In this application use of telephone lines, images appear on a screen at listening sites at the same time the instructor draws them on an electrowriter. Thus, even relatively difficult courseware involving equations (such as calculus) can be delivered simultaneously to a number of "classroom" student groups remotely located from the instructor.

When narrow-band (3,000 cycles or less) transmission can adequately transmit the desired information, the use of the commonplace, *ubiquitous* telephone circuit obviously merits serious consideration by educators.

CATV Circuits

The unique and pioneering Shawnee Mission School CATV system (Shawnee Mission, Kansas) clearly demonstrates that CATV circuits can be highly effective for one-way audio-video, non-interactive, and non-real-time transmission of school-level structured educational curricula.

New York University's equally effective pioneering use of two-way CATV to create a real-time system to serve senior citizens in Reading, Pennsylvania, demonstrates quite clearly the potential of two-way CATV-based systems in the field of social services.

Despite these successes, however, CATV's subscriber growth rate has not been as dramatic as once expected, and in most geographic areas CATV systems reach less than 30 percent of the population and locations needing telecommunications-delivered educational/medical programming. Further, few communities currently have readily available, as does Reading, *two*-way CATV systems capabilities.

Until two-way, wired city and county CATV installations become more widely established, the national educational significance of CATV in America's structured-curriculum processes is likely to be restricted.

Satellite Circuits

In 1972, faculty members of the University of Hawaii and their Project *PEACESAT* (using NASA's ATS-1) demonstrated that satellite communications methodologies could effectively distribute two-way, audio educational information, whether structured curriculum or seminar-type discussion.

Also during 1972, a thorough technical report, prepared for a committee of the National Academy of Engineering* by Donald G. Hagg, manager of the Advanced Systems Concept Development and Research Department, U.S. Postal Service, made clear the usefulness and achievable economies of satellite circuits for the delivery of bulk quantities of information between America's 125 largest cities

*The Advisory Committee of Issues in Educational Technology.

provided the satellite circuits were used during the night hours, when satellite traffic was anticipated to be light and tariffs, therefore, low.

Also for the same NAE Committee in 1972, I produced a report that projected the potential usefulness of satellite circuits in delivering educational and medical programming to the Appalachian, Rocky Mountain, and Alaskan areas and overseas U.S. territories.

Since 1972, few, if any, really basic and major new answers to the how, what, when, where and how much questions about the educational use of satellite have been made. For instance:

- It then could, and still can, be clearly demonstrated that most intrastate educational/medical traffic in the contiguous states can be more economically distributed by means of private microwave or common-carrier systems (especially if audio-video transmission is required) than by satellite systems. Accordingly, perhaps educators in the 48 contiguous states will find that the use of common-carrier satellite circuits on a when-needed basis will meet any satellite-circuit requirements necessary to maintain communications contact with out-of-state resource centers and expertise.
- Just what spectrum space, other than that already allocated in 4-6 and 11-13 gigahertz bands for satellite use, the FCC and the forthcoming 1979 World Radio Conference will make available for educational satellites is still not clear.
- The ability and willingness of any but federal jurisdictions to meet the continuing and staggering capital equipment and operating costs of educational satellite circuits has yet to be demonstrated.

There are, however, two proven facts about educational satellite circuits: 1) They require five to six times more frequency spectrum space than do, say, comparable earth-bound ITFS systems capable of providing the same telecommunications capabilities; and 2) Exclusive of the substantial costs of launching and maintaining a communications satellite, satellite ground equipment requires a capital equipment investment that is at least twice that of earth-bound systems with comparable capabilities.

Most educators therefore believe that educational telecommunications systems should be built from the ground up, not from the sky down.

ITFS Circuits

Although the assessments in table 2 of the generic types of available telecommunications systems are, I believe, quite accurate, when considered as a total data group, they might imply that ITFS is the only truly useful educational telecommunications technology. Such a deduction would, of course, be far from correct. As has been made clear, for certain educational and social-service purposes, other telecommunications methodologies can be just as effective and more economical. The fact remains, however, that ITFS is the only telecommunications methodology which most of those knowledgeable in telecommunications, based on their own use of media, consider critical to the intensive, comprehensive, nationwide effective use of telecommunications in educational, rehabilitative, medical, and social services operations. But, even the listing of its many unique technical capabilities and significant educational applications does not tell the full story regarding ITFS's present and future potential significance.

Growth Rate and Expansion Potential of ITFS

During 1976, when CenTeX studied 63 of the approximately 90 ITFS operations in the United States, these operations were serving more than four million students. Extrapolating these data to the total number of ITFS operations then in the United States, it has been estimated that ITFS systems in 1976 were serving approximately 7,500,000 students.

As part of its continuing effort to keep its study of educational technology up-to-date, CenTeX reviewed federal communications records during May 1977. The results of this review are summarized in table 3.

As table 3 indicates, during the 18-month period following the initial CenTeX study, ITFS overall expansion was 18.9 percent; licensees and applicants had increased from approximately 90 to 103, and the actual number of channels in operation was 497.

Table 3. Statistics on the Current Status of ITFS, Nationwide

Number of ITFS licenses	99
Number of channels in operation	497
Average of number of channels per operation	5
Number of additional channels requested	50
Increase in number of channels	10%
Number of new applicants for systems	4
Number of channels requested	44
Average number of channels per applicant	11
Increase in number of system operators	4%
Total number of licensees and applicants	103
Total number of channels	591
Average number of channels per operation	5.8
Overall expansion of ITFS	18.9%
Number of separate licenses issued	193
Number of new licenses	39
Total number of licenses	232

Public Schools	Private Schools	Graduate Schools	Medicine
52%	10%	33%	5%

Source: Data are from FCC records and are current as of May 1977.

The May 1977 review of FCC records also made clear that two services—rural-area and social-services providers—were becoming significant users of ITFS telecommunications distribution systems.

Of significance are these facts:

- In May 1977, America's ITFS systems were serving more than 7,500,000 students at all levels of education—from pre-school through senior citizen.
- The currently in-place ITFS systems are located in areas where more than 38.42 percent of America's population live. (See figure 2.) With appropriate expansion, therefore, existing ITFS operations could effectively deliver educational, rehabilitative, medical and social services programming to *78,086,745* Americans, and provide the *two*-way audio-video and/or audio return-circuit capabilities required to make many major phases of these four basic public services effective.

Other major factors regarding the distribution scope and power of ITFS delivery systems are discussed in the following pages.

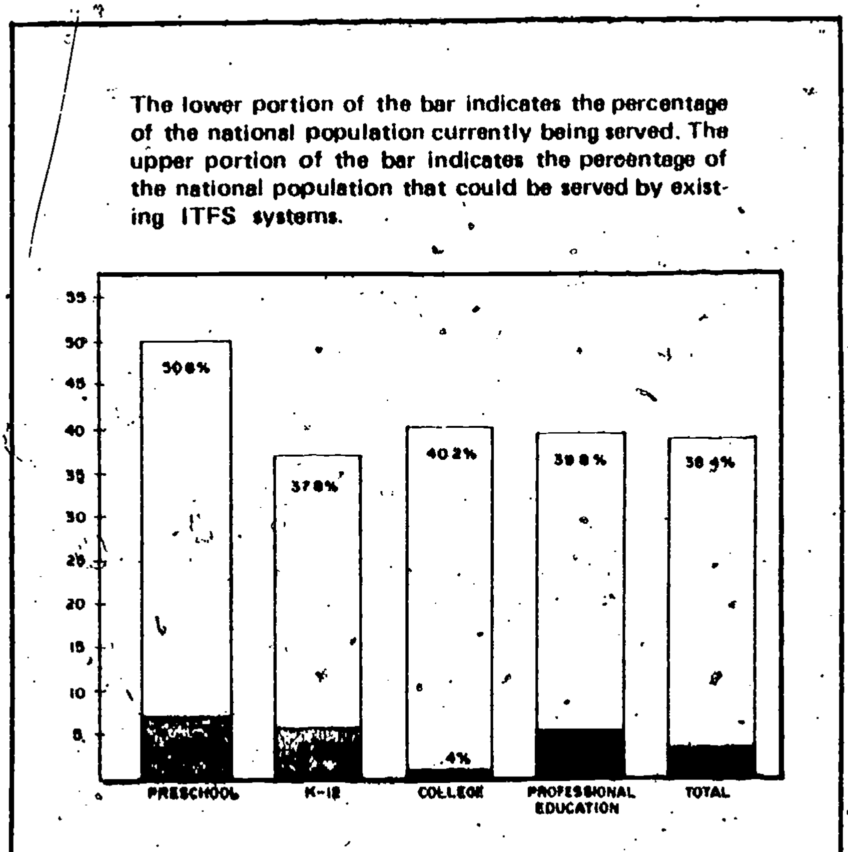

Figure 2. Service areas of current ITFS systems.

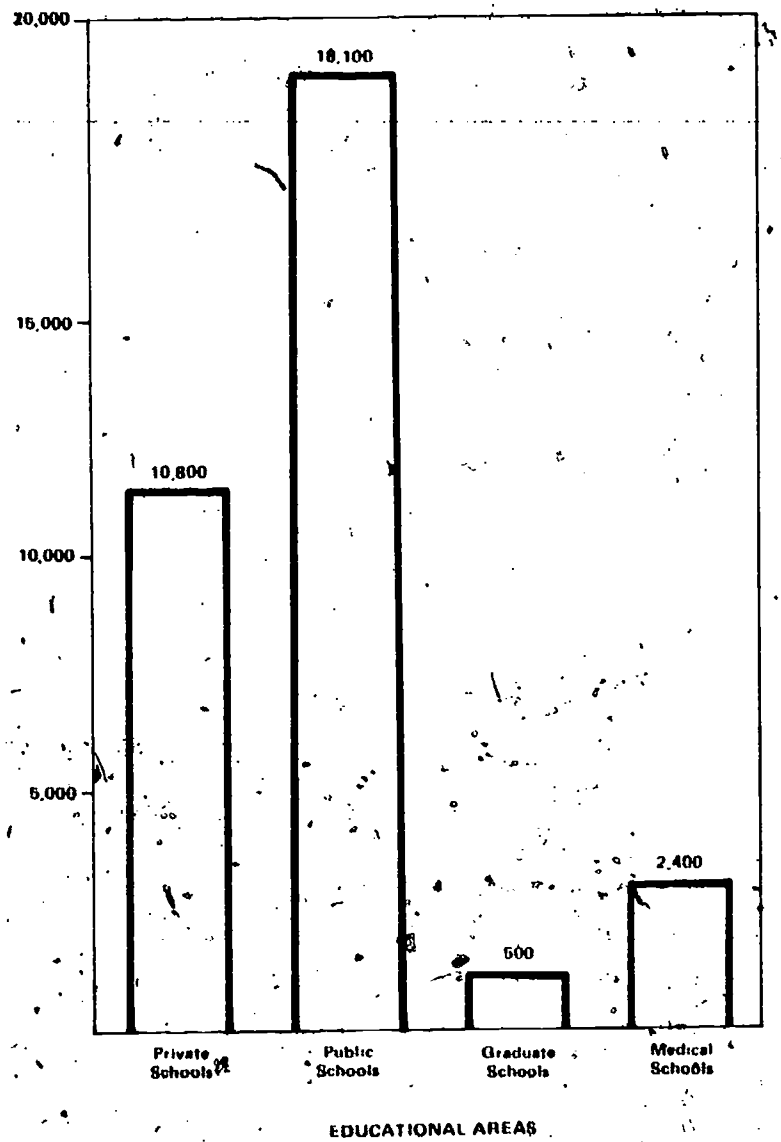

Figure 3. Per channel viewing populations.

Intensive Use of Available Channel Spectrum

It is important to note that the average viewing population of a public school channel is 18,100 pupils (see figure 3); that of a medical school channel is 2,400 "students"; that of the average private school 10,800 pupils; and that of the average graduate school channel approximately 500 students. ITFS really makes heavy-duty use of its assigned spectrum space.

Potential Application and Capacity of One ITFS Channel

As figure 4 so clearly demonstrates, because an ITFS channel is six-megahertz (six million cycles) wide, and because the FCC has not only recognized the vary-

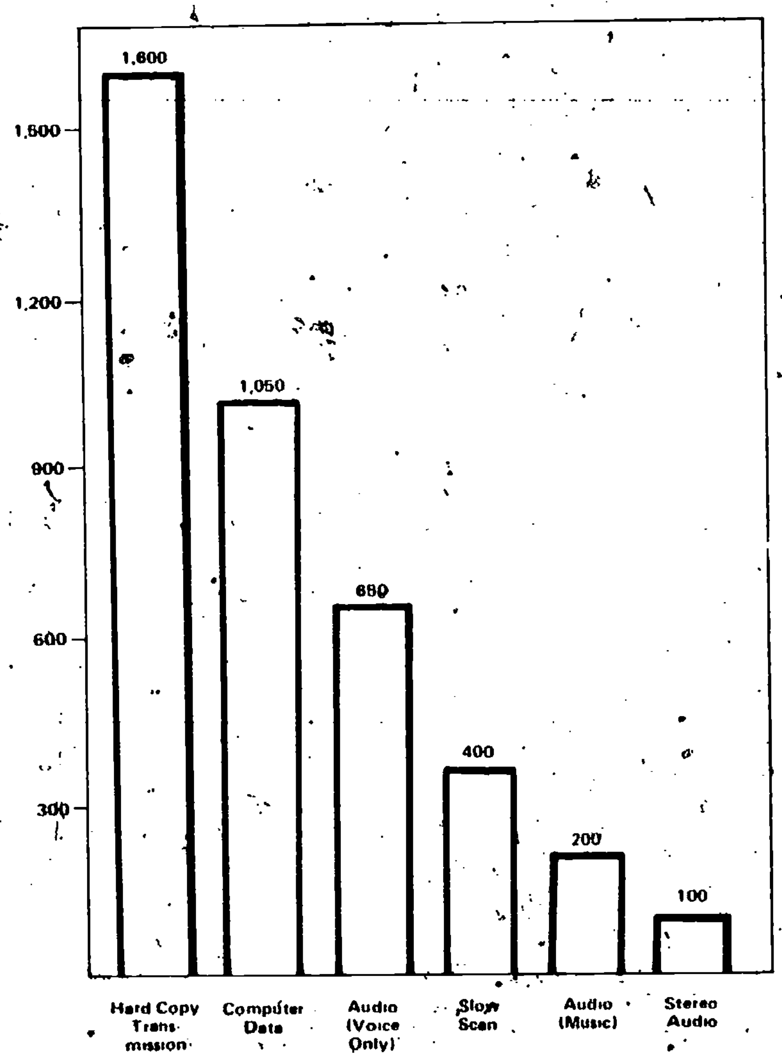

Figure 4. Potential number of circuits available per ITFS channel.

ing telecommunications needs of education but also has adopted rules that ease the use of ITFS systems to meet these needs, *one* ITFS channel can be used for many types of transmission. For instance, a channel can be used to provide transmission either for a single TV circuit or for the transmission of 400 slow-scan circuits; for 650 audio-only circuits or for 1,050 computer access and control circuits.

Multi-channel Capability of the ITFS Spectrum

Because there are 28 contiguous six-MHz channels available in the ITFS spectrum and because ITFS propagation is line-of-sight, ITFS channels (if their applications are appropriately engineered and their use limited to earth-bound systems) have sufficient capabilities and capacity to meet all currently projected nationwide education and health-service telecommunications delivery system needs, except for the 100 largest American cities.

Given consortium-operated telecommunications system objectives and managements and the advantage of the non-competitive time requirements of the various educational/medical services, the ITFS spectrum, as currently engineered, may even be capable of meeting all of the nation's educational/medical telecommunications delivery needs except in the 50 largest cities. Progress in telecommunications componentry and system design will, it is hoped, someday make it possible for ITFS to develop the capacities needed to meet (or more nearly meet) *all* of America's future educational and health needs.

Practical, Available, Low-cost Production Techniques

Educational use of ITFS focuses on the communication of information and know-how, and it need not compete with commercial television for viewer attention. ITFS emphasis is on information transfer and interactive teaching and learning. The effectiveness of most educational programming does not depend on the slick production standards so critical to the success of general TV broadcasting.

FCC regulations for ITFS recognize this fact and permit educators to reduce the technical production standards normally required for broadcasting. This can reduce ITFS production costs by as much as 75 percent, and thus innovative services (e.g., two-way, audio/video teaching) become both feasible and effective.

Lower Capital Investment and Operating Costs

All these factors make the capital investment and operating costs of ITFS telecommunications delivery for education and medicine the lowest of any available today. For instance, an average ITFS transmitter/receiver station currently costs approximately $100,000-$150,000, compared to $1,000,000-$3,000,000 for a public television transmitting-only station or $350,000 to $400,000 for a comparable satellite transmitter/receiver station, plus the cost of a complementary ground network to make the use of such a system comparable to what ITFS already offers at ground level. (It is important to note that one audio/video satellite circuit costs six times the frequency spectrum of its ITFS counterpart.)

ITFS Is Cost Effective

Figure 5 shows the average per student cost of delivering education via ITFS systems to the major student bodies served by the nation's ITFS operations. It will be noted that the figures for each major student body population include capital equipment depreciation as well as total annual operating costs.

Of particular interest are the school figures. The average public and private school annual per-student cost for the type of ITFS school service described in detail in this paper is $5.67 per year. It is to be noted that the National Center for Education Statistics in the 1976 edition of *The Condition of Education* estimates that the current per-student annual school cost averages $1,300. In other words, *the cost of providing ITFS systems to America's schools is less than one-half of one percent of the total per pupil average annual cost of American school education.*

The cost of ITFS services for the distribution of medical education is even more infinitesimal. The annual tuition cost at some medical schools today is more

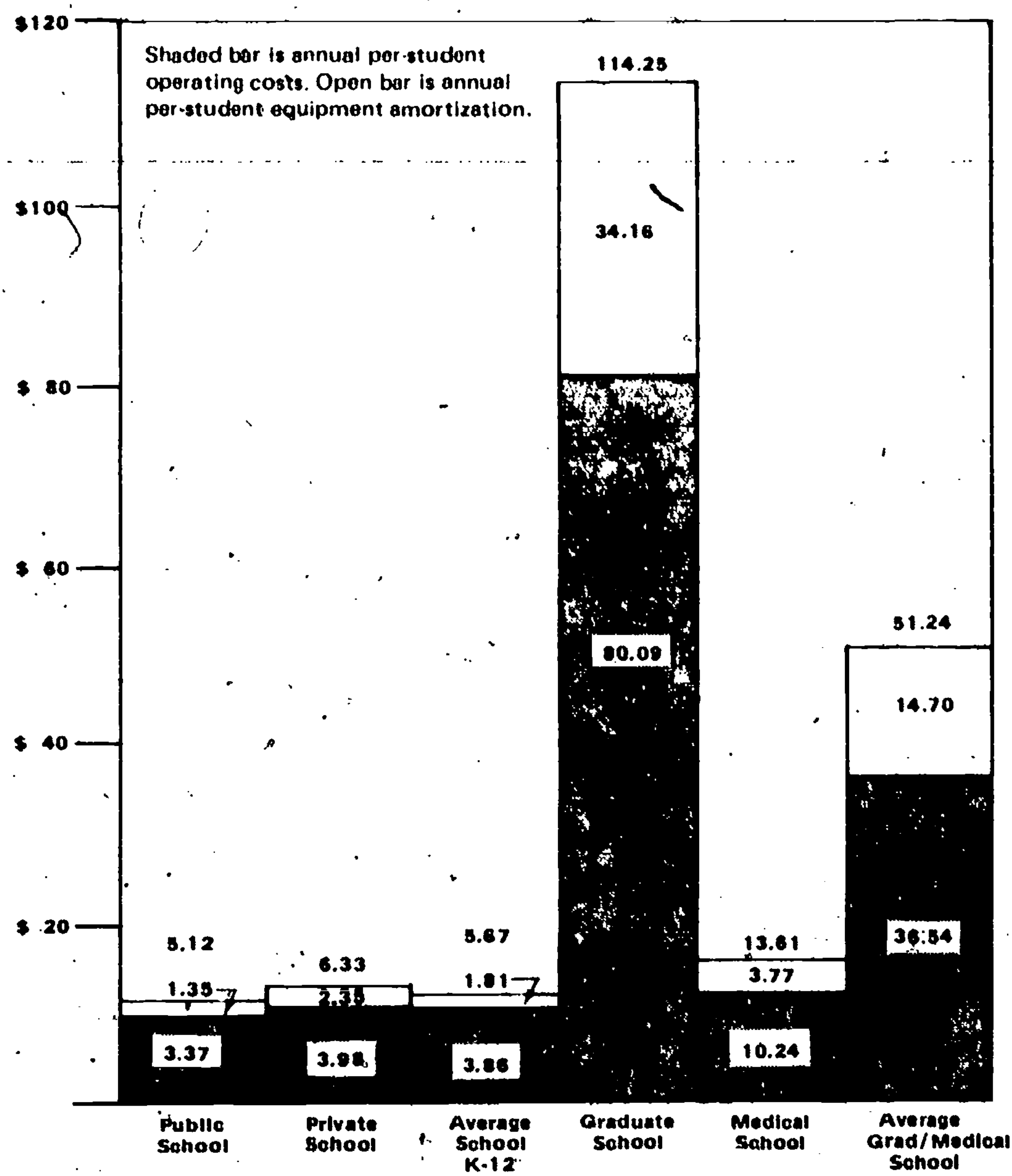

Figure 5. Annual total per-student costs.

than $12,000. Using, however, a much lower annual tuition cost, say, $6,000, or half that of the George Washington and Georgetown medical schools in the nation's capital, the cost of ITFS distribution ($13.61) is less than one-quarter of one percent of the annual medical school tuition fee.

ITFS Generates Its Own Economic Viability

Today, ITFS is the only major educational telecommunications methodology generating its own operating support dollars.

How would public television and public radio survive without the regular, annual appropriation of the millions of federal and state dollars which keep such operations alive and expanding? How extensive would be the educational use of satellite circuits (although there would be some, of course) were the supporting millions of federal dollars and "free" satellite circuits not annually appropriated by Congress? Where are the educational cable and FM-multiplexed circuits that are "carrying their own freight?"

ITFS Has Sound Operations Management

Today, ITFS educational/medical telecommunications systems have an annual expansion rate of 12.3 percent,[5] without the infusion of funding from any federal source.

How has ITFS survived without the underwriting provided by Congress for satellite, public broadcasting, and some other esoteric federally-funded educational telecommunications systems? It survives this lack of federal support because operators of ITFS systems have learned to manage their operations so effectively in the public interest that they are getting by without annual subsidies from the federal trough. What would ITFS do for education if it were given the federal support, under the direction of qualified project officers, that its record merits?

(In the interests of accuracy, it should be noted that during the late 1960s, federal funds were made available to establish ITFS operations, and that HEW's Bureau of Education for the Handicapped, under project officers H. L. Saettler, P. A. Andereck, and M. J. Norwood, is currently providing major federal interest and support to ITFS when used for the delivery of services affecting the handicapped.)

ITFS Is a Democratic Telecommunications Methodology

Because ITFS transmission is line-of-sight and uses very low-powered, relatively simple equipment (which can be safely and easily used by non-technical personnel), and because ITFS systems are low in cost (compared with comparable public TV, satellite and CATV systems), local school, college and social-service organizations—whether publicly or privately controlled—can afford ITFS capital equipment and operating costs. Further, they are readily able to determine local needs, which is essential to the effective use of ITFS for the distribution of services to local or small regional populations.

Unlike public broadcasting, satellite stations and telephone systems, ITFS can, therefore, be used to meet precisely local scheduling and programming requirements, and can be controlled by local, private and public authorities. ITFS is the only major telecommunications technology that permits full recognition of two cardinal principles of American democracy: the *local control* of education and the *diversity* of its objectives and management. Yet, ITFS technologies without negating the principles of local and diverse control can effectively establish ground-based regional, state and even national telecommunications networks.

Barriers to Egalitarian Education

Without question, America has created the world's most democratically-oriented system of education. Despite egalitarian legislation, judicial actions, and ever-increasing dollar appropriations at all levels of government, however, the world's most comprehensive educational system is in dire trouble. This assessment is based on many factors, including the following:

- Many American voters believe the spiralling costs of education are unjustified by either inflation and/or increased instructional scope and quality. (Voters approved 74.7 percent of school bond issues in 1965; only 46.3 percent in 1975.[6] And, witness the recent 2-1 passage of Proposition 13 by California's voters and similar legislation elsewhere.)
- According to figures compiled for the Advisory Committee on Issues of Educational Technology, National Academy of Engineering, the constraints of time and geography are primary reasons for the current failure of the country's educational processes to meet 50 percent of the nation's critically important educational needs.[7]
- Education is the only major American industry that fails to make major use of modern technological developments to increase the scope and distribution of education services and to increase the net productivity of its "workers" and "executives."

What are the barriers to national consideration and use of an educational tool which has demonstrated for almost a decade its effectiveness and economic viability at all levels of education?

In May of 1962, the Congress of the United States, recognizing the educational potential of television, amended its Communications Act of 1934 to provide for "Grants for Educational Television Broadcasting Facilities" (PL 87-447, 87th Congress). The adjective *broadcasting*--rather than *educational*--has been emphasized by most Presidential proclamations, and in decisions by Congress, educator study groups and state legislatures.

The Federal Communications Commission alone has continued to protect the original intent of Congress by emphasizing the significance of the word *educational* in its regulations. Therefore, when it implemented the Congressional amendment by establishing 31 channels (in the 2,500-2,690 megahertz frequency band) for educational use on July 25, 1963, it titled the spectrum area "*Instructional* Television Service," now commonly referred to as the ITFS Band.

It is important to note that the initial 1962 legislation mentioned above includes these basic qualifications regarding applicants:

> (1) that the applicant is (a) . . . responsible for the supervision of public elementary or secondary education or public higher education . . . (b) the state educational television agency . . . (c) a college or university . . ..(d) a non-profit foundation, corporation or association which is organized primarily to engage in or encourage educational television broadcasting.

The Congressional Conference Report establishing the May 1962 ETV Facilities Program (House Report 1609) very emphatically states:

> The conferees placed the responsibility for the execution of this program in the Office of the Secretary of Health, Education, and Welfare (HEW). . . . Under no circumstances should this program be subordinated to or tied in with other Federal programs in the field of education.

The Congress initially designed this legislation to ensure that it received top, prompt attention and to emphasize that funding would go primarily to *educa-*

tional (not primarily to *broadcasting*) organizations. Today, not one of these basic Congressional intents is being followed.

The allocation of grant funds is in a lower-echelon group of the Office of Education, far from the top level of HEW and is made to *public* broadcasting organizations whose primary aim is to produce and distribute, over a wide geographic area, programs of general cultural and informational interest, rather than specific educational curricula.

Oddly enough, it was the educators themselves who first tore up the spikes that held the guiding "tracks" of PL 87-447, of May 1962, to the Congressional purpose.

In 1967, a commission of educators set up by the prestigious Carnegie Foundation published its report on educational TV.[8] This report primarily concerns general public broadcasting, which it analyzes in depth. At its very end, beginning on page 237, the report devotes less than a page to Instructional Television Fixed Service. The remaining 254 pages emphasize that "non-commercial educational television stations may transmit educational, cultural and entertainment programs," with little reference to the use of technology for formalized, prescribed, educational instruction for students.

This Carnegie report and millions of Ford Foundation dollars led to the enactment by Congress of PL 90-129, in November of 1967, which established the Corporation for Public Broadcasting. As its name implies, this organization (with its operational associate, the Public Broadcasting Service) is solely concerned with promoting public broadcasting, and its federally-funded Congressional liaison organizations aggressively and exclusively protect the line of federal funding for their public broadcasting membership. During the current fiscal year, for instance, appropriations will provide more than $42 million worth of federal subsidies for public broadcasting stations, and forecasters believe that Congressional appropriations for public broadcasting will soon exceed *$100 million* per year.

Further, the technically knowledgeable National Science Foundation has spent more than $10 million of the taxpayers' money in recent years to develop costly, esoteric educational telecommunications prototypes, such as those of projects Ticcit and Plato (which would be equally costly to replicate), but it has refused to supply comparable funding levels for the support of ITFS system research and development.

Even HEW's National Institute of Education, which is specifically charged by the Congress with responsibility for educational innovation, appears to prefer spending dollars for spectacular satellite experiments rather than for developing practical telecommunications delivery systems. The satellite experiments are designed to serve approximately 15.1 percent of the nation's population, whereas practical telecommunications delivery systems are capable of serving approximately 84.99 percent of the population, while costing much less in scarce spectrum space and citizen tax dollars.

Fortunately, despite lack of federal encouragement, ITFS is far from dead. Fortunately, too, one federal agency—the Bureau of Education for the Handicapped (Personnel Preparation and Media Services Divisions) has kept ITFS applications research and demonstration alive by funding the world's first use of ITFS to serve specifically the educational needs of handicapped children.

How to Put Educational Technology on the Right Track

Some major decisions and actions will be required at all levels of education and pertinent jurisdictional leadership before educational technology can be put back on track and headed in the right direction. The required steps can be plotted in a step-by-step procedure.

Step One

The first step in getting educational telecommunications back on the track is the establishment of an accurate general understanding among pertinent educators and government officials of the educational telecommunications technologies available and of the potential use and economic factors pertinent to their respective application to one or more components of America's educational processes.

This educational and information objective is a basic requirement for all jurisdictional levels - federal, state and local - affecting educational legislation and operations. Unless this is done, educational legislation and funding will be the result of special group pressures, rather than national interests.

Step Two

The second program step concerns breaking the educational telecommunications monopolies which exist at the national and many state levels.

Current federal funding legislation, for instance, limits the pass-through process of federal educational broadcasting dollars solely to public broadcasting stations. *It is neither in the interest of the nation's democratic future nor in the immediate public interest to limit all federal educational telecommunications funding to a single monopoly controlled by broadcasters, not by educators.*

Federal legislation is needed as soon as possible to preclude vested-interest control of educational telecommunications and to recognize and clearly establish an equal status for both "educational TV," as public broadcasting is called, and *instructional* television, such as ITFS.

Otherwise, a federally maintained CPB and PBS will not only destroy the only self-sustaining telecommunications' operation—ITFS—in the educational telecommunications field, but will create the type of monopoly capable of destroying America's hope for a truly egalitarian educational system.

Step Three

It is most important that federal and state funding dollars for educational telecommunications be placed in the custody of those who are most directly accountable for the use of those dollars.

For instance, funding dollars which are now placed by the National Institute for Education and the National Science Foundation would probably be more carefully and productively used if they were spent by the Office of the Commissioner of Education. Further, the transfer to a single funding source could substantially reduce the amount of currently required overhead dollars.

Step Four

ITFS operators should form a professional society to organize their experience, so that the experience of one member can be promptly made available to other society members, and so that educators, legislators and others needing information regarding the use of ITFS can have an authoritative source from which to secure it.

All other major suppliers of educational supplies and services (cable and public television operators, textbook and audiovisual equipment manufacturers) have such organizations, but ITFS has not had one since the FCC's National Committee for the Full Development of the Instructional Television Fixed Service was abolished approximately four years ago.

Conclusion

In the end, what happens to ITFS will depend on actions taken by the Federal Communications Commission.

Currently, some commercial interests would like to use ITFS for the distribution of pay television programs. At least one manufacturer wants to usurp two 30-megahertz segments of the ITFS spectrum plus guard spectrum (or 36-47 percent of the entire ITFS spectrum) to establish a commercial, limited common-carrier system, under the guise, of course, of a social service for-profit operation!

Even non-profit operations (such as some would-be satellite users and operators) would like to secure for special interest uses portions of the valuable ITFS educational spectrum.

The FCC must be persuaded to resist these attacks on our most valuable educational spectrum resource. The 1971 decision to reserve the ITFS spectrum for non-profit educational use, considered by many to be the most statesmanlike action ever taken by an American regulatory commission in the public interest, was by a bare majority of four to three. Since the composition of the Commission has changed substantially since 1971 (only one of the Commissioners who voted for the establishment of the service is still on the Commission), and since the commercial and other interests trying to secure the spectrum space are served by professional lobbyists, a vigorous and concerted effort must be made on behalf of ITFS.

If the FCC refuses to reduce the ITFS frequency allocation, and if the actions outlined in steps one through four are taken, ITFS will soon take its rightful place at the forefront of America's educational, medical and social service delivery processes.

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John A. Curtis is founder and chief operations officer of the Center for Excellence, Inc., a non-profit research and resource development corporation in Williamsburg, Virginia. He has been a pioneer in railway and highway communications systems and computer-center service operations. In 1969, he was made chairman of the Board of Consultants set up by the Joint Council on Educational Telecommunications at the request of the Common Carrier Division of the FCC. The publication of two papers the year before, "Center for Excellence," and "The Institute for Learning Sciences and Teaching Technologies," contributed directly to that appointment. In 1971, Mr. Curtis was invited to become a member of the National Academy of Engineering's Advisory Committee on Issues of Educational Technology. He founded the Center for Excellence in 1973 in association with faculty from the College of William and Mary.

Bert Cowlan comments:

Before undertaking this assignment, I had assured John Curtis I would be no less gentle with him than with anyone else. I cannot be ungentle; his paper is solid and fact-filled, and I feel somewhat ashamed of myself as a "communications policy planner" that I knew so little about ITFS before I read it. However, there is one area in which I would take issue, since I believe satellites and ITFS can combine to provide far more service, more outreach, and more flexibility at lower cost. (I do agree totally, of course, about the need to stop any attempt by any *commercial* operator to seize any portion of the ITFS allocated frequency band.) Actually, John and I are in agreement about the ITFS/satellite approach recommended by the Public Interest Satellite Association, of which I am co-director, and which I will describe here briefly.

Under existing regulations of the International Telecommunications Union, which governs all spectrum allocation and whose agreements have Treaty power, the only affordable option for low-cost, small terminal, interactive telecommunications for the non-profit sector would be in S-Band, the 2-4 GHz frequency band in which ITFS operates and which is reserved for education, worldwide. The ITU will convene a World Administrative Radio Conference (WARC) in 1979. Decisions made at it will be binding until the end of this century. What has been proposed as a matter of U.S. policy (which U.S. policy-makers are still debating):

1) Seek a dedicated spectrum in S-Band.

2) Proceed with research and development (by NASA) for the further development of the Large Deployable Antenna Satellite Experiment (LDASE), designed by NASA's Jet Propulsion Laboratory, on which, for policy and budgetary reasons, progress has been stopped.

3) Retool the LDASE configuration to be geosynchronous, S-Band, multi-beam, thus protecting the integrity of all ITFS terrestrial systems, since a multi-beam would provide the capability of checker-boarding frequencies and thus avoid interference with any ITFS system's needs.

4) In the short-term, consider a hybrid system in which those ITFS systems so desiring could interconnect via the satellite and re-transmit on their terrestrial facilities.

5) In the long term, build a truly large-antenna, public service satellite telecommunications system that would provide thousands of (non-interfering with ITFS) interactive channels, using low-cost and portable equipment, for educational and public service uses worldwide.

I cannot say positively that such a system --requiring as it still does a great deal of research and development on the leading edge of satellite technology, and involving, as it will, the use of the space shuttle (still an unknown in many ways) to launch the large antenna satellite-- will work. The thrust of my argument is to keep the options open. If not kept open at the WARC, and assuming that S-Band is the only affordable band, education, as has happened before, will become subservient to commerce. We *are* at a communications crossroads; time *is* running out; education--and educators and the deliverers of social services--must make their needs known clearly and quickly. Neither spectrum nor parking spaces for satellites are infinite in affordable terms.

Teleconferencing + Telewriting = Continuing Education in Wisconsin

Lowell B. Jackson, Lorne A. Parker
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The telephone is a look-twice phenomenon. At first glance it appears to be a limited medium with little potential in education. The telephone has thus often been ignored in favor of its more glamorous sisters--television, radio and computerized instruction. But a second look reveals its particular advantages: The telephone is interactive, flexible, inexpensive, widely available and supported by a well-developed infrastructure. It is an audio *and* visual communications channel. Using telewriters, graphic input devices or slow scan televideo systems, a telephone network lends itself to a variety of instructional formats.

In short, the telephone is uniquely suited to many educational roles, one of the foremost being the delivery of programs to a new generation of adult learners.

Continuing professional education and avocational adult education are two of the fastest growing areas of higher learning. Their rapid growth reflects both a new philosophy of education and the need for professionals to keep abreast of information. It is also the result of the simple demographic fact that the U.S. is becoming a society of older people. In the present decade, the number of 25 to 34 year olds will increase 44 percent, and this dramatic shift to an older population will continue well into the 1980s and 1990s.

Higher education has traditionally focused on full-time, on-campus youth enrolled in formal degree programs. However, the new post-secondary student, the adult, has a different view of education and wants the opportunity to learn in his or her home community. These part-time learners of all ages and lifestyles have diverse learning needs. Rather than defining education as a terminal degree program to prepare one for future goals, the adult learner sees education as a self-directed activity that continues through life. Education, conceptualized as lifelong learning, is a vehicle for on-going vocational development and leisure-time pursuits.

Aside from a personal interest in professional growth, continuing education is increasingly viewed as a necessity in many fields, including engineering. The tendency for professional associations and licensing boards to encourage continuing education will most likely accelerate, forcing educators to revise their curricula and teaching methods.

The adult learner is also often a distant learner who requires non-traditional delivery systems. To reach adults in their home communities, higher education, which is primarily campus-based, must implement new modes of instruction. The development of outreach programs, however, is often limited by budgetary constraints. The delivery of instruction to students near their homes or places of business is usually not justified economically if an instructor must travel great distances to serve a few participants at each classroom site. What alternative, then, is most economically feasible, makes best use of teaching resources, and effectively meets the educational needs of distant adult learners?

In response to this question, many educators are turning to the telephone, one of the oldest and most effective mediums. Although invented over 100 years ago, it remains the basic instrument of the new communications technology. Following many small-scale experiments in the 1960s, the telephone's unique advantages are leading to a second generation of educational telephone networks in North America and Europe.

There is almost universal agreement that two-way communication is a necessary element of long-distance education.[1] A telephone network is interactive, allowing students and instructor to exchange information, ask questions and receive immediate feedback. The process of interaction between faculty and students and among students themselves is perhaps the most important of the educational processes. While television and radio may be appropriate for some courses, these essentially one-way systems fall short when discussion and immediate feedback are required.

A television network, which uses cables, microwave or broadcast channels, is also costly and cannot easily be modified to incorporate new receiving locations or to shift transmission sites. A telephone network can use various combinations of dedicated and dial-up lines to minimize cost while maximizing reception and transmission flexibility. For example, dedicated lines may interconnect any number of remote classrooms, while dial-up lines give people at other locations access to the network.

The telephone also offers instructional flexibility. Course materials can be modified easily at reasonable cost. The latest telewriting equipment or slow-scan televideo system can display a variety of graphic or pictorial information to supplement audio instruction.

In Wisconsin the focus has long been on the telephone. The Wisconsin idea - that the boundaries of the campus are the boundaries of the state - provides the philosophical base for statewide outreach programs. In this supportive environment, the University of Wisconsin Extension's Statewide Extension Education Network (SEEN) and Educational Telephone Network (ETN) have flourished. Today these telephone networks annually attract over 30,000 students - engineers, teachers, physicians, nurses, librarians, lawyers, business people, social workers and others.[2]

Wisconsin's Statewide Extension Education Network (SEEN)

Wisconsin's Statewide Extension Education Network illustrates the application of the telephone to engineering education. SEEN was developed in 1969 to meet the instructional needs of extension engineering. For the past eight years, its unique capability for both audio and visual programming has made it possible to deliver continuing education to engineers throughout the state, even in the most isolated communities of northern Wisconsin.

SEEN uses leased, commercial telephone lines to simultaneously transmit audio and visual material to many widely separated classrooms. Two-way audio communication allows students at any SEEN location to participate actively in the course, asking questions and exchanging information with the instructor and fellow students at all the connected sites. Electrowriters supply the visual element. Any material that is customarily shown on a classroom chalkboard equations, diagrams, outlines, graphs, line drawings can be presented instantly on the electrowriter and transmitted over the telephone lines to all SEEN locations. Students view the material exactly as it is created by the instructor and may comment or ask questions any time during the session.

The SEEN system links more than 20 locations throughout Wisconsin (see figure 1) with approximately 3,500 miles of long-distance telephone lines. The locations were selected according to population densities, educational needs of local residents and distribution of engineers and other professionals in the state. This configuration allows the network to serve 80 percent of Wisconsin's engineers and technicians. The classroom settings vary; some are in county courthouses, while others are on campuses or in manufacturing firms. In addition to intra-network communication, a telephone call from anywhere in the U.S. can be tied into the system, thus providing contact with outside experts.

Programming for Engineering Education

Extension Engineering offers SEEN programs in both non-credit continuing education and credit undergraduate and graduate education.[3]

Continuing education, the largest program and the basis of the entire Wisconsin teleconferencing network, is directed to the practicing engineer and other professionals. Engineering courses are usually conducted over a six- to eight-week period, meeting once or twice each week. They tend to be practical state-of-the-art courses tailored to the needs of professional engineers (e.g., Industrial and Manufacturing Engineering Refresher). Continuing education courses are usually offered between 4:30 and 10:00 p.m., Monday through Thursday, times that are convenient for working engineers. Participants earn Continuing Education Units (CEU) for each program satisfactorily completed.

Wisconsin engineers who enroll in continuing education programs have a unique opportunity to earn a professional development degree in engineering, a post-baccalaureate degree pioneered at the University of Wisconsin. The P.D. program is based on the special needs and personal objectives of the full-time employed

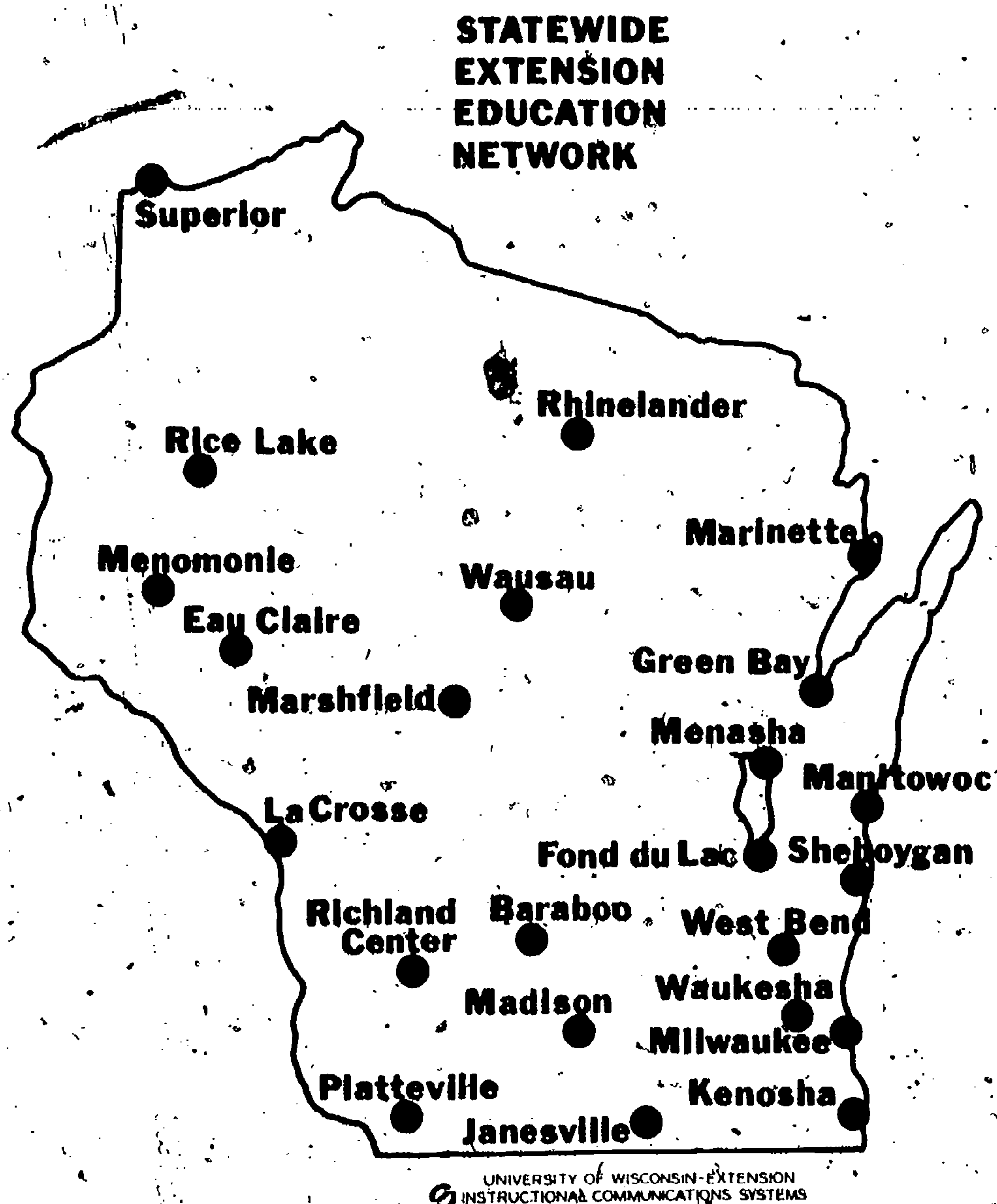

Figure 1. The SEEN network serves 80% of Wisconsin's engineers and technicians.

engineer. Each engineer's plan is flexible and can be changed to reflect new learning objectives. The 120 CEUs required may be earned in short courses, institutes and seminars, workshops, correspondence study, video cassette courses and individual guided study programs, as well as in SEEN courses.

Undergraduate and graduate credit courses are available to both off-campus and on-campus students. These courses are customarily conducted during the morning or afternoon hours. Continuing engineering students may also take the courses at any SEEN site. Resident campus students are usually enrolled in SEEN courses that are simultaneously telecast to the 14 two-year campuses of the University of Wisconsin Center System, an arrangement often more economical than offering separate classes at each school. In many cases, the inclusion of working students who are occupationally associated with the subject matter has added much to the relevance and scope of instruction. In such subjects as product liability, welding metallurgy or pollution control, the experienced engineer has contributed much to the course and challenged the instructor to keep abreast of engineering practice.

Engineering SEEN courses may originate in Madison, Milwaukee, Wausau or other locations, allowing flexibility in program topics and the most effective assignment of faculty specialists from any part of the state.

Administration Is a Cooperative Effort

The administration and management of the SEEN engineering programs involves three groups: Instructional Communications Systems, Extension's Department of Engineering and Applied Sciences, and Extension agents at the local level.

- Instructional Communications Systems (ICS), a division of University Extension, is responsible for administering SEEN, coordinating network programming and managing the technical system. Coordinating functions include program scheduling, instructional design, promotion and evaluation. ICS also serves as a liaison between Extension Engineering and the local agents. Technical management of the system involves the operation and maintenance of the telephone network, studios, classroom hook-ups, electrowriters and audio equipment, as well as the production, recording and distribution of programs.

- In Extension Engineering, course design, faculty identification and all academic matters related to SEEN programs are managed by the director of Electronic Media Programming in Engineering (EMPE). The EMPE director initiates courses, conducts direct mail promotion and coordinates with other Extension departments, such as math, business and management, concerning offerings of probable relevance to engineering clientele.

- The third branch of administration is provided by the Local Program Administrator (LPA), an Extension agent headquartered at or near a SEEN location. The LPA is the contact person at each site, who is responsible for scheduling, managing, and promoting programs locally. The LPA may also have a program aide to welcome and assist students and to operate the audiovisual equipment.

The Faculty

The instructional services for SEEN courses are supplied by three types of faculty: 1) the professional staff of Extension Engineering; 2) the teaching faculties, primarily in engineering, at five or six of the 27 campuses in the University system; and 3) the engineering and industrial community with appropriate experience and teaching expertise.

Faculty in the first category supply the bulk of the non-credit offerings, which deal with their areas of professional competence. These teachers are able to respond quickly to the changing aspirations of continuing engineering clientele. Participation in SEEN teaching is encouraged as a substantial method of professional advancement.

The SEEN courses offered for credit are generally taught by resident campus faculty and adapted directly from existing courses offered to students on campus. Courses offered by these faculty members are generally those simulcast to the network from a class of resident students. Teachers in this category were in the past compensated by an "overload" payment in addition to their regular faculty salary, but they now often engage in SEEN programming as part of their regular academic activities.

Building on the long experience of the evening non-credit offerings based in Milwaukee, some of the SEEN schedule is devoted to simulcast versions of these courses. The instructors may be from any of the three types of faculty. Those not on the staff of UW-Extension are usually compensated at an hourly rate.

SEEN Engineering Programs At-a-Glance

Table 1 presents statistics about the SEEN engineering program throughout its operational life. Since courses differ in length, credit status, and design in relation to the contact hours required per credit, the CEU has been used to represent the total time spent by the student on the course, including outside reading and study.

Experience and projection show that the engineering portion of SEEN can be expected, with good management, to maintain an average of about 1,000 CEUs per semester, generated by about ten courses, each with approximately 25 students.

Table 1. SEEN Statistics, 1970-1977

Semester	Number CEU	Enrollees	Avg. Enroll./ Course
Fall 1970	652.8	77	7.0
Spring 1971	1202.0	157	17.4
Fall 1971	938.8	76	6.3
Spring 1972	827.3	88	11.0
Fall 1972	1324.1	181	15.1
Spring 1973	936.8	137	15.2
Fall 1973	906.0	153	17.0
Spring 1974	1168.6	295	29.5
Fall 1974	926.1	271	22.6
Spring 1975	1349.0	400	36.4
Fall 1975	933.6	183	22.9
Spring 1976	1051.5	273	24.8
Fall 1976	735.8	156	26.0
Spring 1977	733.2	286	28.6
Fall 1977	1139.4	275	25.0

The Technical System

A successful educational teleconferencing system, whether made up of two or 200 locations, includes three basic components: 1) the terminal or station equipment, 2) the interconnecting transmission system, and 3) the network control center. Among the variables that influence system design are the number of locations; the geographic area covered; the network configuration; whether the system is a four-wire, multi-point dedicated network or a two-wire dial-up network; and the network's intended use. No two designs are likely to be the same, but several ingredients are common to successful systems:

1) An educational teleconferencing system should be able to connect participants at widely scattered locations.
2) The system should provide a communications environment that duplicates (as closely as possible) the single-site discussion group.
3) Terminal or station equipment should provide even sound distribution and allow easy participation.
4) The system should be manageable, allowing additional locations and equipment as well as modifications to meet user's changing needs.
5) A network control center should provide a program origination point and essential supervision of the system's technical operation.
6) The transmission system should provide clear, intelligible communication between all points on the network.
7) The system should be able to connect groups anywhere in the world via regular telephone service.
8) Methods should be developed to recognize and clear quickly any technical problems interfering with service.
9) Equipment should feature the latest technology and be reliable and serviceable.
10) All terminal equipment, station location interfaces, and installation procedures should be standardized throughout the system.[4]

With these general capabilities in mind, the three basic components of the SEEN system will be described in greater detail.[5]

Station Equipment

Each of the SEEN classrooms has identical equipment: a Darome Convener for two-way voice communication and a Victor Electrowriter* to either transmit or receive graphic material. Using these devices, an instructor can present both audio and visual information to students in a number of widely scattered locations.

The Darome Convener** (figure 2) is a self-contained, portable conference set

*The Electrowriter, manufactured by Victor Comptometer Company, was an early pioneer in visual-telephone devices. Recent developments in telewriting and televideo systems are reviewed at the end of this chapter.

**The Convener was developed cooperatively by Instructional Communications Systems, the Darome Company and the Wisconsin Telephone Company to meet the unique need for immediate, two-way communication in an extended geographic area.

Figure 2. Participants at all network sites interact via the Darome Convener, a portable unit with a speaker and 4 microphones.

that contains four microphones and a speaker that plugs into a standard telephone jack and AC power outlet. Students simply press a bar at the base of the microphone to participate in class discussion. Each microphone has a 20-ft. cord to allow easy access by students. As many as 16 microphones may be placed in a single classroom using a jack provided on the unit and audio mixers. The audio amplification system produces highly intelligible sound in a classroom seating up to 300 people.

Electrowriters permit the transmission, reception and projection of any visual material customarily shown on a classroom chalkboard. As shown in figure 3, the instructor writes on the electrowriter transmitter with a special ball-point pen. Pen position and movement create tone signals that are carried over regular telephone lines to electrowriter receivers in SEEN classrooms around the state. These signals are translated by the receiver into an instantaneous and faithful reproduction of the instructor's writing. The image on the receiver is then projected onto a screen, which becomes the classroom chalkboard.

The basic electrowriter system consists of a transmitter and receiver, each of which have an electronic pen, servo-mechanism, and a writing area of 17.5 square inches. The SEEN electrowriters were modified by Instructional Communications Systems to double the writing and viewing area, thus making a two-frame system. When one frame is being developed by the instructor, students can still see the frame previously discussed.

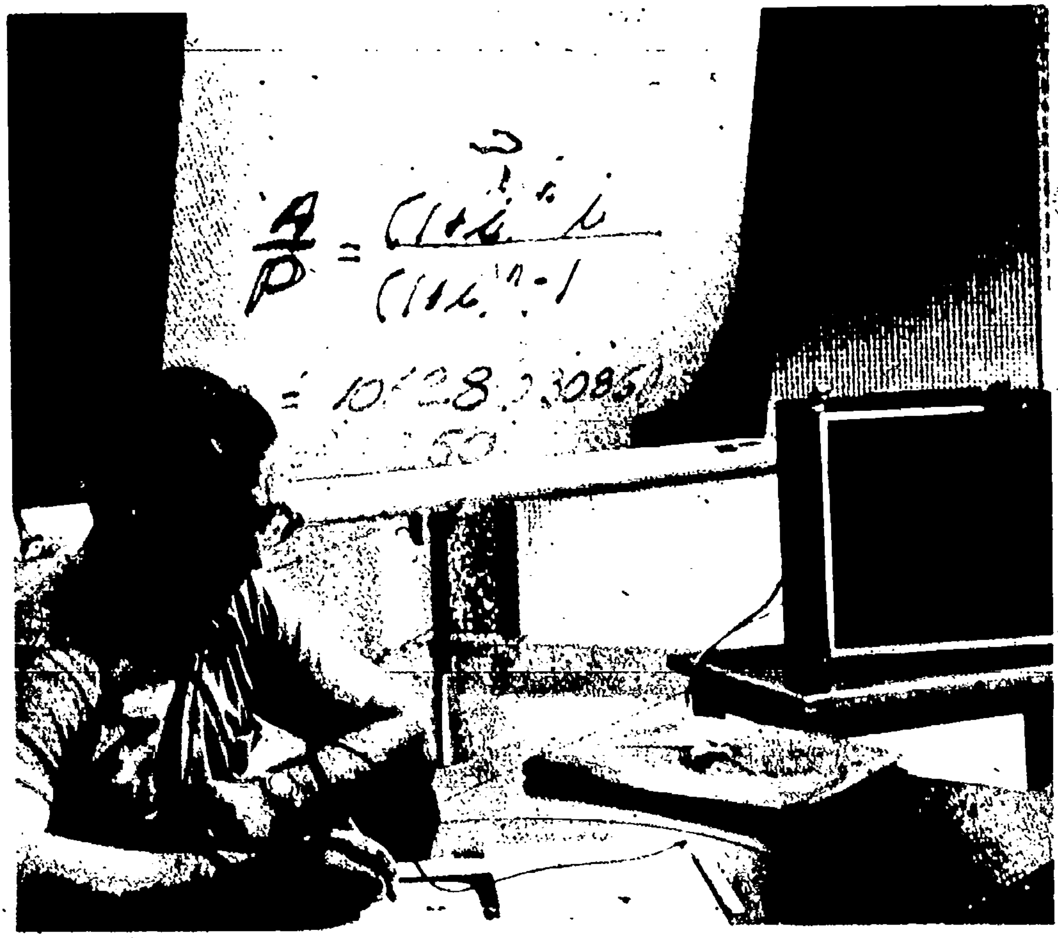

Figure 3. As the instructor presents written material on the electrowriter, it is projected onto screens in the SEEN classrooms.

Distribution Network.

The SEEN system uses two dedicated, four-wire, multi-point teleconferencing networks; voice signals are transmitted over one network, while the second network simultaneously transmits the signals from the electrowriters. Having two of the four-wire networks gives the system greater flexibility, for both audio and visual information can originate from any SEEN location.

SEEN's dedicated system uses permanently installed facilities leased from the telephone company on a 24-hour-a-day basis. Because the listening centers are permanent, all points on the system are wired to operate like a party line. On a four-wire system of dedicated lines, each message is carried on its own pair of wires, eliminating feedback on the return loop. Greater control over signal levels, signal-to-noise ratio, and signal bandpass also results in a transmission quality far exceeding that of a two-wire conference system.

The basic building block of a multi-point, dedicated network is a four-wire, six-way bridge. Using this together with existing telephone transmission facilities, a network of any size can be designed. Since these bridges can be located regionally, a network can be formed in a regional building-block fashion. The practical size limit for any region, however, is 20 stations, because of the noise created by the multiple facilities and circuit terminations. Most of the techniques used to construct a multi-point, private line teleconferencing system are standard operating procedures within the telephone industry. Equipment is available from several manufacturers and suppliers.

An important ingredient in a successful dedicated telephone network is the ability to connect other locations to the four-wire system. By bridging a dial-up call to the private line network, SEEN's coverage is extended to any location where there is a telephone.

Studio Control Complex

The studio control complex consists of studios from which programs may originate and a control room for network operation. It is located on the University of Wisconsin-Madison campus and is operated by Instructional Communication Systems.

The control room and studios were designed to provide smooth, trouble-free programming and to minimize the burden on the instructor. Because all technical aspects of a program are handled by a trained engineer, instructors are free to concentrate on their material and presentation.

The control room (figure 4), is equipped to handle program control, telephone

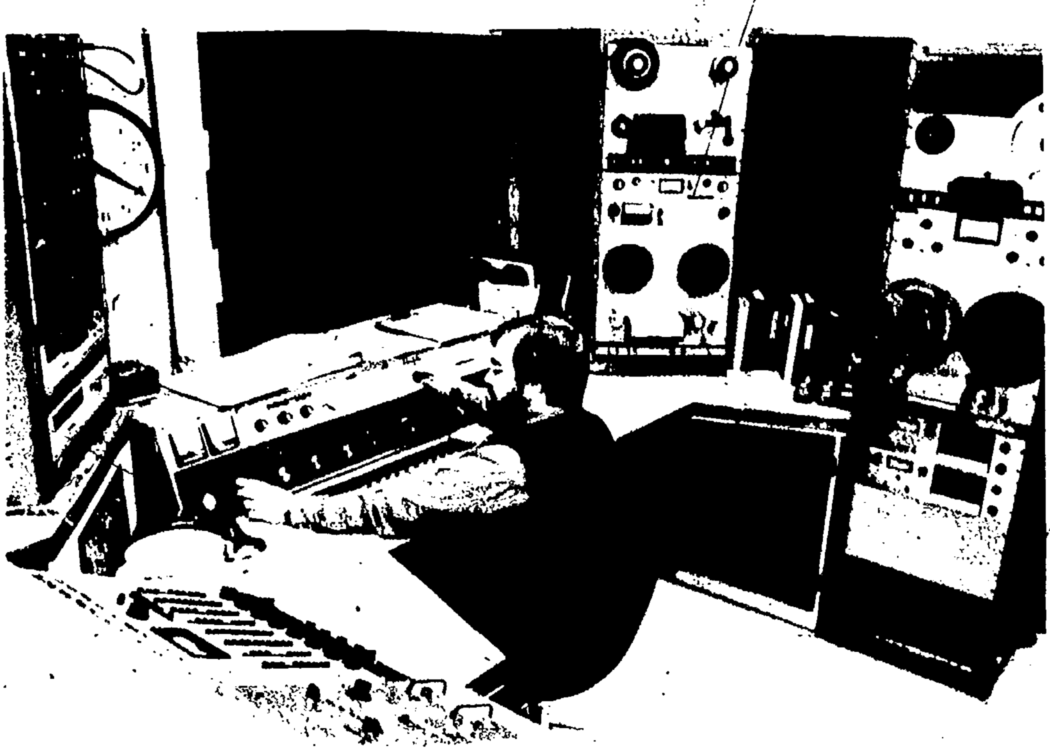

Figure 4: A control room engineer handles the technical aspects of program and monitors the network to detect any problems.

network control, studio sound control, monitoring, and network failure detection.

The control room technician uses a console to control program audio sources, such as tape recordings and microphones. For example, the technician loads any insert tapes on the tape machines and plays them on cue from the instructor. The technician also controls the electrowriter signals and records programs for future reference or "make-up" sessions.

Complete control of the entire telephone network is maintained in the control room. Before program time, the technician establishes the teleconferencing network, quickly tying in the appropriate locations. The network of dedicated lines can be arranged as programs and enrollments dictate. Participating locations can be selected for total system programming, or regional networks can be established and programmed simultaneously. Dial-up bridging controls also allow the technician to tie regular calls into the private network.

Studio sound system equipment is used to control the distribution of audio programming to the studios, so the instructor can hear the response from the network; to the control room, so all audio channels can be monitored; and to administrative offices, so staff can listen to programs. The control room also provides general building paging with emergency override to all areas.

Monitoring is crucial to the quality of network programming. Console controls and VU meters allow the technician to cue and listen to any of the audio sources without connecting them into the network or program. The technician is also able to monitor selectively the output levels at the distribution console and correct the level quickly. Transmit signals are monitored to check that signals are getting through the master bridges at the telephone company. Visual quality is monitored on an electrowriter receiver in the control room.

Quick detection and resolution of network failures is vital to the success of any teleconferencing network. Within a 16-hour programming day, an average of three or four system failures may occur on Wisconsin's two educational telephone networks. Adequate monitoring and test features are therefore necessary to minimize network downtime and program interruption. An experienced control engineer can isolate a problem quickly and identify the source, whether station equipment, transmission line, carrier system, or some other characteristic failure. More complex failures can be reported to the telephone test board, which then helps to isolate and correct the problem. Given the ability to quickly isolate a region, the technician can bypass the problem area and continue to operate the remaining parts of the network. A control room microphone allows the technician to talk to any point on the network.

The electrowriter transmitter is contained in a special table that keeps it flush with the table surface for ease of writing. The electrowriter also sits on a swivel base that can be adjusted for the most comfortable position. A microphone head-set frees the instructor's hands for writing.

An electrowriter receiver in the auxiliary control room is used to project the visual presentation onto the screen in the studio as the instructor writes on the transmitter. Eight bar-activated, table microphones allow students to interact with participants at other SEEN locations. Tables and chairs are arranged as a classroom setting, with each table having two microphones.

Program Planning

Effective use of the SEEN network depends on careful program planning. From the inception of a topic through final production, programming is a complex process that requires close coordination among the instructional department, ICS staff, and local UW Extension agents.

Program planning basically involves seven stages: content selection and development, network scheduling, operational design, program announcement, promotion, registration and production.[6] Standard procedures guide programmers through this process. A 20-minute videotape acquaints programmers with the many elements involved in effective programming, including support services available at ICS and other Extension departments. A brochure on planning procedures is also available to programmers.

Content Selection and Development

The content of SEEN engineering courses is initiated and developed by Extension Engineering faculty. The EMPE director oversees the selection of courses and instructors.

For continuing education courses, Engineering has found that effective programming is based on an accurate determination of the education needs of its clients. These needs are determined through: questionnaire surveys; voluntary suggestions from both instructors and students; advice from persons such as industrial training directors or those serving on various continuing engineering studies advisory committees; and spontaneous "targets of opportunity" that indicate a subject likely to be of current interest to a specific clientele. For example, close watch is kept on legislation that appears to require an increase in some technical skill or knowledge, such as a new uniform single-family housing code or a solid waste disposal law.

Graduate and undergraduate courses are based on the more traditional requirements of a degree program as well as the willingness of an instructor to offer a course in the SEEN mode.

Scheduling of Programs

Program time on the SEEN network is usually scheduled at an annual meeting held in January. One or two weeks before the meeting, programmers are invited to submit programming requests for the academic year, which are sorted and preplotted on a master schedule to best utilize network hours and resolve conflicts before the meeting. The meeting itself allows programmers to review the entire schedule, negotiate hours if needed, and firm up their program times. Two weeks after the meeting, all requested network time is rechecked and confirmations are sent to the programming departments. Further requests for time can be made during the year.

Operational Design

The overall operational design of a program involves both the programming department and the Instructional Communications Systems (ICS) department.

Each group has certain responsibilities but works closely in planning the following:

- Target clientele: Identifying target clientele and program objectives.
- Budget: Determining program materials, mailings, production, support staff, honorariums for speakers, people needed to make the program successful and arriving at a program fee.
- Promotion and publicity: Planning brochures, press releases, radio spots, feature stories, radio-TV appearances.
- Production timetable: Establishing pre-recording, telephone tie-ins, remote program origination, A-V materials, cassette packaging.
- Instructional approval: Obtaining department chairman and divisional dean's approval.
- Registration process involved.
- Evaluation instrument to be used.
- Program materials: Determining handouts, books required.
- Course format to be followed.
- Station selection: Serving statewide or certain locations.
- Program initiation request: Confirming the operational design; also the official contract between the programming department and ICS.

Program Announcement

A program announcement is prepared by the ICS program coordinator in conjunction with the program department to provide the local program administrator (LPA) and network coordinators with pertinent information about the program. A schedule card must be returned within a given time, usually two weeks, if the network facilities cannot be scheduled. The LPA determines location availability and uses the schedule card to inform ICS accordingly. From the schedule cards returned, a listing of confirmed locations is sent to the program department and the registration office, which keeps a checklist for location requests. The program department then completes its program brochure identifying specific network locations. The program announcement, with its approximate 60-day lead time, gives the LPAs and the programmer ample time to schedule and promote the programs properly.

Promotion

The promotional strategy for SEEN engineering courses has been largely based on direct-mail announcements. Approximately 20,000 people in Wisconsin and some engineers in Iowa, Minnesota, and Illinois, receive brochures. An internal mailing list is augmented by a few outside lists.

There are three types of direct-mailings: (1) an annual directory that lists all Engineering Extension offerings and describes the SEEN system and other instructional modes; (2) a catalog of EMPE courses (SEEN and various television formats), on a semester or annual basis; and (3) monthly-reminder brochures of upcoming programs, generally grouped in interest categories.

More general promotional vehicles also are used, such as the newspaper tabloid—an economical and convenient medium—prepared each semester by ICS and the Program Information Office. It lists all programs by department and includes dates, times, fees, clientele, and a general description of each course. Newspaper ads and public service TV spots have been used on occasion.

Of growing importance to promotion are the local program administrators. Their local contacts with potential clientele have been increasingly effective in generating enrollments, and their efforts are enhanced by special news releases prepared by Extension's Program Information Office for distribution by the LPA in local news media.

Registration

Registration for SEEN engineering courses is conducted primarily by mail preceding the first program. Enrollment forms on the program brochures are addressed to the EMPE director who, after listing the registrants for each course, forwards the enrollments to Extension's central registration office, which processes the forms and deposits the enrollment fees in the programming department's account. Copies of the registration forms are sent to the registrant, the programming department, and to the local program administrator at the participant's location.

Production

Before the first program session, ICS staff contact the instructor to confirm the production format for the course. If an instructor is unfamiliar with network facilities and production capabilities, an appointment is arranged to demonstrate the equipment and explain the production process.

Production requirements for each program are written on a standard form and given to the network engineer for use at transmission time. Included are the locations participating in the program, origination site, tape inserts, dial-up telephone participants, and tape duplication services.

Programs on the SEEN system can originate at any of the network locations, but most engineering courses originate in Madison, Milwaukee, or Platteville, where the majority of faculty members are located. The programs may be produced live or prerecorded for later telecast.

In addition to the SEEN studio and regular monitor-control functions, other production services are available to faculty, including:

- *Faculty production lab:* A workshop area where faculty may use cassette and reel tape machines, turntable and telephone for convenient recording, editing and listening to program materials.
- *U-Tape-It studio:* A self-operated, push-button control studio in which faculty record lecturers and interviews.
- *Studio recording and editing:* A technician-controlled production service available for single-voice and multiple-voice recordings, such as for role playing and panel discussions. Editing assistance is also available.

- *Tape duplication:* Cassette and reel copies of programs available for purchase by faculty and students.

Instructional Design

An interactive telephone network such as SEEN is a unique instructional mode. Although it is similar in some ways to face-to-face teaching, there are important differences. Effective programming therefore requires that certain elements be incorporated into course content and teaching style.

The design techniques used in SEEN programs are based on 12 years of experience with Wisconsin's educational telephone networks and accumulated research in communications, adult education, listening, and learning theory. Workshops, printed materials and faculty consultations help SEEN instructors implement these techniques and use the network most effectively.

Four design elements are considered essential to interactive programs: personalizing the experience, varying the style of presentation, seeking participation from the statewide audience, and obtaining feedback.[7,8]

Personalizing the experience helps students feel comfortable in the distant learning environment by creating a congenial atmosphere and group rapport. SEEN instructors usually adopt an informal teaching manner, allowing their personalities to come through. Frequent use of names and locations identifies participants. By emphasizing common objectives and the sharing of ideas and experiences, learners scattered throughout the state feel like part of a group.

Style of presentation involves many elements, all of which contribute to the goal of helping the learner understand and remember the material. A variety of illustrations presented on the electrowriter, such as drawings and graphs, amplify ideas and underscore key points. The visual development of equations accompanied by a clear, concise verbal explanation help the learner understand the mathematical relationships. Instructors often exploit the two-frame capacity of the electrowriter by reviewing the material previously presented, which contributes to the clarification and retention of ideas. Topic outlines, bibliographies, lists of resources available for self-study, and other hand-out materials distributed before the program help students organize the learning experience.

Participation, an integral part of interactive media like SEEN, does not occur automatically. Detailed class rosters, for example, are used to direct questions to those with specific engineering experience and training. At the beginning of a program, many instructors converse informally with students at different locations to "break the ice" and stimulate discussion.

Feedback enables both student and teacher to assess the learning experience, achieve program objectives and improve performance. Informal question-and-answer periods interspersed throughout the program show immediately how well the material is understood. Many instructors ask participants to send in questions and comments, others make periodic phone calls to their students. Individual or small group projects and written responses to specific questions are other means of obtaining feedback.

Evaluation

Evaluation is an integral part of the programming process that contributes to the overall effectiveness of the SEEN system and the quality of individual courses. Three types of evaluations are conducted for SEEN engineering programs: 1) system surveys of SEEN clientele at three-year intervals; 2) surveys directed to the participants in a particular SEEN course; and 3) spot evaluations to facilitate the critique and management of certain courses.

System Evaluation

The purpose of the system evaluation is to determine the strengths and weaknesses of current programs so that the program design can be improved. Evaluation results show the students' assessments of both instructional and technical elements. These results are analyzed by the program coordinators, educational specialists and individual instructors, and recommendations are incorporated into the design of subsequent programs. The system evaluation also provides peripheral benefits. For example, it functions as an additional channel of communication between the participants and the instructor, and it is a tangible sign of interest in student opinion.[9]

System evaluations of the SEEN engineering programs were conducted in 1974 and 1977 by survey questionnaires mailed directly to SEEN engineering clientele. Response was voluntary, resulting in a sample size of 282 respondents in 1974 and 244 in 1977.

The first part of the evaluation instrument included a series of items that provided a demographic profile of the SEEN student that has been useful in identifying future participants and in structuring programs for this particular group.

Some of the student demographic data is presented in table 2. The two surveys show little difference in any category except the degree of participation in SEEN courses. The number of respondents who are regular SEEN customers (defined by enrollment in more than one offering) more than doubled in 1977.

A statistic which bears on the justification for off-campus network programming is the distance traveled one-way to the SEEN classroom. Approximately two-thirds of the participants were within ten miles of course access both years. (An item added to the 1977 survey revealed that nearly two-thirds of the students were located more than 30 miles from a university campus with any technical curriculum, and one-third were more than 100 miles away.)

The acceptance of SEEN as a delivery system is indicated by the percentage of students who said they would participate in another course. In both years seven out of eight students responded affirmatively.

The second part of the evaluation measured student response to the engineering programs. It contained 30 descriptive statements related to the instructional and technical aspects of the courses. These items were classified into six general categories:

1) The functioning of the technical components of the programs, such as the audio network and electrowriter.
2) The lecturer's delivery of course material.

Table 2. Selected Demographics of SEEN Engineering Students.

	1974 (N = 282)					*1977 (N = 244)*				
Number of Employees in Company	0-10	11-50	51-200	200+		0-10	11-50	51-200	200+	
	4%	16%	20%	59%		7%	20%	16%	55%	
Age of Respondent	20-30	31-45	46-60	60+		20-30	31-45	46-60	60+	
	31%	42%	24%	1%		25%	48%	26%	1%	
Percent of Tuition Refund by Employer	0-20	20-40	40-60	60-80	80-100	0-20	20-40	40-60	60-80	80-100
	15%	2%	15%	11%	49%	16%	2%	14%	16%	46%
Distance Traveled One-way to SEEN Site (miles)	0-2	3-10	11-30	30+		0-2	3-10	11-30	30+	
	14%	49%	27%	7%		18%	48%	24%	7%	
Have Participated in More Than One SEEN Course			19%					42%		
Would Participate Again in a SEEN Course			86%					83%		
Would Not Participate Again in a SEEN Course			10%					9%		

3) The course content and other program materials.
4) The arrangement of the physical facilities at the SEEN classroom site.
5) The program's organization and involvement of the participants in discussion.
6) The overall effectiveness of the system.

Each of the first five categories corresponded to a primary system objective and was evaluated by at least five descriptive items on the survey. One statement at the end of the evaluation asked for the participants' overall feelings toward the program. Responses to each statement were marked as a numerical rating along an ordinal scale as follows: 1 strongly agree (SD); 2 disagree (D); 3 neutral (N); 4 agree (A); and 5 strongly agree (SA). The data collected were analyzed to derive the mean, percentile and standard deviation for each category and the individual items. Their reliability, quality, and predictive power were measured by a MERMAC computer program.

The respondents' evaluation of the engineering program is summarized in table 3. There is little difference in the mean values of each category for the two surveys. The data collected in 1977 show a slightly higher level of satisfaction with the instruction (lecturer, material, organization) and slightly lower rating of the physical aspects of the system.

Table 3: Evaluation of SEEN Engineering Programs

	1974		*1977*	
Category	*Mean*	*Reliability*	*Mean*	*Reliability*
Technical	3.78	.77	3.65	.74
Lecturer	3.58	.84	3.67	.80
Material Presented	3.59	.70	3.69	.84
Facilities	4.12	.58	3.80	.62
Organization	3.55	.80	3.66	.77
Total, All Items	3.73	.92	3.69	.93
Overall Effectiveness	3.69	—	3.73	—

Individual Course Surveys

Whenever the enrollment in a SEEN engineering course exceeds 55 students, (which may happen once or twice a year), a survey somewhat different from the system evaluation is used. Results have been strikingly similar to the system survey results. The value of such individual evaluation in the critique and adjustment of the course instruction is substantial. For the individual course survey a number of questions peculiar to the subject are included.

Table 4 shows the summary results of a 40-question survey designed specifically for a new course. Items scoring below 3.5 are candidates for refinement.

Table 4. Summary of Single Course Survey

Category	*Mean*	*Reliability*
Technical	4.16	.48
Lecturer	3.74	.67
Organization	3.52	.62
Knowledge	3.10	.71
Competency	3.13	.76
Content	3.67	.82
Total Overall	3.59	.92

Spot Evaluation

When the size of a class is so small as to reduce the statistical significance of the responses a standard evaluation form is distributed. The return in this category may be computer-processed, as are the other types discussed above, but are more likely to be "hand-processed." These spot evaluations are particularly valuable for first-run courses with fresh instructors, new topical material, or where attendees appear to be distinctly different from the ordinary class. These evaluations often are deployed in response to random participant feedback that calls for substantiation. Many instructors routinely distribute and collect these responses for their own use.

Costs of the System

The costs of the SEEN system include those for administration, promotion, printed handout materials, instructional fees, line costs, engineering equipment maintenance and a variety of support services such as those involved in conducting surveys, faculty training and local site coordination.

The university costs of the SEEN engineering program in 1977 were approximately $60,000, with about half being spent on instructional costs and half on network operation. Income from student tuition amounted to some $30,000, placing the current self-support level at 50 percent. Continually improved program management and market development might make the program 60 percent self-supporting during the next several years.

Costs in higher education are usually evaluated by two approaches: 1) cost per student contact hour, and 2) cost per continuing education unit. Using the first approach, the SEEN engineering program costs about $17 per student contact hour. In 1977 some 550 students were enrolled in courses with 460 instructional hours at a total university cost of $60,000 (550 x 460 = 253,000 student contact hours ÷ $60,000 = $17). Using the total number of 18,072 CEUs earned in SEEN engineering courses, the cost is about $33 per CEU. A comparison between the cost per CEU of SEEN instruction and other delivery formats is shown in table 5.

Table 5. Cost Comparison of Continuing Engineering Education Formats, 1977.

Format	*Methods Used*	*Clientele Served*	*Avg. No. of Students/Yr.*	*Level and Scope*	*University Cost: Dollar/ Student CEU*	*Student Cost: Dollar/ Student CEU*
Correspondence study (worldwide)	Self-study with study guides and some audio-visual aids	Students remote from campus	1,800	Mostly undergraduate. Usually general interest topics. Seldom enough demand to justify advanced specialized topics.	$14.00	$8.25
Institutes and short courses (Madison & Milwaukee)	Lectures and workshops	Practicing engineers and technical management	12,000	Highly applied. Generally state-of-the-art.	$85.00 (institute) $75.00 (short course)	$100.00 $75.00
SEEN (statewide)	Electrowriter network	Very broad range	550	Applicable to a wide range from college courses to single-topic state-of-the-art.	$33.20	$20.00
Video cassette/ courses (worldwide)	Study guides, Video Lessons	Students & Practitioners on & off campus	1,000	Same as SEEN. No Interaction.	$16.00	$16.00
Evening classes (Milwaukee)	Lectures and labs	Working students, sometimes without company financial support	[illegible]75	Often similar to college courses. Usually more applied. Some state-of-the-art programs.	$35.00	$30.00
University campus courses (Madison)	Lectures and labs	Resident students, part-time students employed locally	2,600	Generally aimed at resident campus students; continuing engineering students can enroll.	$22.50 (undergrad.) $41.25 (grad.)	$5.50 $12.25

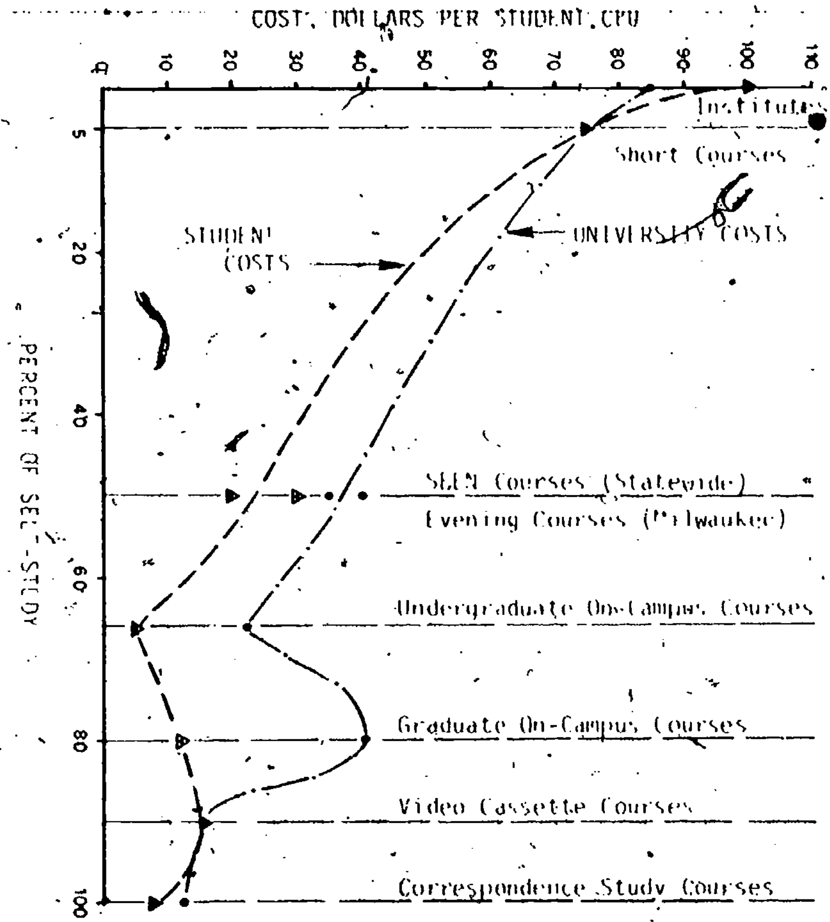

Figure 5. Relative costs and self-study.

Looking at cost data by relating student and university costs to the percentage of "self-study" required of the student to participate in a particular type of instruction, figure 5 clearly indicates a decrease in cost as the self-study component increases. The figure also shows the effect of management to bring student and university costs together, whereas the on-campus difference for public instruction is quite pronounced.

There are other student cost benefits difficult to estimate: those cost savings for travel between business and campus as opposed to SEEN locations in a total community. The surveys in 1974 and 1977 showed, as in the case of other formats such as Institutes and Short Courses, a great deal of the continuing engineering students' direct expenses are often refunded by their employers.

The Future of the Telephone in Education

The telephone has served Wisconsin well in extending education opportunities to engineers and others throughout the state. The teleconferencing networks have increasingly grown in number of enrollments, programming hours, and variety of

The Latest Equipment

The future of the telephone in education depends not only on its effectiveness as an audio-medium but also on its capacity to provide a high quality of visual information. This consideration is especially important in technical fields like engineering where instructors often present mathematical and graphic material. Recently introduced telewriting and televideo systems have great potential in education. A variety of graphic and pictorial information can be presented over regular telephone lines using improved electro-mechanical pens, graphic tablets, video writers, electronic blackboards, computer graphics systems, or slow-scan televideo systems. Some of these devices and their manufacturers are summarized in table 6.

Electro-mechanical pens that write on paper-covered surfaces, such as the Victor Electrowriter, are probably the oldest of the telewriting systems, entering the market of telephone technologies in the early 1960s. Since then, their resolution and accuracy have greatly improved. Their relatively low cost also makes these devices attractive for transmitting hand-drawn graphics equations, line drawings, outlines, diagrams, graphs.

Graphics tablets, video writers and the electronic blackboard are similar in a number of ways. Hand-generated material is accurately reproduced by writing directly onto conductive surfaces. Graphics tablets usually have electronic grids or specially coated transparent sheets that sense pen movements. To produce graphic material on a video writer, one writes directly onto a TV monitor with a light pen. Ordinary chalk is used to present information on the pressure-sensitive electronic blackboard made by Bell Laboratories. The Electronic Blackboard has been tested in continuing engineering education for a number of years at the University of Illinois at Urbana-Champaign. All of these systems digitize the information and display it on monitors at remote locations.

Computer-graphics systems are capable of showing both written material and computer-generated graphics. A graphics tablet is used for hand-drawn information. In addition, these systems are programmed to perform various computer graphics, such as constructing bar charts and diagrams. Some have programmed symbols that can be instantly placed at any point on the televised display. These symbols may be mathematical or simple figures that can be animated to show, for instance, an airplane flying through a cloud or a person walking. Many firms have lines of computer graphics systems or will design packages especially to meet the user's needs.[14]

Slow scan televideo systems add another dimension to telephone instruction the capacity to present pictorial information as well as graphics. Any image that can be captured by a video camera can be shown on a televideo system, including views of the instructor and classroom, outdoor scenes, written and prepared material. The picture is transmitted over the telephone lines during a number of seconds and shown as a frozen image on a remote TV monitor. Past systems were quite limited, used mainly for security-surveillance operations. However, the recent application of electronic technology has greatly improved their performance and versatility.

classes offered. This expansion is expected to continue as more and more adults seek off-campus programs for professional development and personal growth.

Supporting the Wisconsin experience are many studies that show the telephone to be an effective, inexpensive educational medium. Rao and Hicks,[10] for example, reviewed 18 experiences in teaching by telephone and concluded that students learn as much or more in telephone classes as in face-to-face discussion. Similar conclusions were drawn by Hoyt and Frey,[11] Pellett,[12] Blackwood and Trent,[13] and many others.

The new telewriting and televideo systems provide additional flexibility for visual instruction over a telephone network. Combined with its proven effectiveness as an interactive audio medium, the telephone can play a unique role in education–a role that extends teaching resources to adult learners in many distant locations.

Table 6. Selected Telewriting and Televideo Systems.

Capability	*Device*	*Manufacturer*
Hand-drawn graphics	Electro-mechanical pens	
	Telescriber	Telautograph Corporation
	Telenote/Telescreen	Talos Systems, Inc.
	Electrowriter	Infolink Corporation
	Graphic tablets	
	Audiographic Systems	Interand Corporation
	Graphic Tablets	Tektronix, Inc.
	Intelligent Digitizer	Summagraphics
	Cybergraphic Systems	Talos Systems, Inc.
	Video writer	FOR-A Company, Ltd.
	Electronic blackboard	Bell Laboratories
Hand-drawn graphics and computer-generated graphics	Computer graphics systems	
	Telestrator Electronic Graphics Systems	Interand Corporation
	Interactive Graphics Systems	Tektronix, Inc.
Hand-drawn graphics and video pictures	Slow scan televideo systems	
	Phone Line Television Systems	Robot Research, Inc.
	Narrowband Video Systems	Colorado Video, Inc.
	Telephone Video Systems (monochrome and color)	NEC-America, Inc.

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Lorne A. Parker is director of Instructional Communications Systems at UW Extension, where he heads three major statewide communications systems that provide continuing education. A member of the Wisconsin faculty for the past ten years, he played a significant role in the development and operation of university communications systems to take education to the people. Parker did his doctoral research at Wisconsin in mass communications and adult education, with specific focus on compressed speech. He has M.A. and B.A. degrees in radio, TV and film communications. Author of several books and numerous articles, he has served as a consultant to many telecommunications projects.

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Bert Cowlan comments:

"Teleconferencing + Telewriting = Continuing Engineering Education in Wisconsin," by Jackson, Parker and Olgren, describes well an extremely sophisticated system known, by now, the world over. (Or, so one must assume, given the charges quoted to me by one of the authors of theppaper to spend a few days observing the project. There seems to be, these days, an unpleasant correlation between the cost of observation and the popularity of a project.) The chapter's opening paragraph virtually says it all and the second paragraph is even more to the point.

If this program is as effective as it is (and there are no doubts), why should it not be more widely available? Why, too, should the focus not be extended by beyond continuing professional education? (I would hardly advocate, as do some institutions of "open learning," using telephony for "Witchcraft I" or "Skateboard III," but a good technology, a usable and affordable one, should always be scrutinized for further applications. This would be true, in my frame of reference, regardless of whether some uses are more cost-beneficial than others; not all skills (such as, for example, a widespread knowledge of basic life-saving techniques) lend themselves to cost-benefit analysis, or, for that matter, to zero based budgeting.)

There may be technologies, if not yet in place at least on the drawing boards, that will use satellite-mediated instruction and turn out to be even less costly than the ubiquitous telephone. This is not satellite-pie-in-the-sky; they are close at hand and will be discussed in the chapter on satellites. The point here (and I make it frequently in these commentaries) is that we seem to need a national policy, both educational and communicational, to deal with many good things that are in place and working, but are local and fragmented. (This is not to be taken as an argument for federal curricula, although, for certain kinds of curriculum material, that might not be the most evil course to follow, especially where some measure of central coordination would provide for a wider distribution of educational valuables and lower costs for all.)

The point made by Jackson et al, that "a television network, which uses cables, microwave or broadcast channels, is also costly and cannot easily be modified to incorporate new receiving locations or to shift transmit sites," is an excellent one. The point could also apply to telephone installations, of which costs are rising. The satellite technology-that-is-not-yet-here-but-could-be, if the proper regulatory, policy and political decisions are made, might be an answer. (Satellite telecommunications, for the purpose of these comments, are seen as telecommunications, not broadcasting, and can as easily—and far more cheaply—be narrow-rather than broad-band.) And, I have no illusions about the need for color motion pictures in education; recent evidence has developed that in many cases they are counterproductive.

Since I have not seen the Wisconsin project in operation, any comments about equipment, production and pedagogical approach and the like would be unseemly. It all sounds superbly thought through, though, in terms of comparable projects on a lesser scale that I have visited. The costs seem reasonable, especially when one factors in the ever-increasing cost of travel. There have been figures mentioned for satellite configurations as yet unbuilt that are but a fraction in terms of delivery costs (software, courseware stays about the same) of these.

That graphics-by-telephone will improve is accepted as a given; both quality and costs of the initially-required equipment seem to be improving and dropping, respectively. Whether this is true for installation and line charges is a matter worth further study.

—*B.C.*

How to Establish and Operate A Radio Reading Service Via SCA

Rosanna Hurwitz and Thomas Fish
The University of Kansas

A Radio Reading Service (RRS) provides printed information via closed circuit methods for people who are unable to read for themselves. Use of the service offers the possibility for a more independent life style to the blind, the physically handicapped and the elderly.

To establish a Radio Reading Service is a challenging experience. Planning surely spells the difference between real success and demoralizing failure. This chapter is written as a guide for those who are interested in starting their own RRS.

The Audio-Reader Service at the University of Kansas was launched through the generous efforts of a local philanthropist who decided the blind should have access to daily newspapers, books, and other information through radio. Stan Potter, director of services for the blind in Minnesota, who had pioneered the first Radio Reading Service,* told her how the service in St. Paul operated. She bought a new transmitter for the main channel - KANU-FM - tape recorders, a cart machine, a turntable and 500 receivers, and hired two staff members.

Audio-Reader, the second Radio Reading Service in the United States, went on the air October 11, 1971. Lacking organized support for the venture, our benefactor carried the costs by herself for a year-and-a-half. Several concerned members of the Kansas legislature managed to get the Audio-Reader added to the state library budget for one year, and the University of Kansas agreed to administer the program if the legislature would fund it the following year. That was five years ago. Our status remains much the same today.

How to Start Your Own RRS

In order to launch a Radio Reading Service that will continue to operate and grow, there are several important factors to consider. The priorities are as follows:

1) Form a general advisory committee of agency representatives, individuals, and private organizations to determine the needs and interests of the area to be served and to find eligible clients.

*See page 99.

2) Determine the availability of subcarriers of preferably public radio stations, and the interest of these stations in making a subcarrier available for this purpose.
3) Find an agency that shares your goals and is willing to provide at least some sort of basic budget and administer the service.

The latter might be an agency for the blind and visually handicapped, a state telecommunications agency, a university, a vocational rehabilitation agency, and so on. The possibilities vary from place to place, but a well-established funding agency with an interest in the radio reading service is critical in establishing and continuating the service. With a basic budget to depend on, grants to provide for special projects and programming can fill additional needs. (If, however, a granting program is the sole support of the service, questions arise concerning the continuation of what will have become a valuable service to those who depend on it, once the grant runs out.) The parent agency or organization ideally will share your goals, provide basic funding, furnish whatever other help is necessary, and let you provide your own service, developing it in the way that best meets the needs of your listeners.

When it comes to fund raising or influencing legislation and assisting your administrative agency, the general advisory committee is the nucleus to depend on. Committee members are the political trouble shooters and the people who can raise a matching grant, along with the parent agency. The group ideally should include newspaper publishers, representatives of local service clubs, elected political officials, radio and TV ownership, the Chamber of Commerce president, local industry, etc.

Administering the Radio Reading Service

The administering agency is a critical factor in the success of a Radio Reading Service. If this group is an independent, non-profit corporation, it must spend much time deciding the essential funding level, goals of the program, groups to be served, and the type of director the service needs. Good people in the past have been hired and fired because a board of directors was not willing to let a director direct. By the same token, the director should be sensitive to a fund raising group that rightfully expects to be fully informed of the program's workings. Total candor before commitment is essential on both sides.

If the administering group is a state agency, there will be a built-in advantage in having at least a basic operating budget and the established reputation of that group to back a fledgling Radio Reading Service.

We feel a state university or a college is particularly well-suited for this role. The direction of most educational institutions is three-pronged: academics, research, and service. The possibility of improving the quality of life for the blind, the physically handicapped and the elderly fits neatly into the school's service category. Further, a program that provides a broad range of services to many different groups, such as eligible print-handicapped people, is possible under the direction and sponsorship of a university. In the words of the Chancellor of the University of Kansas, Archie Dykes, "The Audio-Reader Service is an important part of the University of Kansas Outreach effort to serve all of the people of our State."

The University of Kansas provides its Audio-Reader Service with housing, utilities, a basic operating budget, students (who may participate for university credit), grantsmanship expertise and an outstanding main channel that carries the signal. Audio-Reader was the first radio reading service to be housed on a university campus and we feel it is one of the best possible options.

Feedback from Listeners

Our programming advisory committee is composed of the listeners. It should be formed as soon as possible after the service takes the air and should contain a good cross section of the listeners.

Our committee consists of 50 people who volunteered via the annual survey we conduct of our listeners. We call them each month to ask certain specific questions. The answers provide new programming ideas. We ask on the air for comments on a regular basis, so input is not limited to this group.

Facilities and Staff

After you have ascertained the needs of your area and organized your supportive general advisory committee, found a subcarrier to use and an agency to take fiscal responsibility, you are then ready to find space, hire staff, buy the necessary equipment and recruit volunteers.

Space should be adequate but need not be lavish. We house seven full-time staff, two half-time people, a guide dog, nine announcers, and anywhere from 75 to 100 volunteers in 955 square feet of space. We also have the use of the basement for storage.

A small reception area is nice, but office space (which may be shared), recording studios (which can be very small and must be sound treated), an on-the-air studio and a control room are necessities. Ideally, you should have additional space to audition tapes, store, pack and mail receivers, a production and interview studio for special local production, tape library space, and somewhere to meet with the volunteers, students and visitors.

Your space could be anywhere, but when decision time comes, think of accessibility for the handicapped, for older volunteers and students, adequate parking, and neighborhood noise. (Unless the insulation qualities of your building are excellent, or you are prepared to soundproof the whole area, look for a quiet spot.) If you pay your own rent, you will decide on the basis of your pocketbook.

Next comes the hiring of staff. The number of people you can hire will naturally depend on space and budget. Critical to your operation is a director who cares deeply about your goals, knows how to implement them, likes working with people and will work twice the hours you can pay to get the job done. Of equal importance is a technical director or chief engineer who can install equipment, do preventive maintenance and advise on the purchase of appropriate equipment. We would advise you to buy the best equipment you can afford.

From personal experience, we most earnestly recommend that professional broadcasters be hired for the director and technical director positions. Whether or not the FCC considers us broadcasters, that is exactly what we are. We broadcast an all-talk format, which presents challenges that many commercial and public broadcasters never have to meet. Professional broadcasters can contribute the skills and techniques that keep listeners from becoming bored, as well as the knowledge of format and programming that can be a significant factor in the "listenability" of a Radio Reading Service.

The third person to hire should be an office manager to keep books, records, volunteer schedules, and do the typing. A program director and/or operations manager to oversee the announcing staff and assure the smooth flow of volunteers, students and other personnel, is very helpful. We also have a blind student who auditions all tapes to assure their quality and calls our Program Advisory Committee each month to get their programming suggestions and feedback. We have a field engineer and a rehabilitation program director as a part of our vocational rehabilitation grant. Add a 10-hour-a-week development director (who actually works more like 35 hours per week), a secretary-receptionist, and a traffic person who does the program logs, publishes the monthly program guides and helps with receiver records, and you have a picture of the Audio-Reader staff. (See figure 1.)

The essential staff members for a new service are the director, chief engineer and the office manager, plus the necessary announcers. This staff will get and keep you on the air, if you have a willing group of well-trained volunteers. (Audio-Reader operated for a long time with a director, an assistant director/engineer, and a few students on work-study grants who served as announcers and handled the typing.)

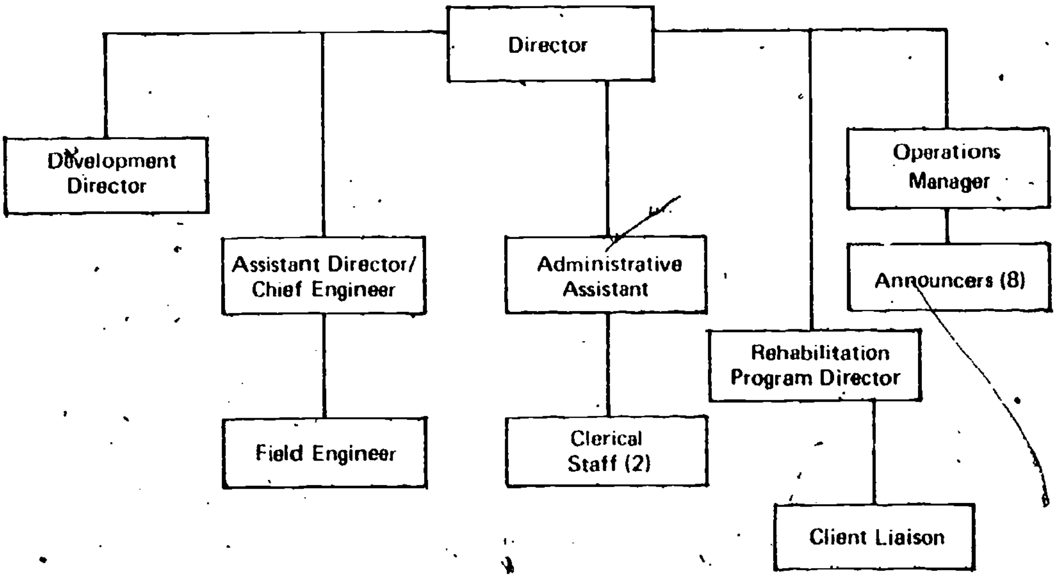


Figure 1. Staff of the University of Kansas Audio-Reader Service.

Programming

The purpose of a radio reading service is to give print handicapped people access to printed information that is not generally available to them. The most popular program any radio reading service provides is the reading of the daily newspapers. Access to this information creates opportunities for greater social interaction as well as greater personal independence. We offer the most recent best selling books, current magazines, and feature programming that includes weekly grocery shopping information, as well as practical suggestions in the form of vocational rehabilitation information. Audio-Reader provides a monthly program guide for its listeners in large print or in braille.

Technical Considerations & Costs

The equipment necessary to start a Radio Reading Service might include that described below.

The FM transmitter has three main sections: the exiter, the driver and the final power amplifier. The subcarrier generator is the most important part of the system. It is a small part of the exiter which multiplexes or modulates the Radio Reading Service on the air; it must be compatible with the exiter. If your local FM radio station does not already have this important part, the generator might be purchased as an option to the existing exiter.

If you are planning a new FM station or Radio Reading Service and will be purchasing a new exiter with the generator, specify 6 kHz deviation for the generator. This will enhance your signal by providing extra loudness in the fringes of your listening area. The injection level should be adjustable on the exiter and should be at 10 percent of the total modulation of the main channel, assuming a stereo operation. The price on this will be in the neighborhood of $1,000 to $1,500 for the generator and $4,000 to $7,000 for the entire exiter package.

For legal installation, compression and limiting equipment will be needed to achieve the highest possible loudness without over-modulation. A subcarrier modulation monitor will need to be purchased to measure "on air" modulation, injection and frequency deviation. The cost of this equipment varies with the manufacturer, but should fall in the range of $3,000 to $5,000. In some cases, the FM main channel may already have this equipment on hand, if they have been previously using their subcarrier for other purposes—background music, meter telemetry, and so on.

Distribution amplifiers may be needed at the studio location, if you are planning a large studio installation with many inputs and outputs. Patching facilities would also be needed in that case. If you are at a remote site from the main channel FM station, you probably will have to use a telephone audio loop to feed the main channel station with the program material. Whether or not a program amplifier would be needed in this situation would depend on your individual service. It is advisable to consult with the main channel engineers on these items. Prices for amplifiers, etc., might range from $1,000 to $3,000.

Miscellaneous items could include tools, wire, switches, lamps, AC hardware, meters, and so forth. These items are costly and take a long time to be delivered—plan ahead. Costs on these essential parts will vary, but you can count on $1,000 to $3,000.

The audio console purchase will depend on your budget, but you should take into account how many audio sources you will have to mix on the air. How many mikes? How many lines? There is a wide variety of items from which to choose. Again, the main channel engineers can give helpful advice. Buy the console to suit your needs from a reputable company, preferably with a guarantee to cover repairs. Some of the newer consoles are modular, so that the working circuit cards may be removed and returned to the factory for repair. Costs range from $1,000 to $30,000.

If you are planning to incorporate music into the programming, you will need to purchase one or two turntables and associated tone arms, magnetic cartridges and preamplifiers for both the "air studio" and the "production studio." Good turntables for broadcasting can be cued faster and easier than the home entertainment machines. Consult the trade publications for these and other items.

How many microphones will you need? Determine how many readers you will have at any one time. For example, an interview or newspaper studio might require two to four microphones; the recording studios for books need one for each room. Costs range from $50 to $200 per microphone, except for condenser mikes, which cost from $400 to $500.

To determine how many tape recorders you need, first decide how many recording rooms you wish to have. One tape recorder is required for each room. For the actual "air studio" we would recommend three or more machines to add the most flexibility. A minimum of two is necessary to permit smooth program transition. If you produce your own feature programs, you need a production studio, which requires at least three additional machines. Buy the best you can afford. Prices range from $1,000 to $3,500. Avoid home entertainment equipment, since it is not designed to withstand long, continuous use.

Broadcast tape cartridge machines are not mandatory but will enhance between-program capability. Prices range from $400 to $700. Cassette equipment provides flexibility in gathering information from the field. They are compatible with equipment of the Library of Congress and some other Radio Reading Services. Prices range from $75 to $300 per monaural unit.

Who Is Listening?

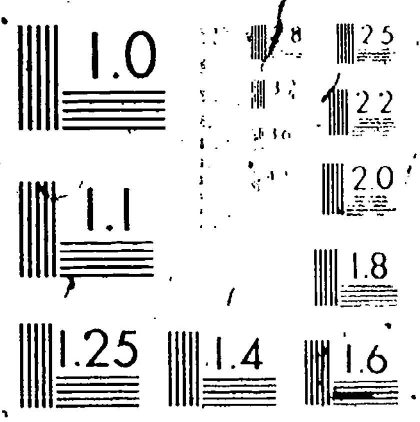
Audio-Reader currently has 1,200 individual SCA (subsidiary communications authorization) receivers distributed. The breakdown by the age of our listeners is as follows:

Age	*No. of Listeners*
0-19	6
20-39	12
40-59	50
60-92	1,132

The average educational level reached by our listeners is high school graduation.

There are also several central hospital installations where patients can listen throughout the hospital on ceiling or pillow speakers, or on unused TV channels within the hospitals' cable TV installation. There are presently seven hospitals with 2,660 patients who have access to the Audio-Reader program in this way.

Other patients in 57 nursing homes are being served. Most of the nursing homes have established special listening areas so that many listen together to daily newspapers, a favorite book, or special programming. These nursing homes house from 30 to 200 patients each. Those who are not ambulatory and want individual receivers are sent one for personal use. We know of only one senior citizens center with an Audio-Reader listening room, but other such installations are planned. An additional 1,000 individual receivers will be distributed this year, and many more hospitals and nursing home installations are planned as we expand our listening area.



MICROCOPY RESOLUTION TEST CHART

Recruiting & Training Volunteers

Before embarking on the task of recruiting volunteers a most critical aspect of a Radio Reading Service—several factors need to be considered.

- Who are your listeners?
- What is their average age?
- What educational and cultural interests will you need to cover?
- Are you programming for an urban or a rural population, or both?

A survey sent to prospective listeners will provide this information. Once these factors are determined and you know for whom you are programming, you will know what kinds of volunteers can best meet the needs and expectations of your listeners. Possibilities for providing volunteers might be found in community resource organizations such as those that coordinate community volunteer activity (a volunteer clearing house), service clubs, church groups, the League of Women Voters, and the American Association of University Women. If a college or university is part of your community, faculty members and spouses, students, and retired staff and teachers offer excellent recruitment possibilities. Do not overlook valuable help available from the retired members of your community. Members of the American Association of Retired Persons (AARP) and the Retired Teachers Association are often good readers and they have the time to help you. In beginning your drive for volunteers, do enlist the help and support of the local media. If the newspapers and local radio and television stations publicize your efforts, many people will seek you out to offer their help.

How do you screen prospective volunteers? Two people on our staff handle screening–the operations manager and the director. After a brief visit just to put the guest at ease, the prospective volunteer is given a list of 100 words to read aloud. Fewer than ten mistakes means we have a potential newspaper reader.

If the vocabulary test is passed, we then have applicants read a newspaper article and a brief passage from a book to give us an idea of their style and where they will best fit into our format. We make a big effort to fit readers to their favorite areas of interest.

Turning down volunteers requires tact. We usually tell them of other areas in which we need help and suggest other activities, such as helping in the tape library or visiting nursing homes. What if a poor reader has already been accepted or if a formerly good reader's performance can no longer be tolerated? There are no easy answers to this question. Occasionally a volunteer can be shifted sideways or steered towards a different kind of reading material. Others can be given help to improve their reading.

Reading for Credit

Another source of volunteers for those of us on a university campus are students who want to earn credit. At the University of Kansas, students in some journalism and speech courses may enroll for one or two hours of credit (three hours a week for one credit-hour and five hours a week for two credit-hours). As the students have no papers to write and no exams to take, we are very tough. They must produce many hours of material, and it must be excellent. Each hour missed is subtracted from the final grade. Students who miss seven hours earn an Incomplete and must start from scratch the next semester. If they do not make it the second time, they earn an F. We have acquired some of our most dedicated volunteers from among these students, many of whom return semester after semester as volunteers after they have earned their maximum five hours.

Other Volunteers

Children occasionally record for us to add variety to our sound. Their voices are lighter and offer good contrast. One nine-year-old has just completed a series titled Career Opportunities Unlimited, for which he interviewed all sorts of people to discover what their jobs entailed and to see if handicapped people had the opportunity to do the same work.

When putting together the program logs and the monthly schedule and program guide, male and female, light and heavy voices are mixed to give as much variety to the sound as possible. We are not looking for professional performance just friendly people who can project their interest in others and who have clear, easily understood voices.

Without these wonderful people, the most exotic decor, equipment and physical plant are worthless. The best advice we can offer is to recruit with enthusiasm, screen and train with care, and be certain to communicate your appreciation to this most vital aspect of your radio reading service.

National Organizations

In 1975 the First Annual Convention of Radio Reading Services was held in Oklahoma City under the sponsorship of the American Foundation for the Blind. Many representatives of various national groups interested in this new concept in electronic media were present. Such groups as the National Federation of the Blind, the American Council for the Blind, Radio Station Management, the Library of Congress, the Corporation for Public Broadcasting and the radio reading services themselves were represented.

The Corporation for Public Broadcasting has arranged with National Public Radio to initiate a pilot project specifically for radio reading services. The project will include ten hour-long programs in a magazine format with topics that pertain directly to the needs of radio reading service listeners.

The American Foundation for the Blind continues its interest in Radio Reading Services with support of convention efforts, and Regional Seminars using their own national experts and resource people from The Association of Radio Reading Services.

Conclusion

The establishment of a successful Radio Reading Service one that combines the elements of responsiveness to listener needs, that permits volunteers the satisfaction of time spent in a fulfilling way, offers community and state leaders a meaningful outlet for their influence and generosity can be accomplished if the basic elements are patiently brought together. The step-by-step organizational structure is critical to providing a strong, ever-growing Radio Reading Service that offers listeners greater personal independence.

Rosanna Locke Hurwitz is director of the Audio Reader Service at the University of Kansas. With a B.S. in special education, speech and hearing, she has served as a speech therapist in two public school systems. Before joining the Audio-Reader staff in 1974, she was community affairs director for KLWN Radio in Kansas. She was elected to the executive committee of the National Association of Radio Reading Services in March 1977.

Thomas F. Fish is assistant director and chief engineer of the Audio-Reader Service. While majoring in radio and television film at the University of Kansas, he worked for the University's KANU-FM. He joined the Audio-Reader staff in 1974.

Bert Cowlan comments:

"How to Establish and Operate a Radio Reading Service via SCA," by Rosanna Hurwitz and Thomas Fish, was the first paper I read from this volume. I found it warm and tender, a comprehensive and excellent guide for other do-it-yourselfers in the much-neglected field of providing services to the blind, the aged and the handicapped. But a sad commentary on our society emerges, since it seems that something so well worth doing must be limited to the *local* level. (It was also a sad commentary that I could not find, in three of the most popular almanacs in current use, *any* figure for the number of legally blind citizens of the United States. One did show a USOE figure of 24,000 blind children enrolled in local public schools and public and private residential schools. The *U.S. Statistical Abstract* did provide a total figure: there are 468,000 legally blind citizens. If one adds in others who by virtue of age or other handicaps cannot read or read with difficulty, the total is probably awesome.)

It is good that an Association of Radio Reading Services has been formed and that, as the Hurwitz/Fish paper points out, the CPB and NPR are gearing up to do something about providing even a minimal service in the form of ten one-hour programs. The choleric question I must raise, though, is: Why is so little being done for so many? If we are an aging society (as well as a communications-oriented one), more and more people will require —or could make use of—similar services. Should these not be embedded in national educational/telecommunications policy, well-funded rather than *ad hoc*, and underpinned by long-term policies? What would happen, for example, if National Public Radio went quadraphonic and needed both of the subcarrier frequencies (67kHz and 41kHz) now being used (one or the other, that is) to carry this service, which now seems largely to be carried on public radio stations? What also might be the beneficial effect of purchasing sub-carrier receivers *en masse*, through a central purchasing agency, rather than having to buy them in what are assumed to be small quantities for $50-$85 apiece?

Perhaps a good injunction for the Association of Radio Reading Services would be promptly to seek legislation for long-range, nationwide funding, for mass purchasing of necessary equipment, for turning this activity into a truly national service and for reserving frequency space on which the service can be carried out. Whether this would be via a dedicated sub-carrier (we might all be able to force ourselves to live with a little less Muzak) on SCAs or a dedicated spectrum on a public service satellite, is an open issue.

—*B.C.*

Radio Reading Service: The Minnesota Experience

C. Stanley Potter
Minnesota State Services
for the
Blind and Visually Handicapped

In the mid-1950s, the Minnesota State Services for the Blind established its Communication Center. It grew out of needs expressed by blind people, their counselors and their teachers. While library services in braille and on recorded talking books had been available in the United States through the Library of Congress and Regional Libraries, the only material that dealt with current happenings in the state was *The Minnesotan*, a monthly braille magazine. Its circulation was limited to about 300, since the demand for braille materials was declining. The decline resulted from the rising proportion of blind people who had lost their sight as adults, of whom fewer use braille for reading. The first purpose of the Center was to put material of local and current interest from *The Minnesotan* into recorded form to be circulated biweekly for auditory reading, in order to reach many more people.

Also in the mid-1950s, blind and visually handicapped children were in ever increasing number remaining in their home school districts and being educated with their seeing peers, rather than in state schools for the blind. This meant that textbooks in almost infinite variety had to be transcribed from print into braille and on tape. Individual students needed the books selected by local officials for the education of all children in their districts. Textbooks are published in such variety that many of the books transcribed are used by only one child or college or vocational school student. Others, over a period of time, are used by many

The second purpose of the center was to provide all students with all the books they require for their studies, in a form that enables them to read them on their own, and that is available through a single center resource. Carefully selected, well-trained volunteers with a variety of talents and backgrounds, who could sight-read fluently and accurately, have enabled us to provide on demand a high volume of such diverse materials.

Unserved Needs

While that was a good start in approaching our communication requirements, it soon became apparent that other cultural and social changes were affecting the blind and physically handicapped and their communication needs:

1) More and more blind people were finding employment in industry, in the professions, in the service occupations, and in business.
2) More and more handicapped homemakers were using rehabilitation services to develop compensatory skills in mobility, personal self-care and in the care of their family. With their new independence, they were becoming more active in women's organizations, church groups and local political interest groups.
3) Fewer and fewer of the increasing number of elderly blind people were living with their children. More of them were receiving rehabilitation services that permitted them to maintain themselves in their own homes. Many of those with other illnesses were living in rest homes.

In summary, the younger blind people were living and working with people who saw and read and talked about what they read. Many of the older people, whether at home or in an institution, had lived their lives as seeing persons with newspapers and other printed material about them, until they lost their sight. Both groups were denied access to the world of immediacy that they needed to exploit the emerging opportunities for acceptance and social intercourse.

Library materials in recorded form are a great asset to many, but they are no substitute for the "localism" that a newspaper brings, nor do they bring current best selling books while these are still fresh. It takes several months to select and have books transcribed and placed in regional libraries and, as with any library service, the number of copies is limited. A person may wait for months to borrow a requested book. (I will never forget the blind woman who said to me, "By the time I can get a best seller, the ladies in the beauty shop have quit talking about it for six months.")

The Search for a Solution—Why SCA?

We were faced with a problem: a substantial group of *visually and physically atypical* people were rapidly becoming *socially and vocationally typical* participants in society, but lacked the current and local information available to the people around them. For a long time, radio seemed the obvious answer, but in what form? On what frequencies? At what cost? After examining these questions, it appeared that a good answer, and perhaps the best one, might be found in the subsidiary carriers of existing FM stations. They offered several advantages:

1) In the crowded spectrum, requests for additional frequencies would be unnecessary.
2) The cost would be within reach, since the expensive transmitters, towers and antennas were already present for another purpose. The remaining expenses of any broadcaster – studios, program production equipment, automatic level controls, personnel and SCA rental – seem manageable.

*Subsidiary Carrier Authorization. Any FM transmitter can broadcast several programs simultaneously, provided the necessary encoding circuiting is use. The desired program can then be separated from the other decoding circuitry, if it is present in the receiver being used. Stereo broadcasting of this capability and a third channel is very feasible, usually at 67 kHz above the main channel.

3) At 100 megahertz, signals are stable day and night, affected little by changes in the ionosphere, which alters reception patterns on the lower frequencies. These frequencies are not limited as severely by terrain as are the much higher frequencies.

Yet what could one-tenth of the power of even a full-power FM station do in a state that spans 300 by 400 miles? What performance standards could be obtained technically in SCA receivers, and at what cost?

To answer these questions, in 1967 we began to investigate. We found that SCA technology in receiver design and transmission standards had not been given a great deal of attention, but we were able to determine that one could expect good SCA performance for distances from a transmitter equivalent to the reception of stereo, which — depending on main channel power, terrain, antenna height, full legal SCA injection and effective automatic level control — was 50 to 60 miles. If an outdoor directional antenna cut for the transmitter frequency was used to replace the customary receiver whip, somewhat greater distances were attainable.

Since that time, receiver design has substantially improved. The improvements do not extend reception capability much, but provide vast improvement in the quality of the SCA signal, greater freedom from crosstalk, and — with some manipulation of the audio frequency curve - better and more pleasant readability.

The Radio Talking Book Network

The Minnesota Radio Talking Book Network began its transmission on January 2, 1969. In those early years, broadcasters in many parts of the country were concerned about the use of SCA, because of what was known as the "birdie," a variable whistling sound that could be heard when listening to a main channel with SCA operative. The birdie turned out to be a receiver phenomenon that disappeared with the introduction of the phase locked-loop circuitry now common in FM receiver design.

The Minnesota Radio Talking Book now uses a network of ten transmitters and transmits reading matter, mostly very current, nineteen-and-a-half hours a day, 365 days a year. Its audience is made of 4,000 individuals to whom receivers have been loaned, and the residents of several institutions with high populations of handicapped and aging persons. Institutional systems consist of an SCA receiver feeding one channel of an audio distribution system, which the hospital or other institution may already have available; or the receiver may be a carrier current type of retransmitter, so that the signal is available throughout the facility in the rooms of residents or patients.

The type of receiver used in individual homes is crystal-controlled, has a single combination power switch and volume control and, in addition to its internal speaker, a low impedence output jack for the headphone supplied. This jack doubles as the output for feeding a tape recorder or other audio device.

For those extremely handicapped by paralysis or other disorders, an easily installed touch-sensitive remote switch is supplied by the agency. This permits listeners to turn the receiver on and off if they can move any part of their body even slightly.

In our own lab, we build a small carrier current transmitter, the output of which is in the order of 200 milliwatts. This unit is installed inside the cabinetry of receivers to be loaned to those who are active in their homes and need to be able to read in any room. A small handheld battery-powered receiver is supplied, however, which is fixed to the frequency of the retransmitter.

> **Why "Radio Talking Book"?**
>
> "Talking Book" is a term with which the public is widely familiar. Radio's purpose is not to replace the phonograph talking book, nor the more recent tape talking books. Its purpose is to add a new dimension to auditory reading: it is immediate and has the capacity to be local. It should not be considered a substitute for library services in which a person can choose what to read and when to read it. Like all other immediate media - newspapers, radio, and television - it must be programmed, and the programmers must devise systems that will provide for broad input from listeners and will be guided by their reactions.

Summary: The Advantages of SCA

We have found the SCA system of providing a radio talking book service (or whatever you wish to call it if you are doing similar programming) an appropriate and highly desirable medium. It is perhaps the only feasible method of doing what we want to do, for the following reasons:

1) It is the only cost-effective system for providing full-time service (in Minnesota, 19½ hours a day). To us, full-time service is important, since we want to include a broad cross section of the materials being read by the public. We want to meet the needs of people with a wide variety of interests. We want to provide materials usable by people with various levels of comprehension, and we want time to provide programming for those with shorter attention spans, such as some of our institutionalized and older listeners.

2). The SCA is regarded by the FCC as a private means of communication. We have a stable, gradually increasing audience that has come to understand why we include books that many people like, but that others find offensive. (If our signal were available to a continually variable public audience, we would be under frequent criticism from people who do *not* understand.) Our readers do tell us what they think, and sometimes in no uncertain terms. I quote two reactions to the same book:

> Who selects . . . the filthy books . . . such as the 8 p.m. book (*Fear and Loathing: On the Campaign Trail '72*). You are beating the commercial stations - filth - maybe it will bring you notoriety. As ye sow so shall ye reap. You have many good things on.

> . . . All of the volunteers are pretty wonderful. I especially like Eunice Grier and I enjoyed Lawrence Becklund reading *Fear and Loathing: On the Campaign Trail '72.*

While much of what we read would not be considered offensive by anyone, we do read material that many people might read comfortably in private, but that few would read aloud to another. Many feminine listeners have told us that from our "Strictly Feminine" program they have learned a great deal about everything from hair-dos to clothing styles to sex. About the latter, they gained information they had no idea women around them were reading, and that no one had read them or talked to them freely about.

What about the magazines and books that are printed specifically for the purpose of stimulating vicarious sexual experiences? People who can see are free to find such stimulation in many ways, from reading to just plain girl (or boy) watching. We can include such materials in closed circuit broadcasting, and the earphone provides privacy in reading whatever one chooses to hear.

3) The third virtue of the SCA system is that it permits us to read copyrighted materials without requesting permission, which must be the case if the material is to be fresh. We are careful about eligibility: only those who cannot effectively read printed materials, because of visual or physical handicaps, are listeners. They are people who would not buy a publisher's book or magazine, because in its printed form they cannot use it.

Radio Reading Services are gradually growing in various parts of the nation. Some of them are operated by broadcasters as an additional service to the handicapped population. More are operated by agencies for the blind, public or private, or by organizations established for the specific purpose of developing and operating a Radio Reading Service. Except for the broadcasters who provide the service themselves, most organizations are leasing the SCA capability. Some systems serve a single urban area. Others, through networking, serve a whole state. There is no doubt that radio reading is rapidly becoming a highly important influence in the lives of handicapped people.

There are now approximately 50 Radio Reading Services using the SCA medium in the U.S. and Canada, plus about 25 planning sites. The Association of Radio Reading Services was formed at a national conference in 1977. The Association is concerned with legislation and giving its members technical, organizational, program and fiscal development advice, as well as with the publication of other relevant information. Further information may be obtained by writing the author.

C. Stanley Potter is an educational psychologist who has been director of the State Service for the Blind in Minnesota since 1948. He has had extensive experience in psychological counseling and has served on the committees of several states and national groups involved in vocational rehabilitation into the integration of school-age blind children through applying special education materials and techniques. Mr. Potter, who holds the M.A. in education, is president of the National Association of Radio Reading Services.

He may be reached at: State Services for the Blind and Visually Handicapped, 1745 University Ave., St. Paul, Minn. 55104.

Bert Cowlan comments:

C. S. Potter's "Radio Reading Service: The Minnesota Experience," was designed as a companion piece to the preceding chapter by Hurwitz and Fish, and it strikes me in precisely the same way. The emphasis on improving SCA receiver design certainly seems a major step in the right direction. One would only hope that, along with design improvements, cost effectiveness is also addressed; that cheaper receivers will be developed so that as these programs proliferate (which is devoutly to be wished), more individuals or agencies can afford to purchase them.

The added emphasis on portability shows an impressive sensitivity to listener needs; why should not the blind be able to "read," as do the sighted, in any room? Also impressive, at least to this reviewer, is the attitude towards sex and the inclusion of volumes with "high" sexual content. After all, *blind* is not synonymous with *asexual*.

As with the Kansas program already discussed, it is sad that a program such as this is not nationally-funded and nationally available. It will be even sadder if, as suggested in my comments on Hurwitz and Fish (and assuming the same SCA frequencies are used in the Minnesota project and provided, as in Kansas, largely by public radio), public radio turns to using its SCA's for some other purpose, such as quadraphonic sound. (While Potter refers to ten FM transmitters, he does not indicate who owns them, whether they are commercial or public.) However, it seems possible that, were all the radio reading services put under the aegis of a well-funded national organization, a first act of such an organization might be to seek, in the rewrite of the Communications Act of 1934 now underway, dedicated frequencies for that service. I am well aware that this proposal may be considered rank heresy by those in public broadcasting. But what can you expect from one who still owns a black-and-white television set? —*B.C.*

Cable Television: A Useful Tool for the Delivery of Education and Social Services?

John A. Curtis and Clifford H. Pence, Jr.
Center for Excellence, Inc. (CenTeX)

Community Antenna Television (CATV) was first established in 1949 in remote areas of Pennsylvania and Oregon.* The concept was a simple one: Television signals could be provided in areas of poor reception by using an antenna sufficiently high to receive a remote broadcast signal, and then redistributing the signal via coaxial cable to subscribers who could not otherwise receive a good signal on home-type antennae. For this service, subscribers were willing to pay a fee. An entire community could thus be served from one master antenna, leading to the FCC designation of the service as "Community Antenna Television."

CATV's Early Childhood: A Period of Robust Growth (1950-1960)

CATV's birth-and-growth pattern has been exactly the reverse of almost every other American technological innovation, including that of the broadcast industry that spawned it. Cable television began in remote rural areas, expanded into the suburbs and is now beginning to penetrate large urban areas. Most major electrical and electronic developments from the electric light and telephone to radio and TV have begun in heavily populated areas and then spread outward into the countryside.

By 1952 (the first year for which *TV Factbook* reports CATV statistics) there were 70 operating CATV systems serving 14,000 subscribers. During each of the next two years, both the number of systems and the number of subscribers more than doubled: 150 systems served 30,000 subscribers in 1953, and

*While documentation of the "first" CATV system is a matter of debate, it is generally agreed that parallel developments in Oregon and Pennsylvania led to operating CATV systems in both areas during this time period. (See Mary Alic Mayer Phillips, *CATV: A History of Community Antenna Television*, Northwestern University Press, Evanston, Illinois, 1972.)

300 systems served 65,000 subscribers in 1954. By 1958, ten years after the first systems were established, there were *525* systems serving *450,000* subscribers (see table 1).

Table 1. Growth of the CATV Industry.
(as of January 1 of each year)

Year	*Operating Systems*	*Total Subscribers*
1952	70	14,000
1953	150	30,000
1954	300	65,000
1955	400	150,000
1956	450	300,000
1957	500	350,000
1958	525	450,000
1959	560	550,000
1960	640	650,000
1961	700	725,000
1962	800	850,000
1963	1,000	950,000
1964	1,200	1,085,000
1965	1,325	1,275,000
1966	1,570	1,575,000
1967	1,770	2,100,000
1968	2,000	2,800,000
1969	2,260	3,600,000
1970	2,490	4,500,000
1971	2,639	5,500,000
1972	2,841	6,000,000
1973	2,991	7,300,000
1974	3,158	8,700,000
1975	3,506	9,800,000
1976	3,651	10,800,000
1977	3,801E	11,900,000E

E=estimated . Source: *TV Factbook*, 1977

Note: The change in the number of systems operating each year is determined by three factors: 1) new systems which began operation during the year; 2) older systems coming to the attention of the *Television Factbook* for the first time and therefore included in the total for the first time; 3) The splitting or combining of systems by operators.

Most of these early systems were small rural ones, which retransmitted commercial broadcast signals of only a few (one to three) stations, and until 1953, technical capacity limited cable transmission to no more than five television channels. By 1957, however, 12-channel cable capacity—the channel capacity of a standard television receiver of that time—became a reality, and cable seemed ready to take on its city-born cousin—commercial TV.

CATV's Youthful Period: New Responsibilities

With adolescence there usually come "rules of conduct." During CATV's early days, such rules were primarily developed on the local level and usually took the form of jurisdictional franchise agreements granting permission to run cable over public property, and establishing payment scales for this right, usually a percentage of gross profits.

By the 1960s, however, two developments radically altered the CATV picture:

1) Cable operators began to make serious efforts to originate local programming. Although some system operators had been experimenting with local origination, such origination had until the 1960s been an exceptional rather than normal operating procedure.
2) Cable operators began to use microwave technology to import signals from television stations too distant to be picked up over the air. This development was significant in two respects.

First, the long-distance, multi-program importation created CATV's first real threat of competition to the local broadcaster. Until this threat, big-city commercial station operators had been only too happy to have their service areas extended by cable systems.

Second, since the operation of microwave transmitters requires Federal Communications Commission licenses, the Commission—which up to this point had been reluctant to impose regulation on cable systems—now had a responsibility to do so. FCC regulation of the CATV industry, once it began, continued to increase in scope and severity.

In 1962, the Commission began to impose case-by-case restrictions on those CATV systems using microwave relays and, by 1966, the FCC asserted its jurisdiction over all cable systems, including those not using microwave relays.[1] By 1966, FCC rules even mandated the carriage of local signals and imposed procedures for the importation of distant signals into the top TV markets.*

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*The FCC claimed these regulations were designed primarily to protect the fledgling UHF station operators, who might be the first to be hurt by the importation of distant signals.

CATV's Adulthood

For the next several years, there was concerted effort to develop comprehensive regulations for CATV through a series of proposed rule-making hearings, which invited comments from all concerned parties. Prompted by the President's Office of Telecommunications Policy (OTP) insistence that a workable pattern of cable regulation be developed, comprehensive rule-making was completed by the Commission in 1972.

Briefly, the 1972 rules included the following:

Authorization

In order to begin operations, a cable system must obtain a certificate of compliance (CAC) from the FCC. Granting of the CAC is contingent upon the cable operator having first obtained a franchise from the appropriate local authority. Broad guidelines were provided for use by local governments, but local governments are allowed considerable latitude with regard to such details as fees, terms of agreement, geographic areas of franchises and subscriber rates.

Signal Carriage

1) Cable systems *must* carry all local stations licensed to communities within 35 miles of the served community.
2) In addition, cable systems can, if they so choose, import distant signals to provide, in conjunction with the "must-carries," a total of:
   a) Three network and three independent stations in the top 50 markets;
   b) Three network and two independent stations in the next 50 markets; and
   c) Three network and one independent stations in markets smaller than the top 100 markets.

   Stations within the top 50 markets may import two distant signals, even if local "must-carries" fill the allowable quota.

Protection of Local Broadcast Interests

1) Network programs imported from a station must be blacked out if the program is carried simultaneously by the local network affiliate.
2) In the top 50 markets, syndicated programming may not be shown on cable for one year from the date that it is first sold anywhere in the country, nor for as long as it is under contract to a local station. (The next 50 markets are subject to similar though less restrictive regulations.)

System Requirements

1) All new systems with 3,500 or more subscribers in major markets (all new systems regardless of market size since 1977) are required to have *20-channel capacity* and *two-way capability*. Older systems with 3,500 or more subscribers must meet these standards by 1981.
2) Systems with 3,500 or more subscribers must also provide four access-channels (for local, educational, public and leased use) if system capacity

permits and demand exists. Systems with insufficient channel capacity must make at least one channel available for the four previously listed uses combined. Systems must also make equipment available for local production.[2]

More Recent Regulatory Restrictions

Subsequently enacted FCC rules were made to protect feature films and sporting events from "siphoning" by pay cable. On March 25, 1977, however, the U.S. Court of Appeals for the District of Columbia (which is the court of original jurisdiction in FCC matters) struck down these regulations in *Home Box Office vs. F.C.C.*, finding that 1) the FCC had no evidence showing them that pay cable would adversely affect the public interest; 2) the rules violated the First Amendment; and 3) they were issued without statutory authority. The Supreme Court declined to hear the case on appeal by the FCC, thus allowing the court's opinion to stand.

But the 1972 FCC rule-making still stands, and the latest federal copyright legislation puts further mature and reasonable restrictions on the unrestricted CATV use of programming material owned by others.

Continuing, but Less Dramatic, Growth

Within this regulatory framework (and, many feel, in spite of it), cable television has continued to grow. During the period from January 1972 to September 1976, for instance, the number of cable systems grew from 2,770 to 3,715, an increase of 34 percent. During the same time period, the number of subscribers grew from 6,000,000 to an estimated 11,500,000, an increase of 91.7 percent.[3]

Though America's CATV industry is today a sizable operation, the 30-year-old fledgling has yet to become the mighty and comprehensive giant once predicted. For instance, in 1971 the Sloan Commission on Cable Communications predicted that CATV would have penetrated 40-60 percent of the national market by 1980.[4] Today, its penetration is believed to be approximately 17 percent.[5]

A recent CenTeX study includes data regarding the nation's 15 largest CATV operations (as of September 1, 1976, as reported by the 1977 *Television Factbook*). These data indicate that America's 15 largest CATV systems have obtained an average market penetration of 23 percent in the operating areas in which they are franchised* (see table 2).

*The cable industry statisticans prefer to use a more flattering "saturation" percentage, which is the ratio of cable subscribers to the number of homes passed by its cable. This figure ignores the homes in the uncabled portions of the system's geographic franchise area and does not, therefore, reflect the true market penetration with regard to the total population that the system is franchised to serve. CenTeX thus sought to determine the true market penetration based on the total population of the franchised areas.

Table 2. CATV Market Penetration Analysis.

Rank	Location	Subscribers[1]	Households[2]	% Served
1	San Diego, CA	116,012	330,531	35.1
2/10[3]	New York, NY	133,556	513,078	26.0
3	Los Angeles, CA	78,899	1,067,789	7.4
4	Oyster Bay, NY	65,000	341,517	19.0
5	Suffolk County, NY	64,749	374,983	17.3
6	San Jose, CA	61,500	171,643	35.8
7	Allentown, PA	58,300	276,139	21.1
8	Northampton, PA	55,000	112,150	49.0
9	Austin, TX	54,300	98,505	55.1
11	Wilmington, DE	42,000	63,510	66.1
12	Toledo, OH	42,000	162,574	25.8
13	San Francisco, CA	41,991	238,558	17.6
14	San Rafael, CA	40,175	68,679	58.5
15	Santa Barbara, CA	39,333	54,692	71.9
	Total	892,815	3,874,348	23.0

[1] As of September 1, 1976, as reported in the 1977 *Television Factbook*.
[2] Based on franchise area data supplied by the FCC and population data from the 1970 census.
[3] Two systems serve Manhattan. Data from both systems have been combined for this analysis.

But table 2 also would appear to indicate the following:

- CATV's market penetration in large city areas, where commercial TV broadcasting stations are highly active, is still low (Los Angeles, *7.4%;* New York City, *26%;* San Francisco, *17.6%*).
- In cities where coverage by the commercial TV broadcasting operators is less energetic, where local program initiation is less active, CATV's market penetration appears to go up (in California: San Diego, *35.1%*; San Jose, *35.8%).*
- In city areas quite distant from areas of locally-targeted commercial broadcast activity and where local CATV programming is high, CATV market penetration is impressive (Wilmington, Del., *55.1%;* Santa Barbara, Calif., *71.9%*). In distant cities where terrain permits reasonably good local use of other-city signals, however, market penetration drops (Allentown, Pa., *21.1%;* Toledo, Ohio, *25.8%*).
- In suburban areas well-served by large commercial TV broadcasting systems, CATV finds market penetration difficult (Oyster Bay, N.Y. and environs, *19.0%;* Suffolk County, N.Y., *17.3%*).

- In city and county areas, outside the range of big-city TV broadcasting systems, CATV has, from its inception, done well (Northampton, Pa., *49%; San Rafael, Calif., 58.5%*).

In brief, the CATV industry has, during the 1970s, continued to penetrate well the rural, county and city areas away from the areas saturated by commercial TV broadcasting services, but it has not become the dynamic social force and communications system giant once predicted by its proponents. Neither has it become the money-making "machine" once envisioned.

CATV's Maturity: The 1980s

The questions now facing the CATV investor—be it the investment of dollars, time, energy, or expertise—are these:

1) Can CATV penetrate America's major urban and nearby suburban markets on an economically viable basis?
2) What are the tools available to accomplish the penetration of these heavy-population-density areas?

Before considering data which may possibly provide answers to these two fundamental questions, the following facts should be noted:

- Some 3,700 "ordinary" cable systems are today serving more than 8,000 communities and more than 12,500,000 subscribers, who are, in most instances, located in far-from-big-city rural, suburban and urban areas.[6]
- The cost of installing cable on existing poles in rural and suburban areas is reported to average $6,000 per mile; the per-mile cost of underground installations in densely populated areas, $80,000.[7]
- Today, both the federal government and private industry are investing heavily in the development of new technical and programming tools to facilitate CATV's big-city market penetration ambitions.

All of these efforts combine two basic strategies: The development of *locally* unique programs and services not today obtainable from commercial and public broadcasting stations; and individual program participation methodologies designed to encourage and enable CATV subscriber participation in locally unique programming (whether TV games or educational course ware).

Typical examples of the current, new-tool developments which may give CATV the necessary marked impact to compete effectively in big-city and near-big-city areas with commercial and public broadcasting services are discussed below.

Warner's Qube System

One prototype system, which the entire industry is watching with more than a casual interest, is Warner Communication's Qube system in Columbus, Ohio. Qube is a 30-channel, interactive system. A small computer terminal in the subscriber's home permits the subscriber to participate in programs—take tests, vote on public issues, and even to have home fire-and-security protection. The computerized set-up will also make possible the transmission of specific programming exclusively to pre-selected subscribers ("narrowcasting").

The Qube system, which started full operation in December 1977, also provides three educational channels (one pay and two free) and a local production origination channel.

Qube's home-located "black box" control unit provides five different response buttons for viewer program participation. This capability enables the subscriber to take multiple choice examinations, to respond to public-opinion polls, and even to request information or order merchandise.

One of the premium (pay) channels will feature continuing education, enrishment and hobby/how-to courses under the "Better Living" heading. A free educational channel is "Qube Campus," featuring courses offered for credit by three local universities in a variety of formats. The second free educational channel, called "Culture and Learning," will carry a variety of cultural, informational and educational programming, including captioned materials for the hearing impaired, some "narrowcast" specifically to that population.

The local live channel, "Columbus Alive!", offers a variety of programming with heavy emphasis on viewer participation–talk shows, quiz and game shows, sports, interviews and "happenings."

Obviously, Warner has invested a lot of its dollars and prestige in Qube. The company openly states that its investment is more than 12 million dollars, but justifies this substantial sum on the belief that Qube will not only test subscriber reaction to a comprehensive interactive cable communications system, but that the Columbus experience will provide an indication of how other urban areas (the "last frontier" of cable) might react to and support such systems.

W. Spencer Harrison, Warner's executive vice-president, has stated, for instance (as quoted by the *New York Times*): "If it [Qube] works, urban cable television will become a reality. If it fails, cable in the large cities may be a dead issue for many years."

Mr. Harrison may, indeed, be accurate in his observations. Though the prospect of customers accumulating charges at the rate of $1.00 to $3.50 per program (the range of the Qube system) is bound to make huge system investments look less formidable than the average fee of $7.87 charged for pay channels, such as those of Home Box Office, the question becomes this: To what extent over a period of time is the consumer likely to use and pay for special programs designed to serve his unfilled, desired, but perhaps economically impractical, needs? Are there enough unfilled needs to support the huge initial Qube-type investments? Warner's management obviously believes the answer to such questions is yes.

CATV's Educational Service Potential

One of the traditional strengths of the American educational system (and, it might be argued, of American democracy itself) has been the *local control of education.* Cable television is especially well-suited to serving local educational needs. Cable systems are usually locally operated, even if not locally owned; they usually follow jurisdictional boundaries (because of franchising procedures); they have more potentially available spectrum space than commercial or public broadcast television, and they can be made available inexpensively to potential educational users, including people in their homes as well as students in schools or universities.

Why has this potential not been exploited more widely? Again, there are multiple factors working in combination.

In the first place, an educational entity has to decide that television can help to meet its educational objectives (assuming that the objectives have been defined). This is no small hurdle, especially since the educational use of television has a less than perfect track record, and there will always be those who mistrust technology in any form. Second, there must be a fairly substantial initial commitment of funds to the endeavor.

For those who are willing to take the trouble, however, the results from the use of CATV circuits for the distribution of educational programs can be rewarding. A case history may help to illustrate both the problem and the rewards.

A Case History—Shawnee Mission

In 1969, the Shawnee Mission Public Schools (SMPS) in suburban Kansas City, Kansas, began operation as a unified school district serving ten municipalities in Johnson County.* One of the school districts consolidated had a closed-circuit system serving six schools, which was operated for one additional year by the unified system. In the meantime, a study of various telecommunications options for a district-wide system was undertaken. The options were ITFS; district-owned cable and leased cable. All, however, were beyond the financial means of the district.

About the time that the whole idea was about to be abandoned, TeleCable (a Landmark Communications cable subsidiary) was granted a cable franchise for nearby Overland Park. Included in the franchise agreement was one channel for educational access and the option to lease up to three more channels. TeleCable has subsequently obtained franchises in all but one of the municipalities comprising the Shawnee Mission district. One of the municipalities specified the provision of two educational access channels in the franchise agreement. Since the same cable system serves all nine municipalities, this meant two channels for the entire district.

The regular programming of one channel began during the 1972-73 school year, and two-channel operation came in the next year. Thus, three years elapsed between the feasibility study and the beginning of programming.

Originally, programming was fed upstream to the cable head-end, which is located in the next county, closer to the expected geographic center of the eventual cable service area. The distance the signal had to travel (through 31 amplifiers) resulted in significant signal deterioration. A decision was therefore made to originate from the cable head-end itself, using video cassettes. While this effectively eliminated live programming, its loss was considered acceptable in light of the improved signal quality gained by originating from the head-end.

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*All data on Shawnee Mission Public Schools were developed from personal interviews with SMPS staff, January 9-10, 1978.

One experiment conducted while live programming was still possible was the two-way interactive use of the system for two homebound students. While this experiment has been reported as successful in some cable literature, it is the opinion of the system's chief engineer that they "never really got the [two-way technical]bugs out of the [cable]system."

Shawnee Mission originally produced about 50 percent of its own programming, but as high-quality programming has become more available from others, this figure has decreased over the years to a current 20 percent. In addition to pre-recorded TV programs, Shawnee Mission also purchases videotape rights to 16-mm films, so that all cable origination can be done on video cassette, thus eliminating the need for a film chain at the cable head-end, where space is at a premium. Programs are typically repeated several times at various hours and on different days to permit maximum scheduling flexibility by individual teachers for their specific student populations. In addition, open time is made available to distribute material requested by individual teachers.

Of the 64 schools in the district, all but two are served by the cable system. One is in a municipality without a cable franchise; the other in a municipality that is franchised, but that has a school in the area to which cable has not yet been extended. (These two schools are currently being served by "bicycling" the cassettes to meet these schools' needs.)

In addition to the Shawnee Mission schools' daytime use of the two educational channels, the channels are used during the evening and weekend by Johnson County Community College. JCCC's programming is largely non-credit and community-oriented, and is targeted for the general population.

The Shawnee Mission experience is a good example of how a school district institutes cable use. It is also illustrative of what is necessary to operate a high-quality educational program distribution system. It is estimated that the equivalent of seven-and-one-half full-time employees (spread among the 14 full-time and eight part-time staff of Shawnee's Educational Media Services operation) are required for the cable operation. In addition to the annual personnel expense of approximately $91,000, more than $30,000 is spent annually on program acquisition-tape and film rental or purchase.

From a cost-effectiveness viewpoint, the following is important to note:

1) CenTeX's analysis of SMPS-supplied cost data indicates annual per-pupil cost of $4.40 (which includes all personnel and material costs as well as 10-year-based amortization of all capital equipment investments.)
2) The $4.40 Shawnee Mission figure compares with $5.12, the comparable figure (from a recent CenTeX survey) for the national cross-section of the public school system using ITFS systems for the distribution of teaching expertise and materials. However, the ITFS systems surveyed: (a) can use *four* channels rather than the *two* channels of the Shawnee Mission system; (b) can distribute live, real-time programming, as well as recorded programming, and therefore can provide for interaction (either video and audio or audio-only) between instructors or resource persons and the student viewers; and (c) are privacy-protected, a feature important to most educators using telecommunications delivery systems.

But the important point is this: given two or more channels and a fully cable-reached school system with 37,000 or more students, CATV at the school level of education is cost-effective.

The Delivery of Social Services

In 1974, the National Science Foundation (NSF) awarded seven grants for the design of experiments to deliver social services via interactive cable television. The grantees were consortia, each consisting of a research organization, local government agencies and a cable system. The experiments proposed by three of these consortia were ultimately funded for implementation. These experiments have only recently been concluded- thus only some preliminary data are available. But even these preliminary findings have important implications for the future of cable as a social services/educational delivery methodology.

The Reading, Pennsylvania, Experiment

One experiment investigated the effect of two-way cable television on senior citizens' knowledge of available social programs, services and benefits, and on their knowledge of and participation in community political and social processes. New York University conducted this research in Reading, Pennsylvania, in cooperation with the ATC-Berks Cable TV Company, the City of Reading, the Berks County Senior Citizen's Council and the Reading Housing Authority.

Three neighborhood centers, one in a multi-purpose center and two in senior citizen housing projects, were linked via interactive cable. The offices of the major city council members and other public officials were regularly connected to this interactive system, and several local schools and nursing homes participated on a rotating basis.

Although the original design called for limited home viewing by 117 senior citizens by means of converters, initial response was so favorable that the programs were aired over a regular cable channel so that all subscribers could view the programs and participate via telephone.

Over a 15-month period there were more than 450 hours of interactive programming covering a broad range of subjects of interest to the elderly - from talks with the mayor and city council members and information on preparing wills to self-entertainment by group singing and peer-group counseling. More than 70 agencies participated in the programming, 20 of which later became regular users of the system. Social service agencies provided 49 percent of the programming, local government 21 percent, and educational institutions 15 percent.[8]

Much of the success of the Reading Program is attributed to these facts:

- The pertinent consumers were involved at every level from program conception to production.
- The local system was therefore used to meet local needs on a regular and continuing basis, with the result that there was both increased awareness and increased participation on the part of the local senior citizens.

Perhaps the greatest evidence of the success of the program is not in the pile of statistics amassed, but in the fact that a local non-profit organization was created to continue operation of the system at the end of the experimental phase - funded by private, industrial and government contributions. Programming has expanded into the evening hours, and subscribers in the Kutztown cable system, some 30 miles away, now participate through a microwave interconnect. A local branch of the Pennsylvania State University is now using the interactive system to conduct adult education courses for college credit.[9]

The Rockford, Illinois, Project

In Rockford, Illinois, a consortium involving the City of Rockford, the Department of Telecommunications of Michigan State University and Rockford Cablevision used interactive cable to deliver training in pre-fire planning to city fire fighters.

The 210 firefighters were divided into four groups participating in different experimental treatments:

1) Two-way individual (each fire fighter with his own terminal);
2) Two-way group (one terminal per station, with group consensus response entered);
3) One-way paper-and-pencil (at the point where interactive groups would respond, fire fighters in this group marked an answer sheet, which was mailed; and
4) One-way, no response (these groups simply watched the tapes, serving as the control group).

All groups took a 27-item pre-test transmitted via cable, with conventional paper-and-pencil answer sheets. Then the two-way groups were familiarized with the response terminals (modified cable converters) through a series of video games generated by the system computer at the cable head-end. These games and fire trivia quizzes were continued throughout the experiment to maintain interest. Of the original 210,193 fire fighters, 92 percent completed the course.[10]

Preliminary analysis of results indicates that, as expected, the interactive groups fared better on the post-test than the control group. The group that used paper-and-pencil response scored almost as well as the two computer-interactive groups. There were no significant differences in the performance of the individual and group terminal groups, but the "satisfaction" quotient of the individual terminal group was significantly higher.[11]

As in the case of the Reading experiment, the Rockford system has, according to local users, proved worthy of continuation. Currently, teachers at 14 Rockford schools are participating in interactive, inservice training, as are nurses in three Rockford hospitals.

The Spartanburg, South Carolina, Experiment

Another NSF-funded project involved three experimental programs conducted by the Rand Corporation using the TeleCable system in Spartanburg, South Carolina. These experiments were designed by Rand to test three modes of delivery/interaction:

1) Outbound voice and video with data return;
2) Outbound voice and video with voice return; and
3) Multi-point interactive video.

The data return interaction was applied to adult education offered by Spartanburg Technical College to prepare students for the General Equivalency Development (high school equivalency) examinations.

The home terminals used in the course operated in two modes. In the first mode, students could answer multiple choice questions; in the second, they could indicate that they would like the teacher to review the last point, move on to new material or send other limited messages. The responses were transmitted to the teacher in the cable studio and were also compiled and printed out in hard copy for the teacher at the end of each class.

Post-test data did not reject the hypothesis that cable instruction is no worse than conventional face-to-face instruction. In fact, the cable group made slightly more gain in every area except spelling.[12] Despite the limited nature of the interaction, there may be a number of educational applications where this methodology can be useful.

Multi-point video was tested in the context of inservice training of personnel at daycare centers. A series of workshops was conducted both from the cable studio and from daycare center sites, each of which was capable of origination of both video and audio. A second group of daycare centers received the programs, but were not interactive in any form. A third group, outside the cable area, served as the control group.

Of the three groups, the group that watched the programs but did not interact showed the greatest gain (gains were limited in all groups due to unexpectedly high pre-test scores). This might indicate that the presence of cameras and microphones for interaction worked to the detriment of the interactive group, since many participants found cameras distracting and felt that the ability to ask questions via audio alone would have been sufficient.[13]

If some video interaction is desirable from the viewer's standpoint, but not necessarily from the standpoint of the video-interactive participants, video interaction from a limited number of points, perhaps in rotation, might be appropriate, with audio interaction from other points. This method has the added advantage of producing an interesting, yet *inexpensive* program.[14] This is also being confirmed by a Rand Senior Citizen programming project in Spartanburg, which is similar to the Reading experiment.

Voice-only return was tested in a parent education course dealing with child development. Unfortunately, the program's efficiency was not tested against video *and* audio return, but only against telephone return, coupled with limited data transmission (which occurred infrequently). The results of this experiment therefore could not be expected to show any significant difference in the results of the two systems, and, in fact, did not.

These NSF-funded projects were only a few of many submitted, and those submitted represented only the tip of the educational/social service iceberg. But as each new idea is tried, the knowledge about cable and its usefulness increases.

Technological Developments and CATV's Future

Two factors that may hold long-range promise for cable are fiber optics and low-cost digital processing equipment. Fiber optics uses a fine glass fiber to transunit a beam of light that has a channel capacity much greater than that of coaxial cable. In addition to being smaller, lighter and more flexible than coaxial trunk cable, it has less inherent signal loss and is not subject to interference from outside electrical signals. Fiber optics may well make two-way audio-video cable circuits technically comparable in quality and cost to over-the-air, two-way, audio-video circuits.

Low-cost digital processing equipment which has drastically reduced the cost and increased the capability of the pocket calculator and which made possible an almost endless variety of living room video games may make feasible the more sophisticated home terminals for consumer interactive use of cable. The feeding of digital information upstream has proved valuable and workable, whereas upstream video especially color has proved troublesome and of dubious benefit in all but highly specialized applications. (The telephone company has also learned this lesson. That's why the Picture-Phone, which has been a technical reality for some years, is not yet sufficiently *useful* to induce customers to buy its service even in test areas. Yet, a brisk business in equipment has developed to feed digital information via the telephone for facsimile transmission and computer data input or access.)

CATV Regulation: Still Wide Open

It seems universally agreed that the real future of cable is as a broadband communications network. There is some divergence of opinion, however, as to how the ultimate system should be structured. Some operators, for instance, argue that cable operators should be considered a common carrier, and note that such classification would separate the current programming and distribution functions of cable's basic service potential. In its response to an Option Paper on Cable Television by the staff of the House Subcommittee on Communications, the National Cable Television Association (NCTA) had this to say with regard to common carrier status:

> At the same time as deregulation eliminates cable's status as "ancillary to broadcasting", it would be contrary to the public interest to impose, now or at a future date, a new regulatory status -common carrier -through the separations [sic] of cable programming and ownership of facilities . . . [efforts] to maximize program offerings and eliminate developmental lag of cable technology will be thwarted by common carrier status.[15]

Nor, says NCTA, should the telephone companies be allowed to become the monopolistic "one-wire" purveyor of communications services. Competition creates incentives for building new facilities and would reduce Ma Bell's historical reluctance to make wholesale changes where equipment obsolescence has been a factor.

For obvious self-interest reasons, NCTA supports a Congressional subcommittee recommendation to provide a period of cable deregulation to allow a marketplace determination of the need or lack of need for federal regulation. (NCTA would like to see a specific prohibition against non-federal—i.e., state and local regulation for the same period, or at least limited regulation within Congressionally established guidelines.)

Effects of CATV's Philosophy of Regulation

CATV's "regulate everybody else but me" philosophy may boomerang against the industry.

America has, since enactment of its anti-trust laws during the early 1900s, been quite suspicious of monopolistic controls of its communications and broadcasting services. Though on the surface CATV appears to be a highly fragmented industry, actually America's top 10 CATV operators already control more than one-third of the industry (see table 3). Thus, a decision by relatively few operators could significantly affect the entire industry. Such a situation does not encourage further deregulation at either local, state or federal levels.* Further, the original FCC rule-making process clearly warned that the FCC reserved the right to make common-carrier use of CATV circuits a matter of future deliberation and perhaps rule-making.

Table 3.
The 20 Largest U.S. Multiple System CATV Operators.

Operator	*Subscribers*	*Operator*	*Subscribers*
1. Teleprompter	1,084,193	11. UA-Columbia	182,000
2. Warner Cable	550,000	12. Service Electric	139,000
3. Community Tele-Communications	539,000	13. Midwest Video	134,020
4. American TV & Communications	500,000	14. New Channels Corporation	129,833
5. Cox Cable Communications	354,490	15. Continental Cablevision	128,900
6. Viacom	304,000	16. TeleCable	128,600
7. Communications Properties	245,444	17. Storer Cable	126,099
8. Sammons	242,792	18. GE Cablevision	115,000
9. Cablecom General	190,729	19. Athena Communications	101,000
10. United Cable Television	184,000	20. Cablevision Properties	88,029
Total 1-10 (38.6% of all cable subscribers)	4,194,648	*Total 11-20* (11.7% of all cable subscribers)	1,272,481

Source: 1976 *CATV System Directory*

*Mary Alice Phillips offers one scenario in which cable television exhibits a growth pattern similar to that of the American automobile industry—ultimately resulting in a few "giant" operators (in her book, *CATV: A History of Community Antenna Television*, Northwestern U. Press, 1972, p. 171).

Conclusion

Although the blue-sky talk regarding CATV's role in creating a "wired nation" no longer echoes loudly in the halls of Congress or the pompous prose of the ill-informed expert, the facts are these:

- CATV is alive and well and in many localities is operating profitably.
- When CATV can provide complete access to the population of a given geographic area, it can compete effectively on a cost basis with other media in delivering educational and social services–provided the delivery does not require *two*-way video transmission.
- When local franchising authorities, such as those of Shawnee Mission, Kansas, insist on the availability of two (or more) "free" channels for educational purposes as a part of the cable operator's franchise agreement, CATV can become a powerfully useful, as well as cost-effective educational/social service delivery medium.

Over-the-horizon technologies may enable CATV, during the 1980s, to provide economically the multi-channel (10 or more channels for simultaneous program distribution) and the two-way audio-video and digital circuit capabilities required for the delivery of many educational, social and medical services.

Then, and only then, will CATV fulfill its once-forecast significance in American life.

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Note: Information reported from M.L. Moss and Wm. Lucas (refs. 8-9 and 12-14) was derived from pre-publication drafts, which differ somewhat from the published versions.

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Bert Cowlan comments:

Curtis and Pence earn my instant appreciation for putting a question mark at the end of their title. Too often, and especially of late, we are treated to vivid brochures that proclaim cable television (two-way, interactive, with lock-outs to prevent the kids from watching R-rated movies) is the answer to all our problems. Just think, these brochures scream, you may never have to leave your home again. (My choler tends to rise.) They also offer us "instant electronic democracy." Despite the proponents of the video Town Hall concept, there is no way I would care to abide by a vote cast in response to television's inevitable simplification of an issue. "The essence of tyranny," someone once said, "is the denial of complexity."

Curtis and Pence note the requirement that (since 1977) all new systems, regardless of market size, are required to have 20-channel capacity and two-way capability. (Older stations have 12 channels.) How much of the capacity and capability is being used? Are most 12 (or 20) channel systems programming to full capacity? Are most interactively capable systems (and how many are there?) using the two-way capability, and for what? In regard to this last, the questions raised by the authors about the much-observed Qube are cogent, in particular the question about how long the consumer will pay for "special programs designed to serve his unfilled, desired, but perhaps economically impractical needs?"

I must question seriously one statement, that "cable television is especially well-suited to serving local educational needs." What's in it for the cable operator? If anything, the behavior of the media marketplace throughout its history seems to show that anyone with a channel is going to program anything that will get a large audience, not a small one. I fear the cable operator will reach for *Jaws II* a lot faster than *Geography I*. And, almost every accounting I have read of any use of CATV in a two-way, interactive mode for homebound students has ended with words similar to those used by the authors: "they never really got the [two-way technical] bugs out of the system."

The cost figures provided baffle me slightly. (The reader should be warned that *all* cost figures tend to baffle me.) The authors state that the figures supplied by Shawnee Mission (and one would have to see the raw data to know what is actually included) indicate annual per-pupil costs of $4.40. They quote CenTeX figures on ITFS at $5.12. They then point out that the ITFS system is four, rather than two, channels. It seems to me that four channels at $5.12 is more cost-effective. And, ITFS can provide interaction; there is no indication Shawnee can do the same. It does seem that some cost-effectiveness/benefit analysis would be helpful here.

I completely agree with the potential value (especially for interactive cable and assuming that interaction contributes positively to the educational experience) of fiber optics technology. It certainly will make a major difference in the wire-up costs in major cities. Digital is clearly the wave of the future; since we are running out of spectrum space, any technology that can provide video bandwidth in only 20 kHz of an increasingly scarce natural resource, is to be encouraged.

I tend to agree, too, with the authors' points (one through four) about CATV's future. Where we *might* disagree (though, to be fair, I have no reason to believe they wouldn't share my view), is on a fundamental philosophical premise. They mention CATV's providing complete access to the population of a given geographic area. I am concerned with the geographic area known as the United States. If CATV is to become the prime deliverer of educational and social services, the central question is then: Who gets left out? Earlier statistics available to me indicated that one could wire up about 85 percent of the United States for "a reasonable cost" (reasonable if education and the delivery of social services were ever to become a matter of national priority), a cost of "x" hundred million dollars. Wiring up the rest might cost as much again! To me, this raises a fundamental question: Is communications for education and the delivery of social services to be viewed as a *right* or a *privilege*? The costs of wiring up "the rest" include, of course, those that need communications for survival: the isolated, the rural poor, migrants, ghetto dwellers, native Americans on reservations. If we believe we are entering both an information age and an information economy, we (the body politic) need to decide this question. If the need is real, then cost should become subservient to need, and the issue can then be left to engineers and technicians to design a need-based system.

–*B.C.*

Communications Satellites for Education and Training: Past, Present and Future

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Almost since the technology was conceived, there have been predictions about the value of communications satellites for improving education as well as other services, but bringing these prognostications to fruition has been slow. A government-funded public service satellite system has been considered, but remains unlikely in the near future. This chapter presents an overview of the educational-training demonstration and experimentation that has taken place; describes the 1970 FCC solicitation for domestic satellite offers and resultant domestic systems; and finally, presents a sharing concept that could possibly bring the predictions of educational use of satellites into existence.

Major interest in using satellites for education began shortly after the 1965 launch of the first International Telecommunications Satellite Consortium (INTELSAT) satellite.[1] President Johnson's 1967 Task Force on Communications Policy, which recommended a serious look be taken at communications satellites for domestic services, sparked U.S. interest.[2] Then, several national education organizations became deeply involved as a result of, among other events, the 1969 agreement between India and NASA[3] for the use of the ATS-F* when launched in the mid 1970s to explore the social benefits of communications satellites. The education organizations hoped to use the satellite in the U.S. for demonstration and experimentation before it was provided to India. Additional impetus was provided to the growing U.S. educational interest by the FCC's 1970 request for domestic satellite proposals, which specifically asked the potential carriers to address educational services.[4] NASA's approval of the Alaskan request for the use of the ATS-1 for medical and educational experiments brought the educational community to the threshold of an extensive period of research with communications satellites.[5]

Early Experiments and Demonstrations

The stage was set for nearly a decade of social research using NASA's experimental satellites. The experimentation and demonstration work began in Alaska in 1971 using the ATS-1, which provided an audio communications capability; shortly

* ATS-F before launch, ATS-6 after launch.

thereafter, Hawaii began sharing the satellite for its own experimentation in the Pacific Basin. The ATS-6 added a video dimension and more power for continued research; using the ATS-6, ATS-3 and ATS-1, Alaska, the 13-state Appalachian region and eight states in the Rocky Mountain region participated in projects from September 1974 until June 1975. Finally, a joint U.S.-Canada experimental satellite (CTS) * was launched in January 1976 to permit continued research with more satellite power and in a new frequency band. Numerous U.S. entities are conducting research using the CTS, as well as the ATS's.** What has been the result of the research?

ATS-1: Research in Alaska and Hawaii

The Alaskan and Hawaiian efforts were the first to gain insight into the use of satellites for public services. They pointed to the viability of such applications and to the broad potential use and economics of narrowband (audio channel) communications. These projects, initiated in 1971, were for the most part concluded in 1974.

The State of Alaska ATS-1 experiment[6] was initiated by the state health community to conduct studies on the impact of interactive communications on health care delivery and its improvement in remote areas; a public education project for remote areas was piggy-backed onto the health effort. Relative to education and training, the health project concentrated on programs for health aides and professional nurses, which supported the interactive health consultative work conducted throughout the experiment.

The results of the experiment showed that in remote areas interactive satellite audio channels can be an effective and reliable means for providing training and professional health consultative communications, and contribute to improving health. The public education project, while fraught with administrative and political problems, did demonstrate that a communications satellite can be a useful tool for providing community information and education services to remote villages; furthermore it can provide effective administrative and information services to teachers and classroom programs for students.

The State of Hawaii[7] (University of Hawaii) expanded on the concept of using a communications satellite to provide services to remote areas by experimenting on an international basis and testing the multimedia capability of an audio channel to support service delivery. Owing to financial constraints, only interactive data and facsimile transmission were added. The first phase tied together campuses of the University of Hawaii on the islands of Hawaii and Oahu. The second phase expanded the project to other Hawaiian islands and to English-speaking nations, territories and protectorates in the Pacific Basin. The third phase dealt with establishing topic networks of interest to users, the major ones being medical, news, education, science, community and intra-national topics.

* CTS is a Canadian satellite that NASA provided some support for and launched. It has been used on a shared basis, but soon will revert totally to Canada.

** The ATS-1, 3, 6 and CTS are being phased out of public service experimentation and demonstration, because various government agencies believe enough has been learned about the technology. While this may be the case for engineers, it is not so for potential users of the technology. Use of the technology will profoundly affect the social, economic, organizational, managerial and other aspects of the users. No prolonged or serious research in these areas has taken place.

The education network experiments addressed supporting normal classroom instructional activities; providing workshops on curriculum development; conducting research seminars; exchanging information through voice data and facsimile transmissions; and permitting primary school students discussion between Alaska, Hawaii and New Zealand.

The Hawaiian project demonstrated the potential of communications satellites for permitting nations to work together toward social development and for the exchange of ideas. It showed that audio channels can support most of the communications needs of diverse communities in a variety of fields and demonstrated that expertise and scarce resources can be economically shared. Finally, the Hawaiian project showed that communications satellites can support all levels of education.

ATS-6: Research in Alaska, Appalachia and the Rocky Mountains

The ATS-6 offered video media in the 2.5-2.7 GHz band,* greater satellite power and a signal beam focusing capability. As a consequence, it permitted the development of small, inexpensive earth terminals which could be placed at the user's site. The nature of the Alaskan, Appalachian and Rocky Mountain projects, and the fact that they shared the ATS-6, required the concurrent use of the ATS-1 and ATS-3. These projects were initiated in September 1974 and concluded in June 1975.

Alaska. Since an operational system was the ultimate goal, the overall objective of the Alaskan[8] work was to gain experience and learn how to plan and operate a satellite system. Eighteen sites participated in the program. All were equipped to receive color television and had a two-way audio capability.

The research encompassed the education, public broadcasting, health and public interest areas. The education activities centered on early childhood education; basic oral language development; health education; and inservice teacher training. In some instances, the programs were broadcast in English and two Alaskan native languages. Instructional programs were available to 1,200 rural school children (K-5th grades) and 150 rural Alaskan educators. The results supported the development of an operational system.

An operational communications satellite system was initiated in Alaska in 1975 using the RCA SATCOM. In addition to the metropolitan areas, two-way audio earth terminals now are being provided to every rural Alaskan community with a population of 25 or more. These terminals are equipped with two two-way circuits, with a capability for eight two-way circuits. One circuit is for conventional telephone, the other for emergency medical service. There is a plan to provide a low data rate computer-based instruction and administration system to these communities in the near future. Twenty-three of the rural village earth terminals are equipped to receive video, and experiments are being conducted on the practicality of transmitting videotaped education programs to videotape machines at these sites during off hours. A local instructor at each site uses the tapes to support pre-school through college programs. Results have been promising.

*A hertz (Hz) is a unit of electronic wave equal to one cycle per second; a gigahertz (GHz) is equal to a billion cycles per second; a megahertz (MHz) to one million per second.

Appalachian Region.[9] The Appalachian project concentrated on providing inservice education to teachers throughout the region. Fifteen widely dispersed sites located in eight states participated. Terrestrial and satellite communications were used to provide for all desired communications, which included video, audio and teletype transmissions.

Four graduate-level courses were conducted during the project. Two concentrated on reading instruction for teachers in the K-6th grades; the other two addressed career education for K-12th grade teachers. The learning activities included videotaped lessons, four-channel audio, interactive seminars, laboratory sessions and library information retrieval.

Results of the research indicated that using communications satellites, linked with terrestrial systems to provide inservice education to teachers in Appalachia, is competitive with the cost and effectiveness of offering similar courses on a university campus. The success of the project led to an agreement for federal funding which provides grants on a diminishing yearly ratio basis until 1982. Research will concentrate on managing and operating a telecommunications network and exploring the service requirements in education, business and industry, medical and health services, human resources, and government. Since the ATS-1, 3, 6 and CTS are now being phased out, it is not clear what satellite will be used.

Rocky Mountain Region.[10] The Rocky Mountain program was the most extensive, working with 69 sites in eight states within the region, plus coordinating the satellite and earth terminal activities for Alaska and Appalachia. Sites were divided into three categories: two-way audio, digital and video; two-way audio and digital; and one-way audio, digital and video. The program sought to demonstrate the feasibility of a satellite-based media distribution system for isolated, rural populations, as well as to test and evaluate user acceptance and evaluate the cost of various delivery modes.

Education and training programs and services that were explored included a career education course for junior high students; an inservice career education course for teachers; community-oriented evening programs; satellite delivered films and videotapes to schools in remote, isolated communities; and an emergency medical technician recertification program. The career education course served 22,152 junior high school students in the eight states; 876 teachers received college or recertification credit.

The project was judged a success by most of its planners and participants. It showed that a large network for services to remote areas is feasible and identified some desirable services. A considerable number of personnel were trained. Nevertheless, the Rocky Mountain project was completely terminated in 1975, and no follow-on program has been approved for the region.

CTS Research Projects

The Communications Technology Satellite (CTS)[11] is a joint U.S.-Canadian experimental satellite designed, among other things, to explore the use of the 12 and 14 GHz frequency band for general communications. Since CTS was launched in 1977, its time has been equally shared by both countries for various experiments and demonstrations.

Some of the experiments that have been proposed or are being executed include 1) the Stanford University/Carleton University (Canada) shared curriculum that enables students in one university to take courses in another; 2) the Public Health Service experiments, sponsored by the Lister-Hill National Center for Biomedical Communications, which involved several institutions to evaluate broadband video satellite communications as an aid to decentralized medical education that would enable health professionals in remote locations to participate in continuing education, and as a medium for more effective transfer of new knowledge generated by biomedical research; 3) the Archdiocese of San Francisco exploration of how video teleconferencing among classroom teachers can be used to help them overcome problems in implementing individualized instruction in their schools; and 4) the states of Washington, Alaska, Montana and Idaho (WAMI) experiments with techniques that might improve administration, as well as teaching techniques and procedures for decentralized medical education.

Numerous other experiments have been conducted, but the ones discussed above are the major problems now being undertaken. All the experimental work has been accomplished with NASA experimental satellites, which are not the type available commercially or planned for operation in the near future. While potential social service users have been traversing the path of the high-powered satellite with small, relatively inexpensive earth stations, the operational systems have evolved a different technology.

The FCC's Request for Proposals

In January 1970, the Nixon administration recommended to the Federal Communications Commission (FCC) that private companies be permitted to build and operate communications satellites on an open competition basis.[12] There was a question, however, whether the FCC should permit anyone who wished to do so to enter the satellite field, in light of the limited knowledge of the technology and its possible impact on terrestrial communications systems and associated markets. Consequently, in March 1970* the Commission solicited proposals to aid it in ascertaining the kinds of communications satellite systems that would most effectively develop the technology for U.S. communications.[13]

Concerning social services, the FCC asked responders to the solicitation to address the following:

> Where the proposed services include television or radio program transmission, the terms and conditions under which satellite channels will be made available for noncommercial educational networks should be cited. We note that parties to this proceedings, such as COMSAT and the ABC network, have proposed to provide satellite channels without charge for the interconnection of public and instructional broadcasting. We believe this to be in the public interest. Applicants preparing television or radio program transmission services should also address the possibility of realizing a "peoples' dividend" to provide some funds for programming by noncommercial educational stations, as suggested by the Ford Foundation.
>
> Applicants proposing multi-purpose or specialized systems should also discuss the terms and conditions under which satellite services will be made available for data and computer usage in meeting the instructional, educational and administrative requirements of education institutions.[14]

* A number of proposals for and comments about domestic communications satellite services had been submitted to the FCC during the second half of the 1960s, but this was the first official request for proposals.

Proposed Domestic Satellite Systems

Eight primary applicants responded to the FCC request. Western Union was first with a filing on July 30, 1970, and Western Telecommunications, Inc., was the last to file on March 15, 1971.[15] Table 1 summarizes the responses by the eight companies. (Details of each company's response appeared in the *Federal Register*.)[16]

- *Western Union* offered to orbit three 12-channel satellites and provide normal service to include message, TV, data and leased channels, and was willing to provide one or more Education Television (ETV) channels if the FCC ruled that it was in the public interest to provide such channels at no charge.

- *COMSAT/AT&T* addressed only message, data, Picturephone and occasional commercial television, offering to orbit three 24-channel satellites, but no public or educational services. They did indicate a willingness to discuss the possibility of public services with the Corporation for Public Broadcasting (CPB), referring to negotiations that CPB and AT&T were conducting on reduced rates for use of land lines for national public television. (In this offering, COMSAT was to provide the satellite for only AT&T to use. AT&T would lease the total satellite system for a fixed number of years.)

- *Hughes Aircraft Company/GTE* offered to orbit two 12-channel satellites and provide normal communication services to include television, cable television, data and general telephone and electronic traffic. In addition, Hughes offered two free nonpre-emptable ETV channels on its first satellite with complete back-up in case of failure of one or both channels. Further, two additional channels were offered on the second satellite, but they would be pre-emptable with no back-up.

- *COMSAT* indicated that it would orbit three 24-channel satellites to provide television, message, data and cable television services, but no public broadcasting or educational services were offered. COMSAT noted, however, that if there were genuine CPB requirements, preferential service agreements could be negotiated.

- *MCI/Lockheed* offered to place two 48-channel satellites in orbit to provide normal television, cable television, voice, data, electronic mail and record carrier trunks. In terms of the FCC education and CPB requests, they addressed all of the FCC interests. They specifically responded to the computer-based educational requirements by offering five free channels for five years for educational service experimentation, to include educational television. Finally, MCI/Lockheed offered to continue to provide the service after five years at reduced rates.

- *RCA* proposed to provide three 12-channel satellites that would provide television, radio, closed-circuit, motion picture and data services, plus public and educational services. Addressing the FCC public broadcasting and educational services request, two channels for national ETV and two for public television were offered at reduced rates. The ETV channels were to piggy-back national public radio stereo; further, lower rates were offered for instructional experimentation, but such services would be pre-emptable.

- *Fairchild-Hiller* proposed to orbit three 12-channel satellites providing normal television, message and data services. Relative to public service and education, the following offers were made: two full-uninterruptable channels for PBS; free use of one or two free ETV channels for direct reception via small inexpensive terminals at schools or for community use; and, one free ETV channel for Alaska.

Table 1. Proposals for Domestic Communications Satellite Systems.

Applicant	Date of Filing	Satellites	Services to be Provided	Areas to be Served	Remarks
Western Union	3/15/71	3; 12-channel (2 active, 1 spare); 4 and 6 GHz	Message, TV, Data, Leased Channel (no change)	50 states (no change)	Free ETV channel offered
COMSAT/AT&T	3/3/71 (replacing filing of 10/19/70)	3; 24-channel (2 active, 1 spare); 4 and 6 GHz	Message, Data, Picturephone R, Occasional TV	48 contiguous states; can also serve Alaska	Willingness to discuss public services
COMSAT	3/1/71	3; 24-channel (2 active, 1 spare);	TV, Message, Data, ETV, CATV*	50 states and Puerto Rico	Willing to negotiate CPB Service
Hughes Aircraft/GTE	1/4/71	2; 12-channel (1 active, 1 spare)	TV, CATV, ETV, Data, GT&E traffic	50 states	Offers 4 free ETV channels
MCI Lockheed Satellite	3/8/71	2; 48-channel (1 active, 1 spare); 4 and 6 GHz 12 and 13 GHz	TV, ETV, CATV, Voice, Data, Electronic Mail, Record Carrier Trunks	50 states	Offers 5 ETV channels free for 5 years for service experimentation; after channels at reduced rates
RCA (RCA Globcom-RCA Alascom)	3/11/71	3; 12-channel (2 active, 1 spare on ground); 4 and 6 GHz	TV, ETV, Radio, Closed-circuit Motion Pictures, Data	50 states and Puerto Rico	Offers 2 ETV and public TV channels at reduced rate; reduced rates for instructional experiments
Fairchild-Hiller	3/15/71	2; 120-channel (1 active, 1 spare); 4 and 6 GHz 7 and 13 GHz	TV, ETV, Message, Data	48 contiguous states at first; ultimately to include Hawaii, Alaska, P.R. and Canal Zone	2 free channels for PBS; 1 or 2 free ETV channels for CONUS; 1 free ETV channel for Alaska
Western Tele-Communications	3/15/71	2; 12-channel (both operational); 4 and 6 GHz 12 and 13 GHz	TV, CATV, Data/Voice	50 states	No mention of public service

Adapted from: Domestic Communications Satellite Facilities: Proposed Establishment by Non-Governmental Entities *Federal Register*, Volume 37, Number 56, Part II, March 22, 1972.

• Finally, *Western Telecommunications* offered to provide three 12-channel satellites for television, cable television, data and voice services. The FCC request for public and educational services was not addressed.

The FCC reviewed the proposals and conducted hearings throughout 1972* and concluded that, with the exception of the joint AT&T/COMSAT and the independent COMSAT submission and minor changes in others, each applicant would be permitted to pursue their pending applications.**[17] Concerning the public and educational service offerings requested in the original proposals, however, the FCC ruled:

> On the basis of the limited information now before us and the obvious uncertainties as to the specific nature, capacity and costs of the satellite facilities that will eventually emerge, we are in no position at this time to initiate any definitive proposal looking toward preferential rate treatment or to even specify the types of entities within the educational and noncommercial broadcasting services that should be eligible for such rate treatment. The Commission will, however, entertain specific proposals by carriers or users for the prescription of preferential rate classification in accordance with sections 201, 202, 204 and 396(h) of the Communications Act. The carriers are of course free at any time to file tariffs providing for such preferential rate treatment subject to review by the Commission in accordance with the applicable statutory process and the rules adopted by the Commission pursuant thereto. Notwithstanding the foregoing, the non-carrier applicants (such as Hughes and Phoenix) who have offered free access to any facilities authorized to them to public broadcasting and other educational entities are, of course, expected to implement the proposals made in their applications.[18]

With the exception of the last line mentioned above, the FCC terminated the proceedings, indicating that operational experience with domestic commercial satellite systems should exist before a policy is established.

Operational Domestic Satellite Systems and Services

In 1973, the FCC approved a number of applications for domestic satellite systems. Western Union was the first company to initiate a U.S. domestic satellite system.

Western Union

In April 1974, the Western Union Westar I was launched by NASA†; Westar II was launched in October to complete the Western Union domestic satellite system.[19,20]

* For details, the reader is referred to the FCC documents and the *Federal Register* cited in the references.

** New submissions were provided to the FCC which eventually led to the AT&T and Satellite Business Systems (SBS) domestic satellite entities.

† NASA launches all domestic and most foreign communications satellites and is reimbursed for use of facilities and the tracking system. The carriers purchase launch vehicles and satellites from private firms.

As figure 1 shows, the satellites are located at 99^{o}W and 123.5^{o}W, oriented to serve the continental U.S., Alaska, and Hawaii. Each satellite has 12-34 MHz transponders capable of relaying all media and data types, with a programmed lifetime of seven years.*

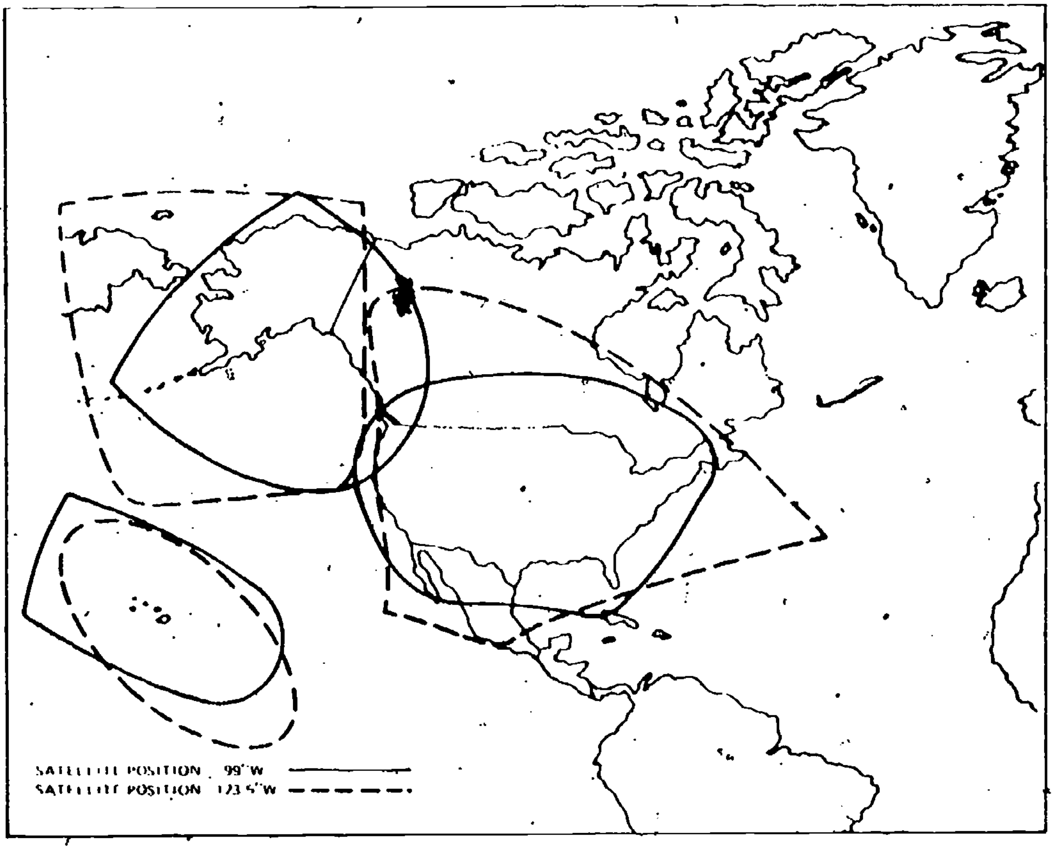

Figure 1. Westar coverage.

The satellites use the 4 and 6 GHz frequency bands, with a transponder power output of five watts. Because of the limited power of the satellite, the multiple users of the band, and the possible interference with terrestrial communication systems in the 4-6 GHz band, 30-foot antennas are used at "receive and transmit" locations. Twenty-six foot antennas are used at "receive only" stations, but 16-foot ones are coming into operation, with earth terminals currently in operation in Los Angeles, New York, Chicago, Dallas, Atlanta and Hawaii.

Westar is basically a point-to-point system (i.e., it provides signals to specified geographic locations or points where signals are received at earth stations and redistributed over existing terrestrial communications systems, such as microwave, cable TV or telephone lines, to customers.) To use the system, information must pass to and from the earth station and the user's facility over terrestrial lines. Initially, the user would pay the terrestrial carrier, such as AT&T, to use the intercon-

*A Western Union-Xerox Corp. merger is in process. Xerox is planning a Xerox Telecommunications Network (XTEN) to establish a high-speed nationwide digital information network.

nect lines, plus the satellite usage rate. The satellite companies have now established "access cities" at various locations, where system users pay only for the terrestrial interconnection to the "access city" point. The companies then pay from this point to the earth terminal. (For example, Western Union does not have an earth terminal in the San Francisco area, but it is an "access city" which forwards Westar communications to Los Angeles, where a Western Union earth terminal is operating. Instead of customers in the Lake Tahoe area paying for terrestrial line usage to Los Angeles, they pay only to San Francisco; Western Union pays for the interconnect between San Francisco and the Los Angeles earth terminal.) The Westar access cities for two-way video include San Francisco, Houston, Los Angeles, Pittsburgh, Washington, D.C., Chicago and Dallas; video reception service is available at the access cities of St. Louis and Seattle/Portland.

Westar Services.[21] Western Union satellites provide video, audio, facsimile and data relay services. Video transmissions are available in monochrome or color on a one-way only basis to single or multiple points. Service can be obtained on a dedicated, long-term multi-schedule, occasional or long-term schedule basis. They are summarized as follows:

- Dedicated service is a full-time use of a video communications channel on a yearly basis.
- Long-term multi-schedule service is a minimum three-year use of a video channel requiring five hours of daily use.
- Occasional use is comprised of monthly scheduled and reserved time services. Monthly scheduled service required 30 hours of scheduled usage per month. Reserved time service does not require a minimum monthly or yearly usage, but the usage must conform to specified times of day or associated rates.
- Long-term scheduled service is provided on an annual basis requiring a minimum usage of 3,600 reception and transmission hours, with at least 30 minutes of usage per operation.

Audio services are available for one-way or two-way point-to-point transmission in a frequency range from 50 to 7500 hertz; a service called SpaceTel is also available providing private audio networks for customers whose facilities are located in Westar SpaceTel service cities.

System Usage Costs.[22] The rates in the United States for the use of communications systems are approved by the FCC, and the rates are basically the same for all communication satellite systems. Accordingly, the rate information for the other carriers is not discussed unless there is a major deviation from usual rates. Special rates can be negotiated with a system user, however, with FCC approval. For example, if a user owns its own earth terminal or long-term leases are desired, lower rates are possible. The following discussion assumes the use of Westar earth terminals. Table 2 shows the rates for the various services discussed above. Service rates are determined according to the number of routes to be served and whether there is one- or two-way service.* Table 3 shows the rates for one-way, two-way and multi-

* Since the cost information presented here is not intended to be all inclusive and may be out of date, it is suggested that the reader write the Assistant Vice President, Regulatory Matters, Western Union Telegraph Company, 1828 L Street, N.W., Washington, D.C. 20036, or phone (202) 862-4600, for more current and detailed information. The other carriers also should be contacted for their specific cost information.

point audio communications services for cities served by Westar. Type I and II channels are offered. Type I provides for service within a frequency range of 300 to 3600 hertz; Type II within a range of 50 to 7500 hertz.

Table 2. Westar Communication Satellite Video Rates.

1. Dedicated	Monthly Lease Rate			
One Channel				
Protected	$180,000			
Unprotected	$120,000			
2. Long Term Multi-Schedule Service 3-Year Initial Contract Period	Minimum Cumulative Payments			
First Year	$ 750,000			
Second Year	1,700,000			
Third Year	2,850,000			
Fourth Year and Each Year Thereafter	950,000			
3. Occasional Use Service *	First Half Hour Or Fraction Thereof		Each Additional Consecutive One-Quarter Hour or Fraction Thereof	
3.1 Monthly Scheduled Occasional	Transmit	Receive	Transmit	Receive
Prime Time	$215.00	$45.00	$105.00	$20.00
Daytime**	100.00	20.00	95.00	15.00
Earlybird***	45.00	12.50	45.00	12.50
3.2 Reserve Time Occasional				
Prime Time	$225.00	$45.00	$112.50	$22.50
Daytime*	100.00	20.00	100.00	20.00
Earlybird**	45.00	12.50	45.00	12.50
4. Long-Term Scheduled Service				
Charges are Constant for All Hours	$150.00	$25.00	$ 75.00	$12.50

Adapted from: *Video and Program Channel Services Tariff*. Western Union Telegraph Company, Tariff FCC No. 261. Latest revision effective date December 1, 1977.

**Prime Time:* the term "prime time" denotes the time period between 4:00 pm and 2:00 am Eastern time, Mondays through Fridays (except for enumerated holidays) and between 2:00 pm and 2:00 am, Eastern time on Saturdays, Sundays, Thanksgiving Day, Election Day, Christmas Day, New Year's Day and July 4; *Daytime:* the term "daytime" (as applied to video channel service only) denotes the time period between 12 noon and 4:00 pm, Eastern time, Mondays through Fridays (except for enumerated holidays) and between 9:00 am and 2:00 pm, Eastern time on Saturdays, Sundays, Thanksgiving Day, Election Day, Christmas Day, New Year's Day and July 4; *Earlybird:* the term "earlybird" denotes the time period between 2:00 am and 12 noon, Eastern time, Mondays through Fridays (except for enumerated holidays) and between 2:00 am and 8:00 am, Eastern time on Saturdays, Sundays, Thanksgiving Day, Election Day, Christmas Day, New Year's Day and July 4.

** Minimum period of use – 1 hour per occasion.

***Minimum period of use – 2 hours per occasion.

Earth terminals may or may not be located at a user's site. (The cost of terminals are in addition to the channel costs. They are leased or purchased by the customer. Not all carriers permit the purchase of terminals.)

Table 3. Westar Audio Rates.

Service Route	Monthly Channel Rates					
	Two-Way Type		One-Way Type		Multipoint* Type	
	I	II	I	II	I	II
Los Angeles - Buffalo	$1,050	$2,400	$750	$1,700	$375	$850
New York - Cincinnati	550	1,800	400	1,300	375	850
New York - Cleveland	550	1,800	400	1,300	375	850
New York - Denver	800	2,100	550	1,500	375	850
New York - Detroit	550	1,800	400	1,300	375	850
New York - Houston	800	2,100	550	1,500	375	850
New York - Kansas City	800	2,100	550	1,500	375	850
New York - Los Angeles	1,050	2,400	750	1,700	375	850
New York - St. Louis	550	1,800	400	1,300	375	850
New York - San Francisco	1,050	2,400	750	1,700	375	850
Atlanta - Los Angeles	1,050	2,400	750	1,700	375	850
Atlanta - San Francisco	1,050	2,400	750	1,700	375	850
Washington - Denver	800	2,100	550	1,500	375	850
Washington - Los Angeles	1,050	2,400	750	1,700	375	850
Washington - San Francisco	1,050	2,400	750	1,700	375	850
Dallas - Cincinnati	550	1,800	400	1,300	375	850
Dallas - Los Angeles	800	2,100	550	1,500	375	850
Dallas - New York	800	2,100	550	1,500	375	850
Dallas - San Francisco	800	2,100	550	1,500	375	850
Dallas - Washington	800	2,100	550	1,500	375	850
Chicago - Atlanta	550	1,800	400	1,300	375	850
Chicago - Boston	550	1,800	400	1,300	375	850
Chicago - Dallas	550	1,800	400	1,300	375	850
Chicago - Los Angeles	800	2,100	550	1,500	375	850
Chicago - San Francisco	800	2,100	550	1,500	375	850
Chicago - New York	550	1,800	400	1,300	375	850
Chicago - Washington	550	1,800	400	1,300	375	850
Atlanta - Dallas	550	1,800	400	1,300	375	850
Atlanta - New York	550	1,800	400	1,300	375	850
Atlanta - Washington	550	1,800	400	1,300	375	850

Adapted from: *Video and Program Channel Services Tariff;* Western Union Telegraph Company, Tariff FCC No. 261, effective November 1, 1977.

* One-way multipoint service is available as an adjunct to one-way or two-way channel service. The total applicable charge for a completely one-way multipoint service arrangement consists of the one-way rate for the longest route within the multipoint configuration plus the multipoint rate for each additional service route. When multipoint service is provided in conjunction with two-way channel service, only one two-way channel may be included in the service arrangement. The total applicable charge for a service arrangement composed of one two-way channel and one or more one-way multipoint channels will consist of the two-way rate for the longest route within the multipoint configuration plus the multipoint rate for each additional service route.

Table 4. General Earth Terminal Costs.

Type of Antenna	Cost*
10 Meter	
Two-way 1** channel video-audio (totally redundant)	$400,000
One-way 1 channel video-audio receive	65,000
One-way 1 channel video, 1 channel two-way audio	165,000+
5 Meter	
One-way 1 channel video-audio	25,000
Two-way 1 channel audio (estimated, no system exists)	40,000
2 Meter	
One-way 1 channel audio (estimated, no system exists)	15,000

* Information provided by Scientific-Atlanta; estimates are based on their information but were made by the author.

** Additional channels can be added for less cost. Installation costs are not included.

If terminals are not located at the customer's site, an interconnection cost must be added and, depending on the media and distance, the costs can be considerable. The rates depend on the part of the country in which the service is being obtained, and on the specific carrier. For example, a yearly 30-mile *one-way video*, with audio microwave link between an earth terminal and a user's facility provided by AT&T, would cost approximately $80,000, but a *two-way audio* capable of handling data transmission over the same 30-mile distance on a yearly basis would cost approximately $2,800. Table 4 shows general earth terminal costs.

As Table 2 shows, dedicated monthly video service is available with a "protected" and "unprotected" rate. *Such service applies only to a full-time video channel*. In the event of a failure, the user is guaranteed a channel on an alternative or "back-up satellite." The user with "unprotected" service does not have this guarantee, but the satellite being used does have a back-up transponder to which he *may* be switched. In either case, in the event of service interruption for *protected service*, credit is allowed for interruptions of one-half hour or more and is computed on a proportionate basis; when there is *unprotected service*, however, credit for interruptions begins at three hours and is also computed on a proportionate basis.

Current Western Union Social Service Offerings. Western Union's original social service offering was to provide one or more free ETV channels, if the FCC ruled that it was in the public interest.[23] The FCC did not so rule, and therefore the free service has not been provided. Western Union has negotiated reduced rates, however, with the Public Broadcasting System (PBS) for service to its public TV licensees*; PBS, working with its affiliates, has purchased approximately 150 earth terminals.[24] Special rates also have been negotiated with other entities for one-time use.[25]

Future Western Union Satellite Systems.[25] Western Union plans to launch an advanced all-digital satellite in 1980-81, transmitting in the 11.7-12.2 GHz band as well as the 3.7-4.2 GHz band. Working in the 11.7-12.2 GHz band, the highly powered satellite is to be capable of transmitting one billion bits per second within a 500 MHz bandwidth by using special techniques; antennas measuring 10 to 15 feet in diameter will be able to be placed at the user's site so that audio and video signals can be directly received and transmitted.

American Satellite Corporation

American Satellite Corporation (ASC)[27] was the second company to offer services, beginning on July 31, 1974. ASC, a wholly owned subsidiary of Fairchild Industries, does not have its own satellites in orbit; it leases time on Westar. ASC is able to compete with other domestic satellites** by providing for its own earth terminals, signing long-term agreements for use of satellite transponders, and providing for unique bandwidth usage.† In most cases, ASC has also sought out a different market segment than its competition.

ASC Services. ASC provides for the transmission of telephone, data, facsimile and television signals, with the first commercially available digital satellite transmissions now in operation. Voice data is transmitted over voice grade channels at speeds up to 9000 bits per second (bps). Wideband data is transmitted at 56 kilobits (56,000) per second (kbps), 150 kbps and 1.544 megabits per second (mbps). This capability permits the customer to mix teletype, data and top quality digitized voice transmissions. Graphic materials can also be transmitted using high-speed facsimile equipment at 56 kbps and above.

Network Configurations. ASC offers three types of network configurations: commercial, dedicated and specialized. The commercial networks are composed of large regional or access-city earth terminals with which customers interface over normal terrestrial lines. Dedicated networks small stations situated on the customer's rooftop or premises permit a private communications system to be established between company facilities free of normal terrestrial interconnects. Specialized networks are customized communications systems that lack the traffic to justify a dedicated network; they are composed of a combination of regional and user facility earth stations.

Earth Terminal Locations. ASC has four major commercial earth stations operating in Dallas, Los Angeles, New York and San Francisco. Access cities or central offices are located in the above locations, as well as in Atlanta and Houston. At these points, signals are relayed, usually by microwave, to the nearest ASC earth station for transmission to the satellite. Conversely, signals are also received by the central offices and distributed to the customers. *Dedicated* earth stations for

* The reduced rates include a charge of $66,666 per month for the first three transponders and $62,500 per month for each additional. For the specifics of the contract, contact the Western Union Office previously noted (p. 132).

** Domestic satellites are sometimes referred to as "DOMSATS."

† For specific and up-to-date rate information, write the Director of Rates and Tariffs, American Satellite Corp., 20032 Century Blvd., Germantown, Md. 20767 or phone (301) 428-6051.

business are located at Chicapee, Massachusetts; Orlando, Florida; and South Brunswick, New Jersey, all for Dow Jones and Co. Earth stations also link Sperry Univac facilities in Blue Bell, Pennsylvania, and Roseville, Minnesota; the Boeing Computer Services, Inc., facilities in Seattle, Wichita and Philadelphia are also linked. *Dedicated* earth stations for the federal government are located at Fairchild Air Force Base, Washington; Loring AFB, Maine; Offutt AFB, Nebraska; Centerville Beach, Moffett and Monterey Naval Stations, California; Barbers Point and Wahiawa, Hawaii; Stockton, California; Kennedy Space Center, Florida; Goddard Space Flight Center, Maryland; and Kaen Point, Hawaii.

American Satellite's Public Service Offering.[28] As noted in table 1, Fairchild-Hiller, the owners of ASC, originally offered to provide:

- Two free PBS channels;
- One or two free ETV channels for CONUS;
- One free ETV channel for Alaska.

None of these proposed services have been provided.

RCA SATCOM

RCA[29,30] initiated domestic U.S. service in 1973 using the Canadian satellite system.* On December 13, 1975, the first RCA three-axis stabilized satellite was launched, and service began on January 15, 1976; the second satellite was orbited March 26, 1976. Each satellite has 24-34 MHz transponders. As figure 2 shows,

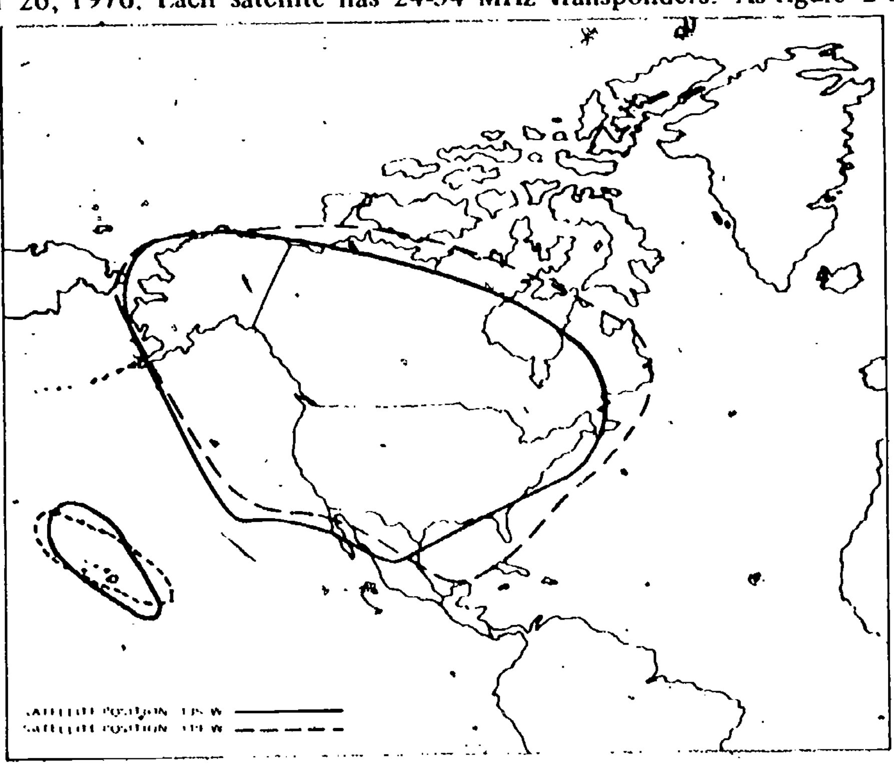

Figure 2. RCA SATCOM coverage.

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* The Canadian satellites, like the U.S. satellites, are located in a geo-stationary orbit (i.e., over the equator and stationary relative to the earth) and can concentrate their signals on the U.S. for communication purposes if permitted to do so by the FCC and the Canadian government.

one is located at latitude 135°W and the other at 119°W geared to serve the continental U.S., Alaska and Hawaii. At launch, the satellites had an expected life of eight years.

The RCA satellites also operate at 4 and 6 GHz, have a transponder output of five watts, and are capable of relaying all types of media and data. The system also uses a 30-foot antenna for receive-transmit locations and, like the Westar system, uses a 26-foot antenna for receive-only earth stations. While RCA is providing services to the continental U.S., a major geographic area of concentration is the state of Alaska, where 100 earth stations are operating; an additional 20 are to be brought into service over the next year or so.

Throughout the U.S., approximately 350 earth stations are in operation. Major RCA facilities are in New York, Chicago, Los Angeles, Houston, San Francisco, Philadelphia and Atlanta; access cities include Washington, D.C., Boston, Wilmington and Dallas/Ft. Worth; those dedicated to government services include Goddard Space Flight Center and Suitland, Maryland; Thule AFB, Greenland; Wallops Island, Virginia; Camp Roberts, Edwards AFB, Monterey and Goldstone, California; Johnson Space Center, Texas; White Sands, New Mexico; and Kokee, Hawaii.

RCA SATCOM Services. System services include the usual range of media signals, but both analog and digital transmission are possible. Point-to-point private networks and, with the relaxation on earth station sizes, combination networks are being provided for customers. Private networks are the fastest growing service area for RCA, particularly in the cable TV area. Home Box Office, Inc., which provides certain cable TV companies with exclusive entertainment, such as first run movies and athletic events, has been expanding rapidly by using the RCA system. Over 170 cable TV communities are using the system, with an additional 180 scheduled for operation in 1978. An example of a combination of networks is the Alaskan Bush Service, which will eventually provide telephone and medical communications to every rural community with 25 or more people. The system combines satellite and terrestrial linkages to reach over 160 villages.

System Usage Costs.* RCA has developed a means to permit two video channels (one-way) to be transmitted over the same bandwith. As a result, the cost of a full-time video channel is approximately $800,000 a year. RCA is experimenting with four channels sharing the same bandwidth, and hopes eventually to put six channels into operation. In each case, the price per channel use will be reduced accordingly.

In a special case, RCA is providing the state of Alaska with one-way video channels at a cost of $540,000 a year.[31] Reduced audio channel rates for the Alaska Native Health Service also have been negotiated.

RCA Social Service Offerings.[32] RCA's original offering for social services included:

- Two channels for national ETV at reduced rates;
- Two channels for public television at reduced rates;
- Public stereo radio piggy-backed on ETV;
- Reduced rates for instructional experimentation, but pre-emptable.

RCA has provided most of what they originally offered, though mainly in Alaska.

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* For specific and up-to-date rate information, write the Administrator of Tariffs, RCA American Communications, Inc., 201 Centennial Ave., Piscataway, N.J. 08854, or phone (201) 855-4450.

American Telephone & Telegraph

The COMSTAR system, because of the American Telephone and Telegraph (AT&T)[33] and General Telephone and Electronics (GT&E) investment, was prohibited from providing all services except MTT, WATS, AUTOVON and other special services until 1979. The FCC felt that an AT&T and GT&E communications monopoly would work against a competitive domestic satellite marketplace, if it were to enter the market with no restraints. Consequently, restrictions were placed on AT&T and its partners in order to give other companies an opportunity to establish a competitive position.

AT&T leases COMSTAR, which is owned by Communication Satellite Corporation (COMSAT). COMSAT launched the first satellite, COMSTAR I, on May 13, 1976, and began service June 24, 1976; COMSTAR II was launched on July 22, 1977.[34] As figure 3 shows, the satellites are located at 128°W and 95°W latitude

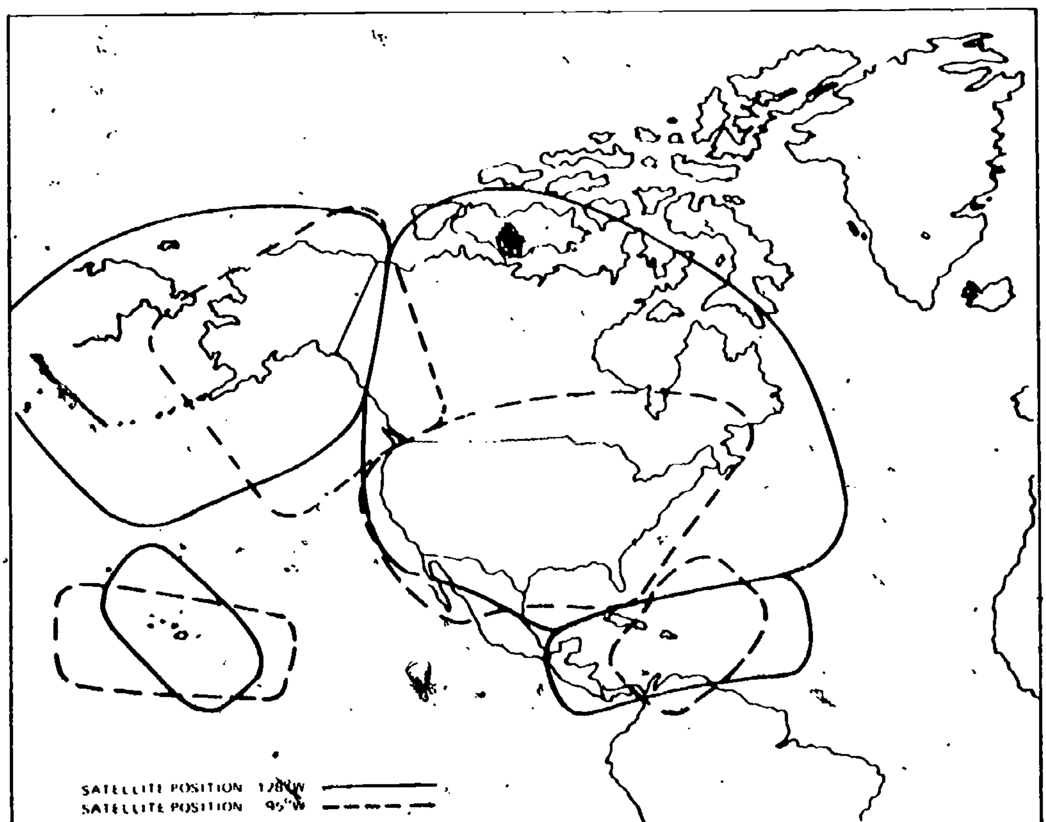

Figure 3. COMSTAR coverage.

and can provide communications to the continental U.S., Alaska, Hawaii, Puerto Rico and the Virgin Islands. The satellites each have 24-34 MHz transponders capable of relaying all media and data types. They have a programmed lifetime of seven years.

Like Westar and SATCOM, the satellite operates in the 4 and 6 GHz frequency bank, with a transponder output of five watts. The system receiver-transmitter antenna size for the earth stations are 26 feet. Some of the earth stations in the system are owned by AT&T and others by GT&E.

AT&T Services.[35] As noted above, service restrictions have been placed on AT&T. It is licensed to provide message service to public and government private-line service. The system has the capacity to handle 28,800 simultaneous conversations or equivalent digital-data capacity. Each transponder can handle up to 1,500 one-way voice transmissions, 44.7 mbps of data or one TV channel.

Earth Station Locations.[36] AT&T and GT&E have earth stations at Hawley, Pennsylvania; Three Peaks, California; Woodbury, Georgia; Hanover, Illinois; Sunset, Hawaii; and Triunfo Pass and Hanosossa, California.

Future AT&T Satellite Systems.[37] In the future, AT&T plans to own and operate its own satellite system with a spot beam feature that will differ from today's systems. Current satellites provide both area coverage and spot beams. Area coverage signal beams cover large geographical areas; this is illustrated in figure 3 with the large signal footprint covering Canada and the 48 contiguous states. The smaller footprints, which are exemplified by the coverage of Hawaii and Puerto Rico, represent spot beam coverage; the primary advantage of this type of coverage is that it allows several geographical locations to use the same frequencies without interference.

AT&T plans to put a system into operation that will still have the area coverage to serve high-density traffic areas, but hopes to improve on the spot beam concept so that low-traffic areas can be served more economically, and the satellite can be used more efficiently. One hundred spot beam orientations will scan the U.S. 80 times a second, communicating by unique address with earth terminals that are operating in the Time-Division Multiple-Access (TDMA) mode.* If this concept can be put into operation, smaller user terminals will be possible, and satellite channel capacity will be increased by over 300 percent.

AT&T Public Service Offerings.[38] Relative to the original offering, which involved COMSAT and AT&T, the companies did not respond to the FCC public or educational services request per se. They did, however, indicate a willingness to negotiate reduced rates. With the restrictions currently placed on AT&T, opportunities to pursue such services have been limited.

The MARISAT System

The MARISAT satellite system was not among the original offers of services and cannot be considered a domestic satellite system in the usual sense. It came into existence to provide mariners with more reliable means of communication.

MARISAT operations began over the Atlantic in 1976; today satellites also service the Pacific and Indiana Oceans.[39] Figure 4 shows the system footprints and access terminal locations. Satellites are located at latitudes 15°W, 73°E and 176.5°E. It is a commercial venture operated by COMSAT General Corporation, RCA Globcom, Western Union International, and ITT World Com and offers commercial ship/shore voice or teletype communications 24 hours a day, seven days a week.[40] The system provides service to the U.S. Navy and to the world maritime industry.

Commercial Frequencies and Capacity.[41] The maritime industry frequency bands are:

* TDMA permits several stations to share the same frequency band.

Ship-to-shore

Ship-to-satellite	1636.5 - 1645.0 MHz
Ship-to-shore	4195.0 - 4199.0 MHz

Shore-to-ship

Shore-to-satellite	6420.0 - 6420.0 MHz
Satellite-to-ship	1537.0 - 1541.0 MHz

The communications configuration provides for two voice channels and 44* two-way teleprinter (telex) channels. If needed, six more voice channels could be provided, in addition to the current teleprinter and voice channels, as a result of the unexpected amount of prime power generated by the satellite's solar cells. The system's voice channels are normally used for data and facsimile transmission with rates of 1200/2400 bps, although 4800 bps have been transmitted during experimentation. It is possible that 9600 bps could be transmitted.[42]

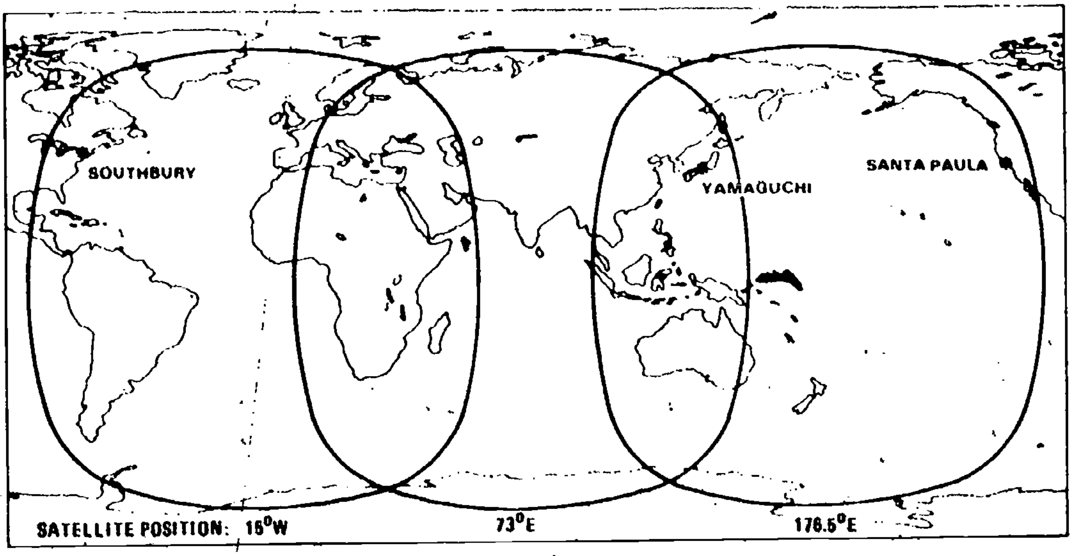

Figure 4. MARISAT coverage.

Earth Station Locations. The satellite and earth station system provide ship and shore communications from the Atlantic, Pacific and Indian Oceans via the MARISAT system. Linkage between the Indian Ocean satellite and the U.S. is made via the earth terminal at Yamaguchi, Japan, which relays the information through the Pacific satellite to the Santa Paula, California, terminal. Information from the Atlantic satellite is received at the Southbury, Connecticut, terminal.[43]

MARISAT Services. Experimental programs have been undertaken by a number of shipping companies to determine the desirability of various types of services. Such efforts have addressed transmitting information and data on payroll, inventory, stores and requisitions, engine room conditions, emergencies, ship rerouting and rescheduling, daily summary reports, weather, simulated time sharing and voyage reports. From these endeavors, operational programs are to evolve; the major one that is anticipated is the Shipping Operations Information System (SOIS).[44]

The SOIS system is the result of a joint effort between the Maritime Adminis-

* Twenty-two teleprinter channels are equivalent to one voice channel; in other words, one voice channel can be divided into twenty-two teletype channels.

tration and the maritime industry. SOIS consists of four components: Cargo Space Documentation (CSD), Intermodal Distribution Coordination (IDC), Fleet Resource Management (FRM), and Maritime Industry Reporting (MIR).[45] The CSD generates the documentation and paperwork that is required for the transport of international cargo; the IDC provides status and utilization reports that are used to monitor cargo handling equipment to make the best use of the equipment worldwide; the FRM provides vessel owners with information needed to allocate their resources more effectively and make more accurate forecasts of sales and profits; and the MIR provides an overall summary of performance, utilization and financial status.

Besides shipping companies, service organizations such as the U.S. Weather Service, Coast Guard and Defense Mapping Agency have worked with ships and owners to provide and receive data and information.[46] Some of the support provided to the ships includes weather forecast information, mariner advisories, port and harbor information, and medical information.[47]

*Service Costs.** Ships are equipped with shipboard satellite terminals (SST) which provide for two-way communication. The SST can be purchased for $62,000 or leased for a two- to five-year period over which the cost can be amortized.[48] The SST interface equipment includes a teleprinter and a telephone. The cost of using the system is $10 per minute for voice with a minimum of three minutes required, and $6 per minute for telex with a one minute minimum.[49]

Possible Training and Education Opportunities. The MARISAT system, while aimed at supporting basic industry operations, could easily be used to provide meaningful and productive training and educational support to ship crews. The system's capability is adequate to handle needed interactive media requirements, and system interface equipment is readily available. Consequently, a training-education support service is technically possible, and such a service is needed.[50]

Satellite Business Systems

Satellite Business Systems (SBS)[51-55] came into existence in December 1975 as a joint venture which involved International Business Machines (IBM), COMSAT General, and Aetna Life and Casualty as partners. SBS is still in its formative stage, but plans to be operational by 1980 or 1981 to provide services exclusively for the large business, industrial and government entities.

SBS differs considerably from the other operational domestic satellite systems. Advertised as the first all-digital satellite, it will have 8-54 MHz transponders with a transponder output power of 20 watts. Figure 5 shows two power coverage areas. In the prime power focus areas noted as Region 1, 16-foot and smaller antennas will be used; 23-foot antennas will be required in Region 2. If launch schedules are met, the satellite will be the first commercial system to operate in the 12 and 14 GHz frequency band. The first SBS satellite is to be located at 110°W and serve the contiguous 48 states. A backup satellite will be in orbit to provide service in case the primary satellite should encounter problems.

The 200 watt power offers some unique possibilities for customer service, since the small 16-foot earth terminal can be placed at the customer's facility, which is

* For up-to-date tariff information, contact Tariff Administrator, MARISAT, 950 L'Enfant Plaza, S.W. Wash., D.C. 20024, or phone (202) 554-6010.

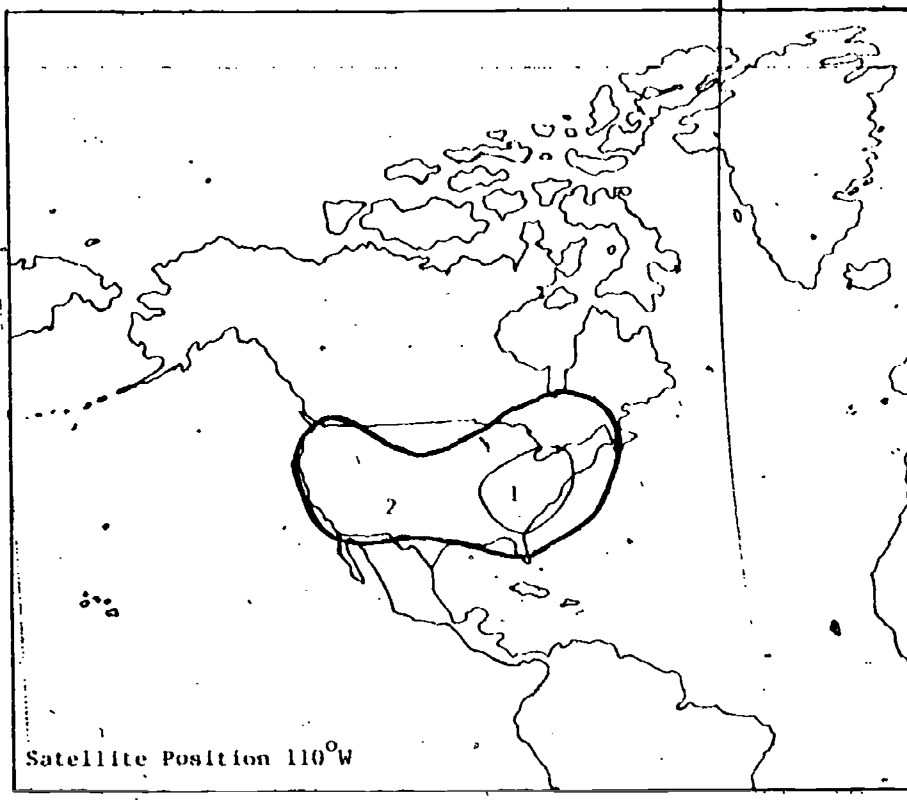

Figure 5. SBS coverage, Regions 1 and 2.

what SBS plans to do. For example, by eliminating the interconnect requirement high volume users will be able to provide complete intra-organizational communications more efficiently and cheaply than by using terrestrial or combination terrestrial-satellite communication systems.

The SBS system will permit geographically dispersed users to combine voice, data and video/image communication into a single, integrated, private-line, switching network.

*The SBS Market and Services.** SBS intends to provide services to industries with high data-transfer requirements between their central computer centers and widely dispersed facilities, as well as to meet high volume multi-media communications requirements. Thus, SBS is concentrating on wooing the top 100 communication capacity users away from rival common carriers.

Each user will be able to establish an integrated network for efficient, effective and protected communications, purchasing a dedicated communications capacity that will be dynamically allocated over the day as demands require. Capacity will be purchased on a block basis, with the minimum capacity somewhere in the neighborhood of 56 kbps.

Users will have a network management facility, so that they will be able to monitor the status and performance of the network, charge traffic priorities or services, and collect usage data for accounting purposes. SBS will also have a management facility to monitor the satellite and earth terminal performance,

*For more specific and up to date information, write Satellite Business Systems, 8003 W. Park Dr., McLean, Va. 22102 or call (703) 827-2000.

distribute a user network efficiently in relation to the capacity of the satellite, support the system's maintenance, and aid users in designing new networks to satisfy increasing or decreasing communications requirements.

For the data communications user, there will be complete digital switching between earth stations, which could affect the placement of computers. There are potential savings in modems* when interfacing directly with other computers; there will be a variety of transmission speeds up to 6.3 mbps. This could be used for relocating total data bases, providing processing backup, or enabling the transfer of work from one computer to another during peak workload times.

Besides the usual communications, SBS also envisages that the communications capacity will be used increasingly for teleconferencing as well as for electronic mail delivery. Because users will manage their own dedicated communications capacity and associated networks, they will be better able to determine what economies and impact can be gained by using them for these services. Nevertheless, since the impact of personal contact on various types of business outcomes is still unknown, it is difficult to estimate how much the network will be used for such activity. The projected SBS technology, however, could make a major contribution to electronic mail delivery by virtue of the available bandwidth and word processing: it will enable a facsimile page to be transmitted in 18 seconds instead of six minutes. SBS also plans to contribute to the mail delivery service through communicating word processors, which is expected to drop the cost of electronic mail below that of today's physical delivery.

System Usage Costs. The rates for the SBS system will be based on a different concept from the current domestic satellite systems. Current satellite usage costs are based on a distance-sensitive concept related to terrestrial communications, where costs increase with the distance the message travels. This is because the cost of building and maintaining cables, microwave towers, and so on (costs associated with carrying the message) increases with distance. This costing concept is not valid with satellite systems except, perhaps, as it relates to the interconnect cities noted in the description of the Westar system.

Since in most cases SBS will be delivering signals directly to the customer's facility through earth terminals physically located at a customer's place of business, distance will play no part in the costs of operation. Rates will be based on the amount of satellite usage and the rental of earth terminals. Currently, these rates have not been established with the FCC.

Educational Applications. SBS itself was not one of the original companies that submitted proposals to the FCC in 1971. SBS is not planning to pursue the education market.

The SBS users will have the opportunity to use the capacity they lease in any fashion they desire, however, and it seems likely they will use it for training and education. Each year business and industry are placing more emphasis on such programs. It is quite possible that communications satellites will be used for comprehensive instructional delivery systems for firms, because the satellites will permit centralized control, plus the distribution of training from a centralized site to widely dispersed field locations. Consequently, business and industry may become the leaders in the use of satellite technology for training and educational purposes.

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*A modem is a combination modulator and demodulator at each end of a telephone line used to convert binary digital information to audio tone signals and vice versa.

Conclusions

While the FCC asked the original proposers of domestic satellites to address the education issue, it finally ruled to wait and see whether satellites were capable of becoming a viable economic component of the domestic communications systems, but did not rule out special agreements that might be negotiated between carriers and education entities. It should be kept in mind that the original offerings of the proposers were solicited under a cloud of uncertainty concerning whether a "closed" or "open" entry* into the marketplace would be approved by the FCC. The uncertainty resulted in rather generous offers by some of the proposers, who perhaps hoped to gain a more favorable position if the closed entry concept was approved.

When the FCC decided not to make educational services a requirement, the proposers chose to address the known communications service markets, and most ignored their original educational offerings. Given the uncertain economic viability of satellites in the communications market, the FCC's decision was proper from a business perspective. Unfortunately, the development of the technology has been influenced by this decision, with the result that low-powered, low-cost satellites have evolved along with large, costly earth terminals, which few users can afford to place on their premises.**

The satellite systems that were envisioned for education would permit small, low-cost, two-way transmission earth terminals to be located at a user's facility, so that multi-media communications could take place among numerous locations. This technology only exists for experimental/demonstration purposes through NASA's ATS-1,3,6 and the NASA-Canadian CTS systems. Chances are slight that such a system will come into operation in the near future, because the demand for such services has not been sufficient to make them appear profitable for carriers. The systems that exist or are planned by the satellite common carriers discussed above are likely to be the only operational systems available to the educational community for the foreseeable future.

Nevertheless, the educational community and others interested in the public service use of satellites may be able to take advantage of the existing systems. Satellite networks are proliferating rapidly with almost 750 earth terminals already in use in the United States and 1,500 expected by 1980. Yet, nearly half the capacity of current systems goes unused. Because of the evolving network and the available capacity, it may be possible to work with those that lease time and equipment, and share the costs. Education and training needs probably can be met by using the systems in off hours, or by purchasing more capacity for a relatively small additional cost, since initial investments in resources already have been made.

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* Simply stated, closed entry meant that one or a limited number of proposers would be able to enter the marketplace, while open entry meant that as many businesses as had resources would be permitted to pursue business.

** The public service demonstrators/experimenters were using 10- and 17-foot antenna systems. The terminals with one receive-only video channel and one two-way audio channel cost $8,635. Commercial systems are just introducing 16-foot antennas that cost roughly seven times that amount. Of course, they are operating with low-powered satellites rather than the ATS-6 type of system.

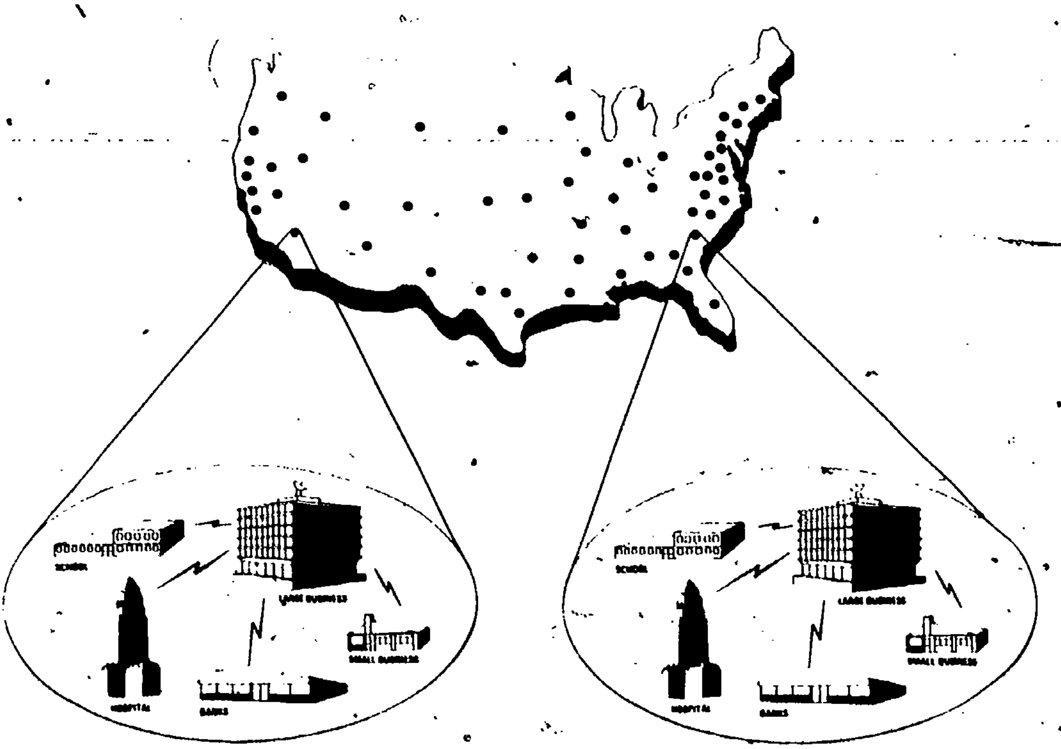

Figure 6. Shared facilities and channels concept.

As illustrated in figure 6, schools, hospitals, banks, small businesses and others located in the vicinity of earth terminals that own or service large business enterprises, CPB, PBS or cable companies, may be able to work with these groups to obtain a sharing arrangement. Considerable information must be gathered, however, before current users can be approached. Information such as what types and amounts of information are to be transmitted or received, the time for transmission and reception, the locations to receive and transmit the information, and the potential budget will be required, plus more, before a fruitful dialogue can begin.

What are the incentives for large businesses and others using communications to share them? One is the sharing of system costs, which can be an attractive prospect, particularly if a commitment has been made for multi-year service. The sharing might also be taken as a tax deduction by corporations. Finally, the full use of existing satellite systems should eventually bring the rates down for all users. Consequently, the sharing concept could be very attractive, particularly if the proper detailed planning is undertaken.

Two problems confront the sharing concept: the owners of a large number of earth terminals, such as PBS,* have receive-only systems, and terrestrial interconnects are required between the terminal and the user. These problems do not seem insurmountable. Adding the two capabilities is a relatively simple task; the cost is another matter, however, particularly that of two-way video, which is extremely expensive. The same applies to the interconnect problem. Nevertheless, if

*Several western states are negotiating with PBS and Western Union for the shared use of the current PBS-Westar network for one-way ETV to various public school systems.

the majority of public service needs can be met with slow scan TV, telex, facsimile, and low data rate transmissions, a relatively inexpensive two-way audio earth terminal capability and audio interconnect line would suffice. If public service users are privy to the FCC's information about planned systems, an agreement may be worked out with the primary users when the initial requirements are being decided.

Nonetheless, as the situation now stands, it is highly probable that the use of communications satellites for education-training purposes will be slow to develop except in major industries. Adding impetus to the growth of the education-training usage will be the concept of shared use of existing or planned non-education-training satellite facilities and channels. This will be the case for public services usage in general. A hard look should be taken at the current Alaskan satellite system, for it is an example of how sharing for public and commercial services can be planned for and operated.

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Bert Cowlan comments:

Polcyn's "Communications Satellites for Education and Training: Past, Present and Future," puzzles me. His history is comprehensive and, to my knowledge, accurate. Where I become unsure is with statements such as: "While rates for special usage can be negotiated with the satellite common carriers, most of them do not offer the technology that would permit widespread use of communications satellites for education and training unless existing systems are shared." The reference is to commercial systems; all available evidence (including the author's own comment about the inadequacy of the commercial technology for education purposes) points to the high cost of such systems, even when shared, as well as to the inappropriate technology, especially if educators feel that interaction is a necessity.

There had been some hope among educators that the system in process of implementation the satellite interconnection of all public radio and television stations—would provide some help in this direction. Let me quote from a recent report that addresses the question directly:

> James T. Ragan, Vice President, Broadcast Services, Western Union [whose WESTAR I satellite is being used for the interconnection system] provided the following statement: "As a result of questions raised . . . concerning the availability of Westar capacity to potential users of the CPB interconnection system, WU and CPB have met to clarify the situation. They are agreed . . . there are currently no known constraints of WESTAR I which will inhibit WU's ability to satisfy user requirements as provided under the terms and conditions of Tariff No. 261."
>
> Philip Rubin, CPB's Director of Engineering Research and Development, does not agree that the situation has been resolved. Because of the contractual relationship existing between CPB and Western Union, precise details of transponder capacity and allocation are, and must remain, proprietary. However, Rubin felt that space would *not* be available. What seems to be at issue here is that Western Union is saying it can provide satellite time to a user *now* [February 1978]; Rubin argues that, since the stations are not fully built, there are not apt to be users wanting space *now* and, by the time the system is fully built and users wish time, there won't be any transponder capacity available.
>
> [Delegates to a series of conferences on this system] were emphatically told, by CPB, PBS and NPR executives, that there will be no spare time on CPB's four transponders; they will be fully utilized from the outset for public broadcasting uses and needs, except, perhaps, for very small segments of time at very odd hours.*

One wonders, then, what commercial system might be appropriate for education/ social service delivery? I also wonder why a government-funded social service satellite system remains unlikely, as the author notes. There is ample precedent for the nonprofit sector being provided with special services (including direct financial aid) and tariffs (the bulk postal rate) by government. Government runs a weather satellite, free to all. It seems to me that an article dedicated to the use of satellites for education ought to advocate a public service satellite telecommunications system, rather than doubt the probability of one ever being achieved.

*A report to the Corporation for Public Broadcasting from the Public Interest Satellite Association. Not available for distribution at this writing.

Regarding Polcyn's statement concerning the Rocky Mountain experiments on the ATS-6, "The project was judged a success by most of its planners and participants," I must point out that considering the great amount of federal funds expended on this project, one would hardly expect those who planned and participated in it – and spent the money – to say otherwise. There might, though, be another view.

Polcyn's comment, in regard to the CTS project, that "while potential social service users have been traversing the path of the high-powered satellite with small, relatively inexpensive earth stations, the operational systems have evolved a different technology," is a pertinent one. One wishes the reason for this had been probed, as it must be rooted in the politics of NASA and the OMB. The hope is, of course, that the present Administration's policy will take into account the need for really inexpensive, small, portable earth terminals and a two-way system for use by educators and those who deliver social services and health care.

In Polcyn's discussion of Westar's services, he writes, "Audio services are available for one-way and two-way point-to-point transmission in a frequency range from 50 to 7500 hertz. . . ." The earlier-mentioned Public Interest Satellite Association report to the CPB included a section in which Western Union audio services (and audio is believed to be extremely effective for most public service uses) were costed out. To quote from that report:

> At the current time, though, Western Union only offers a 24 hour a day, seven day a week audio service, operating at 15 kHz, which is excessive capacity for the user needs [audio-teleconferencing] modeled. There is no occasional service tariff [for audio].

Finally, Polcyn proposes shared use of commercial systems as the best answer for educators. I disagree. There is no reason educators cannot press for policy changes and for the development of a satellite system dedicated to their needs, to the needs of those delivering social services, to the total range of needs of the non-profit sector. This is not to imply it will be an easy battle; involved will be legislation, regulatory agencies and the assignment of international frequency allocations for dedicated spectrum and large-antenna, high-power satellites. Technically, all this can be done. The educational/social service community must want it enough to make the effort.

B.C.