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ABSTRACT

Six experiments in health and education were conducted in rural areas of the continental United States and Alaska during 1974-75, using the National Aeronautics and Space Administration's Applied Technology Satellite-Six. The experimental activities included courses designed for elementary, junior high, high school, and college; continuing professional education; medical consultations and health care support; administrative interaction; and adult enrichment. The study concluded that: (1) systems planning and program content should be based on user needs; (2) effective field personnel require staff support, proper training, and multisource feedback; (3) project objectives, personnel requirements, and interdisciplinary cooperation should be initial considerations; (4) supplementary activities and materials play a significant role; (5) educational effectiveness, target audience, and subject matter are primary program elements; (6) time and money may be larger considerations than anticipated; and (7) interaction between the studio and remote sites needs to be carefully structured and adopted to the specific situation. (NR)

A.I.D. STUDIES IN EDUCATIONAL TECHNOLOGY

A CASE STUDY OF THE ATS-6 HEALTH, EDUCATION AND TELECOMMUNICATIONS PROJECTS

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A CASE STUDY OF THE ATS-6 HEALTH, EDUCATION AND TELECOMMUNICATIONS PROJECTS

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FORWARD

This report presents observations on the U.S. educational and medical service demonstrations which utilized the ATS-6 communications satellite from mid-1974 to mid-1975. After many years of speculation the use of satellite broadcasting for social services had its first major encounter with reality in these projects. The U.S. Agency for International Development commissioned this report to make available some views of this valuable experience to planners in the many developing countries which are considering the use of satellites for development purposes.

The observations by Mr. Cowlan and Mr. Foote were made midway through the life of the demonstrations. Many of the "problems" that were apparent were those of any program of this kind early in its development. Nevertheless, they often illustrate well the complex interplay of administrative mechanisms, technology, and user characteristics with which such satellite applications must cope. To their great credit, the managers and participants in every one of these projects agreed to open themselves to inquiring and critical observation, in order that lessons from their experience would become available to their colleagues elsewhere. We are very grateful for their cooperation.

More formal evaluations will be forthcoming later. The U.S. Department of Health, Education and Welfare, which funded most of the demonstrations, has also designed a series of program evaluations. They will be completed and become available during the next year.

While the present study will point out some significant shortcomings, an overriding fact is that these educational and medical service systems did function. They reached their intended audiences reliably, with a variety of services. The technology, on the whole, served as a dependable way to deliver educational and medical communications and training. The administrative organizations that were set up also operated with reasonable efficiency. Those are substantial achievements for new technologies and new administrative arrangements, in these first trials.

The report points to an area where all large-scale educational activities need continued attention: in the fine-tuning of educational content and method to the needs of diverse groups of learners. We've learned that this must be a continuing process, over time, of producing, testing, and revision; time that these projects did not have. Nevertheless, since satellites necessarily serve large areas and therefore usually diverse populations, operational systems will need to pay priority attention to designing such continuing feedback and adaptation mechanisms into their operations.

The report also illuminates, once again, the need to give serious attention to the complex interaction and organization of learners, programers, producers, managers, engineers, and others who make up such systems. "Systems" planning is not a luxury, for it is only if these satellite services are closely integrated into the fabric of local institutions such as schools, or community centers, or local health service centers that they will be effectively used.

These projects have not illuminated very much the comparative costs, effectiveness, and benefit of satellite-delivered social services, as contrasted with alternative systems. All who examine these experiences need to try to keep separate the satellite delivery aspect from the educational and medical service systems that have used the satellite. Other transmission systems may be more economical for particular places and similar applications --- such as additions to present microwave systems or the promising technology of tethered balloons. Even more importantly, other means of providing educational and medical information and training may prove better, or more economical, for particular populations in particular countries.

Satellite broadcasting does have an intriguing potential, nonetheless, to link remote and rural areas together quickly and perhaps even economically. Satellite technology is moving rapidly on two fronts - first, to lower the cost of television and radio receiving stations, so that communities in rural or sparsely populated areas, or in areas of difficult terrain, can be as economically served as urban centers; second, to provide economical two-way communications, so that those communities can be full partners in a national network. It is understandable, then, that many developing nations are carefully appraising satellite potentials. These first experiences, chronicled in this report, may be useful in weighing these possible payoffs against the complexity of the enterprise.

In these applications of satellite broadcasting, the world is genuinely learning together. In this field, the so called "developing" nations can and will contribute as much to the shared stock of knowledge and experience as will the more technology advanced nations. There will soon be added to these first U.S. experiences the results of India's major village development experiment on ATS-6, during 1975-76, and soon the programs of Canada on the CTS satellite and later, it is expected, the operational programs of Iran, Brazil, Indonesia, and others. It is A.I.D.'s hope that a continuing international sharing of such experiences will help us all to learn how to use these technologies effectively, and economically, as tools of development.

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SUMMARY

This paper reports on an extensive study of experiments in the United States delivering educational and social services via a geostationary video satellite. It describes the space and terrestrial technology involved, the regions in which the experiments took place, and the activities of each experiment. There is an extended discussion of issues raised by the experiences of these video education and health care projects.

The technology of communications satellites can introduce sophisticated telecommunications into rural or into sparsely populated areas more quickly and potentially less expensively than ground-based systems. This potential has aroused considerable interest among planners in areas faced with limited terrestrial communications systems and pressing needs. If a satellite system could successfully and economically be used in areas otherwise underserved, significant social benefits might be achieved.

Six experiments in health and education were conducted in rural areas of the continental United States and Alaska during 1974-1975, using the National Aeronautics and Space Administration's Applied Technology Satellite - Six (ATS-6). The same satellite is being used during 1975-1976 for development programs in India in a project known as SITE.

The satellite has more power on board than previous satellites, and requires only small and relatively inexpensive ground antennas and equipment. The use of low cost ground equipment makes large scale systems more feasible. The satellite signal is focused into a comparatively small area. The target area can be changed easily and accurately by repointing the satellite.

The experiments used one of the ATS-6's video transponders, which provided a color television picture and four accompanying audio channels of excellent quality.

The ground stations for reception-only included a ten-foot diameter dish antenna, associated electronic equipment, and a television set. Some stations in these experiments were

equipped with a satellite radio to permit two-way communication; a very few were equipped to transmit a television picture. The installed cost of a receive-only terminal was between 4,000 and 5,000 U.S. dollars. This figure does not include the equipment for two-way interaction, the costs of running the station, or the costs of materials and staff required for the programming.

The experimental activities included: formal in-school education in grammar school, junior high school, and college settings; continuing professional education; medical consultations and health care delivery support; administrative interactions; and non-formal adult education. All of the projects incorporated some use of two-way interaction, usually through some of the sites talking to the central studio by satellite radio.

Two major conclusions stand out: First, the core technology performed reliably and was the equal of all the demands made on it. Second, the users of the experimental systems accepted the technology, and any dissatisfactions they may have had were generally related to failings in the content or implementation of the system, not in the distribution system itself.

The report discusses a wide variety of issues that came up during the experiments. A few of the more important observations are summarized here:

Hardware

-The technology should serve the project goals, not determine them.

-In planning operational programs, the relationship of the project to the educational and communication systems must be treated as a whole.

-Equipment and system design must be based on an intimate familiarity with the environment and skills of the users. Plan so that routine operations and maintenance can be conducted by unskilled workers.

Field Support

-An educational project almost certainly will require a field staff of on-site workers, to take care of administrative details and/or help teach.

-Field staff need strong organizational support from the project. Good relations between the project's management and the field staff are essential, because the staff's work can strongly influence the success of the programming.

Management

-Management must be based on clearly defined, commonly held objectives for the project. These objectives should be based on locally perceived needs, whenever possible, to ensure acceptance.

-Development of manpower resources for the program must begin well in advance of the implementation.

-Interdisciplinary cooperation is a key to success. To achieve the cooperation, the different skill groups must have shared objectives and probably must be organized as an interdisciplinary team, rather than be segregated by discipline.

-A communication channel for administrative use between the project and the remote sites must be available and its use encouraged.

-Innovative projects must have unwavering high-level support to succeed.

Software

-In educational programs, supplementary activities and materials are important to achieving student learning, maintaining interest, and providing for adaptation to local conditions.

-Production of effective video instructional programming takes more time and money than most planners expect.

-Each instructional program should have concrete objectives. Programs should be tested for effectiveness before they are put on the air, and revised if testing reveals that they do not meet their objectives.

-Primacy must be given to educational considerations. The use of color and slick production techniques, and attempts to copy formats from other contexts are cases in which priorities frequently become reversed.

-Live two-way interaction between the studio and the remote sites can, under some conditions, increase student interest and learning. But inappropriate uses can decrease acceptance and attention.

Finally, the report contains some discussion of general issues and considerations for the future. Implementation of a large scale, satellite-based educational system can function as a catalyst for the introduction of other reforms. Hybrid systems using both space and terrestrial communication links, are discussed. Other technological and cost issues are considered.

INTRODUCTION

"There is no longer any need to argue that the communications satellite is ultimately going to have a profound effect upon society; the events of the last ten years have established this beyond question. Nevertheless, it is possible that even now we have only the faintest understanding of its ultimate impact upon our world. There are those who have argued that communications satellites...represent only an extension of existing communications devices, and that society can absorb them without too great an upheaval." (1)

Arthur C. Clarke

"With the advent of the communications satellite, the term 'international communications' has suddenly taken on a series of connotations that have introduced to the world a new set of problems of vast complexity and grave consequences. Again we find ourselves dealing with a situation, so common in modern times, wherein technology has outrun man's true understanding of its potential, often potentially disastrous, effects on a society." (2)

Dr. Carroll V. Newsom.

The quotations are selected to illustrate the differences of opinion that prevail among those concerned with satellite developments.

Communications satellites are a clear fact of international life in the Intelsat and Intersputnik systems. Weather and earth resources satellites are well known. Brazil, Canada, India, Indonesia, Iran, Japan and other countries already have, are planning for, or are shortly to launch satellites that may be used, in part, for educational and developmental programs.

A great deal of time, energy and money has been spent in developing the technology. Yet few resources have been expended investigating ways to use this technology to promote national development through education and social service delivery. In order to learn about such matters, the United States implemented several experiments in delivery of education and health care by satellite. This report describes some of the lessons learned in those experiments. It is intended for planners and policy-makers concerned with educational and social issues, and it focuses primarily on issues of organization, production, and administration of educational and social service projects involving satellites.

Background to the Study

This study is commissioned by the Educational Technology Group of the Bureau for Technical Assistance/Office of Education and Human Resources (TAB/EHR) of the U.S. Agency for International Development (A.I.D.). In some ways, it is intended as a follow-on to an earlier A.I.D. study, "Broadcast Satellites for Educational Development: The Experiments in Brazil, India and the United States." (3) That study was completed before any of the projects were operational. It attempted to raise issues pertinent to the needs of less-developed country planners, but was limited by the fact that it was written about projects still untested. Certain key issues raised in it will be developed further in the following pages.

The A.I.D. Role

Even before the programs were operational, it was apparent that many nations wished information about the U.S. projects. In order to help meet this need, the Educational Technology Group of TAB/EHR organized in May, 1974, an international working-level conference in Denver, Colorado, site of the headquarters of the Rocky Mountain Satellite Technology Demonstration. The Conference was hosted by the Federation of Rocky Mountain States, a parent organization to the satellite project, and the project itself.

A.I.D.'s interest in such a conference stemmed, in part, from its previous involvement with a series of satellite case studies. Those studies revealed that many of the projects shared common problems, and that there were needs for information exchange and an experimenter network. This is consonant with A.I.D.'s overall directive set forth in Section 220 of the Foreign Assistance Act of 1970: to initiate a wide array of activities aimed at aiding the developing countries in using communications technologies for projects in education, agriculture, health, and community development that strive to increase social equity and accelerate rural development. (For a description of the Conference and its results, see Appendix A.)

The Perspective of the Study

We decided that the most appropriate perspective for the study would be to take several points of view, including that of the users. We also decided _not_ to try to evaluate the success or failure of any of the projects.

Evaluations and other studies of the projects' implications have been commissioned.

Our task would be to look at the projects and talk to the people involved, and to relate what we saw and how the project personnel and the users felt about the projects. Our main objective was to indicate to less-developed countries what useful lessons might be extracted from these projects. Our judgments are, of course, subjective; they are, however, grounded in our experience working in and with LDCs.

People at all levels spoke frankly and were more than willing to share their experiences, good and bad, for the benefit of other countries. We ~~have~~ carefully cross-checked our observations against the information of others familiar with the projects, and we believe that our perceptions are representative of how the projects are working. However, the projects are complex and changing, and it is possible that our report will contain some inaccuracies. The responsibility for any errors in the report must remain with the authors, and not with the people who have contributed to our research.

Methodology and Structure

What we viewed was not the entire range of projects on the Applications Technology Satellite - Six (ATS-6) (4); we studied only the Health, Education and Telecommunications (HET) demonstrations, which are a small portion of the ATS-6 program. (See Appendix E for a table showing the entire range of experiments.)

We were quite familiar with several of the projects before we began the research for this report. We knew and were known to much of the management throughout the system. We followed the recommendations of project management on what sites to visit. We do not feel, however, that this appreciably skewed the basic findings. The cross-checking was extensive.

The approach to gathering information was not highly formalized. In all cases involving programs beamed to children, we viewed them with children. Teacher programs, at least on a representative sample basis, were viewed with teachers and administrators. In several cases we watched video tapes of additional programs so that our view would not be prejudiced by having seen only a single program.

Throughout the system, we saw and talked with people working with and using it. We talked with children, teachers, parents, administrators, school board members, site coordinators, project and component managers and department heads, federal officials, interested academic and other observers and with many who are professionally concerned with evaluating the projects. Before, during and after the active phase of research, we maintained contact with people whose knowledge is of the areas served, rather than of the projects themselves. Some of these are at area universities, some at foundations. All respondents were promised confidentiality. (A list of those we talked to is attached as Appendix B.)

A number of remote sites, some of which were extremely inaccessible, were visited. (See Appendix C for site lists; sites visited are starred.)

Our deepest thanks are due to all of those who gave so generously of their time, energy, thought, files and hospitality.

The remainder of this report will describe the satellite and its associated ground equipment, the HET demonstrations themselves, and the findings that we feel are of interest to those considering an involvement with satellite technology.

The Technology

The Applications Technology Satellite-Six is the sixth in a series of experimental satellites designed to carry out technological, meteorological, scientific and communications research. The National Aeronautics and Space Administration (NASA) began the development of this series in the 1960s, launching the first one in December of 1966. Since 1966, the technology has progressed dramatically in terms of on-board power and the ability to direct a highly-focused signal. The ATS-6 is the most sophisticated and powerful satellite in the entire series.

The ATS-6 Satellite

The essential difference between the ATS-6 and previous satellites is its capacity to broadcast to small, relatively low-cost ground antennas and receivers. The use of small ground stations offers the potential for radical changes in the way communications satellites may be employed for health care, education, or other social service delivery or for personal communications.

Each of the two video transponders on the satellite can transmit a video image plus four simultaneous audio channels. Receivers must be equipped with a switch allowing them to select a particular audio channel; once this is done, the viewers of a program may choose among, for example, four different languages which might accompany the video picture. (Additional information about the technological objectives and specifications appears as Appendix D.)

The ATS-6 was lifted into space on May 30th, 1974, at 9:00 AM by a Titan IIIC rocket and six and one-half hours later achieved its final stationary orbit. Twenty-five minutes after that, it deployed its 30-foot dacron mesh antenna. The satellite is positioned 22,300 miles (35,680 kilometers) above the Equator at 94° West longitude (west of Ecuador and above the Galapagos Islands.) It orbits the earth every 24 hours in the same direction as the earth's rotation; thus it always appears to be stationed in one spot in relation to the earth.

The Ground Stations

The unique feature of the ATS-6 programs is their use of a small, relatively inexpensive ground station for reception and transmission. The low cost of the required station makes the installation of many such stations economically feasible. The earliest plans for these ground stations in the ATS-6 experiments called for a terminal that could both receive and transmit in the 2.5 GHz range. However, it proved impossible for most of the sites to obtain permission to transmit in that frequency because of possible interference with other users; they could, however, receive in that frequency.

In order to enable the remote stations to transmit, a compromise solution was adopted. This was to use the audio transponders on two earlier satellites of the ATS series to provide a talkback link from remote sites. The two earlier satellites (ATS-1 and ATS-3) have substantially poorer signal quality than ATS-6 and require a separate antenna, but the compromise did permit the experiments to retain the two-way capability.

There are three basic categories of remote stations. (See Figure 1 on page following.) They are "receive-only terminals" (ROT), "intensive terminals" (IT), and "comprehensive terminals" (CT). The ROT is the basic unit; it can receive color video signals and associated audio channels, but it cannot transmit. The required equipment consists of a 10-foot diameter parabolic antenna, a preamplifier mounted on the antenna, an indoor amplifier/

FIGURE 1

RECEIVE ONLY TERMINAL (ROT)

1. Receives color video)
2. Receives audio)

CANNOT TRANSMIT

A. 10-foot diameter parabolic antenna
B. Pre-amplifier mounted on the antenna
C. Indoor amplifier/converter unit
D. Conventional television set

INTENSIVE TERMINAL (IT)

1. Receives color video)
2. Receives audio)

TRANSMITS AUDIO

A. 10-foot diameter parabolic antenna
B. Pre-amplifier mounted on the antenna
C. Indoor amplifier/converter unit
D. Conventional television set

a. Very high frequency radio*
b. Separate helical antenna (for radio)
c. Small indoor transceiver

COMPREHENSIVE TERMINAL

1. Receives color video)
2. Receives audio)

TRANSMITS AUDIO AND VIDEO

A. 10-foot diameter parabolic antenna
B. Pre-amplifier mounted on the antenna
C. Indoor amplifier/converter unit
D. Conventional television set

a. Very high frequency radio
b. Separate helical antenna (for radio)
c. Small indoor transceiver

1) Second 10-foot antenna (video)
2) Video signal transmitting equipment
3) Camera
4) Lights
5) Other studio equipment

NOTE: Many sites are also equipped with video tape recorders.

* Operates over the ATS-1 and ATS-3 satellites.

converter unit, and a conventional television set. Many of the ROTs also have a videotape recorder for recording the incoming program, but this is not a required piece of equipment.

The second level of installation is the intensive terminal, which can transmit an audio signal as well as receive video and audio. It consists of the equipment required for an ROT plus a simplex, or push-to-talk Very High Frequency (VHF) radio, similar to those used by aircraft pilots, but operating over the ATS-1 or ATS-3 satellites. The radio requires a separate helical antenna and a small indoor transceiver. Only one site at a time can use the ATS-1 or ATS-3 satellites, so each site must wait until the channel is clear before transmitting. And, the people to whom the transmission is beamed must wait for the sender to finish speaking before responding.

Comprehensive terminals can both receive and transmit audio and video. These are being used only in the Alaska Indian Health Service and WAMI (Washington-Alaska-Montana-Idaho) experiments. In addition to the equipment used at an intensive site, comprehensive sites have a second ten-foot antenna and associated electronics for transmitting the video signal, plus a camera, lights, and other studio equipment.

Control of the satellite and transmission of most of the programs is accomplished through a 30-foot diameter earth station antenna. The main Network Control Center is located near Denver, Colorado, and NASA has two similar stations in Rosman, North Carolina and Mojave, California.

THE HEALTH, EDUCATION AND TELECOMMUNICATIONS DEMONSTRATIONS

Introduction

A broad range of education and health-related activities are being tried out on ATS-6 during its year of availability in the United States. These are being undertaken in three main regions - in the Rocky Mountain area, in the Appalachian States, and in Alaska.

Within each region, a number of different programs are being conducted, usually by more than one organization. Six organizations are chiefly responsible for the satellite demonstration projects, half of which are agencies of the federal or state government. The remaining three are non-governmental regional organizations. The projects operate quite independently of each other, except in the case of hardware procurement. Subsequent sections will describe the regions and the activities of each project.

The HET demonstrations were a late addition to the ATS-6. (5) They were not formally approved and committed until September or October of 1971. The planning for some of them started well after the final satellite fabrication and launch contract had been signed by NASA and the manufacturer. Transponders to suit the projects' needs were "squeezed in" to available space. The shortage of planning time was a source of problems for the projects.

During the 1971-1974 time period, there were several shifts among the federal agencies that were most actively concerned with the projects. At various times, the projects were dealing with: the Office of Telecommunications Policy of the Department of Health, Education and Welfare; the National Center for Educational Technology in the U.S. Office of Education; and the National Institute of Education. These shifts affected the continuity of project planning and funding.

The individual projects had few linkages to each other, either formally or informally. Some were managed by existing educational organizations; some by organizations that had been in existence for other purposes; some by entities created especially for the project.

The National Institute of Education, which funded the educational (as opposed to medical) experiments, defines its goals as follows:

-To evaluate the feasibility of a satellite-based distribution system for providing needed educational services to isolated rural populations;

-To test and evaluate, using a variety of instructional materials, the degree to which the intended audiences accept the service, and determine the costs of various ways to deliver those services; and

-To determine the most effective organizational arrangements for developing and using complex technologies in education. (6)

Geography and Demography

Since many readers will be unfamiliar with the specific areas of the United States in which the demonstrations are taking place, some "setting of the scene" is in order. (See maps and "footprints", Appendix F.)

The regions were chosen because they represent a mix of isolated rural areas, deficient in the delivery of educational and social services and possessed of inadequate communications facilities. By U.S. standards, they were deficient, but LDC standards are different from U.S. standards.

Virtually all of the remote sites outside of Alaska have several important things in common. All can be reached by relatively good roads and highways. All have telephone communications. All have reasonably good postal services. All have radio and television signals available to them, although, in most cases, these do not serve educational and developmental needs.

Any of the problems encountered by these projects are apt to be compounded where the transportation and communications systems are under-developed.

LDCs also often lack an acclimatization to various levels of technology. Generally, even in the smallest and most isolated of American communities there are people who know how to fix things: radios, television sets, automobiles, generators, snowmobiles. Electrical power (even if generator-provided) is available, as is fuel (even if flown in). There are well-trained doctors and teachers available, although in many places there are too few and they may be a long distance away. But, where there is this distance, except in Alaska, there are telephones, there are ambulances, there are ways.

Even in isolated areas we saw schools (and this is true of Alaska, as well) equipped with audio/visual projection equipment and video tape casette machines. Conditions like these constitute the ambience in which the demonstrations took place.

Alaska

Alaska is an enormous state - it encompasses four time zones. Of its 265 villages, towns and cities, two-thirds have no access to railroads or highways. Transportation there is by air or sea, or on land by snowmobile or occasionally a dog team. These communities also lack the kinds of sophisticated communications which characterize the rest of the United States. More than 100 communities are reported to have no communications at all, except for short wave radio. The total population of the state is estimated at about 350,000, of whom 30,000 live in the vicinity of Fairbanks and 100,000 within a thirty to fifty mile circle of Anchorage. Seventy-five percent of Alaska's civilian population (excepting the North Slope, where the oil fields are being developed) live on 10.6% of the land mass. Twenty-five percent live in areas classified as "remote rural."

Alaska's small villages are populated by Eskimos, Indians or Aleuts; in these Native villages life can be very different from the patterns of communities in other American states. Villagers often rely, in some measure, upon fishing, hunting, and food-gathering for subsistence. Incomes are generally supplemented by seasonal employment or public assistance. Year-round jobs are scarce and when they exist, are apt to be held by non-Natives. Incomes are very low; the cost of living is high and rising steadily.

Appalachia

The Appalachian Region, which runs from southern New York to Mississippi, encompasses 13 states and some of the poorest counties in the United States. There are many rural, isolated communities where the terrain hampers transportation and communications. Although excellent interstate highways run throughout the area, local transportation has long been a source of discontent. The area has many one-room school houses. Extremes of weather aggravate the transportation problem and keep many children away from school. Often children do not have enough to eat or warm enough clothing to wear to school.

Appalachia tends to be culturally and ethnically homogeneous, although there are still considerable differences in life style between the Appalachians of the southern part of New York State and those who live in the northern part of Mississippi.

Rocky Mountain Region

Because of the size of the satellite's "footprint", the experiment includes Nevada and Arizona, as well as the states considered to be in the Rocky Mountains. The total area of the eight states is more than 860,000 square miles, one-fourth of the total area of the United States. (This area is larger than Central Europe.) The population of 8,250,000, however, represents only four percent of the national total. Density per square mile is 9.7 people, compared with 953.1 in the State of New Jersey.

The area is one of contrasts. It has some of the highest mountain areas in the United States, and some of the deepest valleys. It has semi-arid plains and sweltering deserts. Ethnically, it has sub-cultures of Native American Indians, Spanish-Americans, Mexican-Americans, Basques, Orientals, and Blacks.

Industry is diversified, communications and roads are generally excellent to good, despite the fact that there are pockets of rural isolation and poverty.

The ethnic and cultural diversity, though, may be more comparable to the less-developed country situation than would be the case in Appalachia and Alaska, although the latter comes close in terms of linguistic diversity and some inter-ethnic hostilities.

About 30% of the nation's Indian population lives in the Rocky Mountain Region, most of them on 70 reservations representing more than 30 tribes and occupying 38 million acres of land. The region also contains about 30% of all Mexican-Americans in the United States.

Blacks are the smallest in number of the major ethnic groups in the region, ranging from 0.3 percent of the population in Idaho and Montana to six percent in Nevada.

Communications Demography

There is, throughout these areas, a high level of familiarity with technology and ability to maintain it.

"When the project was first being planned, it was believed that there were communities with no access to television, either commercial or educational. Examination in depth failed to find communities that did not have some television signal, although choices were extremely limited." (7) Radio and television and ancillary devices, as earlier noted, are almost omni-present, a situation to be found in few, if any, LDCs. National average television penetration is 96% (64 million of 67 million American households have television), although Alaska is excluded from that percentage. Television penetration in the Rocky Mountain Region is much lower than the national average; it sinks as low as 60% in some counties.

As of January 1972, the United States had 125,142,000 telephones, or 60.13 per hundred persons out of a total of 291,329,000 in the world. (This represents about 42% of the telephones in the world.) These are to be found in rural, isolated communities in Appalachia and in the Rocky Mountain area, a distribution unlikely to prevail in the less-developed countries. Contrast the statistics for India and Brazil, nations that are also contemplating the use of satellites for education and development: India has 1,351,200 telephones, or 0.25 per 100 persons; Brazil, 2,064,950, or 2.12 per 100 persons; these are primarily located in urban areas. (8)

Rocky Mountain Educational Project

The demonstration in the Rocky Mountain States is being done by the Federation of Rocky Mountain States (FRMS), headquartered in Denver, Colorado. The Federation's goal is to promote the orderly development of the region and to attempt to solve regional problems by involving the states, the federal government and the private sector in cooperative efforts. The Federation includes the states of Colorado, Idaho, Montana, New Mexico, Utah and Wyoming. Arizona and Nevada are participating in the Satellite Technology Demonstration, although they are not members of the FRMS.

The FRMS project is called the Satellite Technology Demonstration (STD). It consists of several components, implemented by a core staff in Denver, Colorado and by field staff at each site, with an intermediate staff level in each state.

The target audience varies for each series, but all employ the same reception equipment. A total of 68 receiving stations have been established, 56 of which are in rural schools. Of the school-based terminals, 24, or three in each state, have two-way audio communication capabilities. These are termed "intensive terminals" (ITs), in contrast to the other "receive-only terminals" (ROTs). An audio return link is carried out over the ATS-3, an older satellite in the Application Technology Satellite series, which has much lower signal quality than does the ATS-6. (Site list: Appendix C)

The remaining 12 terminals are installed at public television stations in the region, so that the STD programs can be rebroadcast to a much broader audience than that involved in the demonstration. The rebroadcasts can be received on conventional television receivers in private homes.

The STD is the largest of the demonstrations being carried out over the ATS-6. It consists of four distinct activities: "Time Out," a career education series directed at a Junior High School audience; "Careers in the Classroom," an in-service training program for teachers; "Materials Distribution Service," a program which transmits supplementary educational materials, and "Footprints," a series of programs for adults.

"Time Out"

The "Time Out" series on career education is the "backbone" of the STD.

Career education is a relatively new subject and has obvious economic utility. It is a major emphasis area at the U.S. Office of Education. "Time Out" is a one-semester course directed at Junior High School students in the seventh to ninth grades. In the United States, these students fall into the 12, 13 and 14-year-old age group.(9) The broadcasts are daily, 29 minutes in length, and are followed by six minutes of "live" interaction for the intensive sites. The curriculum has been developed and produced for the STD.

The objectives of the course fall into three main areas: (one) "self-assessment," or helping the student accurately assess his own needs, aptitudes, interests and skills; (two) "career exploration," or introducing the student to the broad spectrum of career options; and (three) "decision-making" or helping the student develop skills required for making meaningful decisions.

The content is presented in a "magazine format"; a series of short, independent segments are strung together to form a show. Each segment presents, in humorous or dramatic format, a portion of the day's content. They are bridged together through the use of a science-fiction format that permits rapid "jumps" through time and space. The programs are developed through a team approach in which an educator, two writers and a television director work together from the conceptualization of a program to its final production. Two such teams, overseen by an executive producer, have produced the eighty-one programs in the "Time Out" series.

The 29-minute length was chosen so that programs could be rebroadcast by public television in a standard 30-minute program time period.

During the broadcast of the taped segments there is no interaction with the students, nor are students prompted to make active responses. For six minutes after the end of the taped broadcast, two studio instructors come on "live". (For the non-broadcasters among our readers, "live" refers to broadcasts which are not pre-recorded.) They briefly summarize the day's content and ask for questions from three specific intensive sites. The first site chosen to respond on a given day transmits questions or comments over the ATS-3's audio channel, and the message is relayed from Denver's control center to all of the sites. The two studio teachers, aided by off-camera resource persons, respond to the first site's questions and then take questions from the next site. Three sites can usually be polled in this way, but the six-minute limit for this interactive portion of the program precludes any lengthy exchanges.

The interaction was originally intended to be carried out via ATS-6's audio channels. The compromise solution of using the ATS-3 satellite is not as convenient as ATS-6 would have been.

When the studio teachers announce which sites they will be contacting on that day, the local teacher usually selects a volunteer from the class to ask a question over satellite radio. There is no opportunity for the class to discuss program content or "pool" their questions; the interaction follows immediately after the taped portion. Sites not chosen for that day's interaction have no opportunity to ask questions. Each Friday's broadcast is devoted solely to interaction and review of the previous four day's programs. Most of the sites have the opportunity to interact if they wish during the Friday sessions.

There is a substantial "support" effort for this series. Teachers receive a teachers' guide, containing lesson outlines and suggested activities. Students receive monthly program schedules that provide capsule descriptions of each day's programs and contain games and puzzles related to the program. Administrative support is provided through a local "Site Coordinator," who is, in many sites, a person who works part-time as Site Coordinator and part-time in some other capacity within the school. The local Site Coordinators report to State Coordinators who, in turn, report to the Utilization/Field Services component of the STD. Each State Coordinator has a close relationship with his State's Department of Education.

An internal research group is conducting an extensive program of testing and surveying. After each day's broadcast, students fill out "ratings" of the programming on mark-sense cards and send them to Denver. Pre- and post-tests on program content and other matters assess student progress and attitudes. This information is used for formative evaluation to guide changes in the STD while it is going on.

"Careers in the Classroom"

This is an in-service training series aimed at classroom teachers and school administrators. It is broadcast every other week; 16 programs are spread out over 32 weeks. The content concerns the introduction of career education concepts into the curriculum. The goal of the course is to make teachers knowledgeable about career education and to enable them to assist their students as they face career-related decisions.

The format is a live lecture from an authority in the field for 20 to 30 minutes, followed by approximately a half-hour of interaction with the teachers at the intensive sites. One program is devoted entirely to interaction. Each program is rebroadcast on another day to accommodate scheduling problems. College credit is offered through a variety of institutions. Because the teachers often must take continuing education courses to retain their certification, the availability of such credit is a strong motivation for participation. A small pamphlet containing the outline of the lecture and biographical information about the lecturer is supplied prior to each class.

Materials Distribution Service

Commercial educational films on a wide variety of topics are distributed via the satellite for videotaping and later use by the schools. Approximately 400 films are available and are listed in a catalog. Teachers at STD sites express their preferences on mail-in order forms and the "most requested" films are transmitted. Each site has the option of recording two hours per week of materials; all sites can receive the transmitted programs.

These films come from two organizations which normally distribute educational films by mail. The Great Plains National Instructional Television Library was paid about $14,000 for 100 programs, varying in length from 15 to 45 minutes. In addition, two hundred copies of a teacher's guide were provided for each program. This fee, which was paid by the STD, covers one school year's use of the material.

The Encyclopedia Britannica Educational Corporation also leased films to the STD. Three hundred films, with a catalog list price of about $61,000 were leased, for one school year, for 15% of that purchase figure, about $9000. In addition, a licensing fee was charged for casette machines at each site; this came to about an additional $5000. If the sites wish to keep these films and use them beyond the end of the demonstration project, they may enter into a separate agreement with the owner for 30% of the original catalog price.

"Footprints"

This evening series is directed to the adult community. It is concerned with topics of interest to the rural communities, such as mail fraud, strip mining, and agribusiness. There are ten 50-minute programs in the series; eight of them present information on the evening's topic, and are followed by interaction. One of the programs is entirely interactive and the remaining program has no interaction at all.

Appalachian Education Satellite Project

The Appalachian Regional Commission (ARC) is a federal-state agency that has been in existence since 1965. Its goals are to focus professional expertise and federal monies to find solutions to regional problems and to promote overall development of the region. One of its projects is the ATS-6 demonstration, called the Appalachian Education Satellite Project (AESP). The ARC works through existing institutions known as Regional Education Service Agencies (RESAs) at the local level. The RESAs usually function as educational cooperatives among school districts. For the AESP project, they also coordinate project-related activities at the local level, arrange for local universities to grant college credit to teachers taking the AESP courses, help staff a Project Advisory Council and assist ARC in a number of ways.

There are a total of 15 sites participating in the AESP. They are arranged in five clusters of three sites each. Each cluster falls under the jurisdiction of one RESA. All three sites in each cluster can receive the satellite broadcasts; only one of them, however, can transmit. The two receive-only sites interact directly with the instructor on television through the third site, to which they are connected by telephone. The transmitting site can transmit voice and teletype (not video) to the main studio. Figure 2 presents a diagram of these relationships. (See Appendix C for site list.)

The AESP offers several courses in in-service training for teachers, one on basic elementary reading instruction and the other on career education instruction.

Continuing professional education for teachers is a need that is hard to meet in Appalachia because it is difficult to travel to where courses are given. The choice of career education as a subject has already been explained in the description of the STD. Elementary reading was chosen because reading has long been a problem in the area.

The courses consist of weekly TV broadcasts, classroom activities with an on-site coordinator in charge, and out-of-class assignments. Teachers and school administrators taking the courses receive a packet of instructional materials for the course. In addition, there is a small library of professional materials available at each site. The courses are 16 lessons long. There is an opportunity for interaction either at the end of each day's lesson or during occasional "seminars" that are devoted solely to interaction.

Interaction is accomplished, for the most part, through a hybrid teletype system. Receive-only sites send their questions over teletype via lines to the transmitting sites in their cluster. Non-redundant questions are sent from that site to the broadcasting studio as teletype messages over the ATS-3 satellite. Some questions, usually about topics covered previously, are sent in advance of the program; some are sent during it. A person in the studio receives all the sites' questions, filters out duplicate questions, arranges them roughly by order of importance, and gives them to the television instructor.

The instructor reads the question on the air, names the source(s) and answers it. This system circumvents the problem of long silences (or "dead air") while individual sites get ready to respond, and seems to work fairly smoothly. The interaction link is also used by teachers to submit requests for information which is then obtained by either a manual or a computer search. This service, although somewhat cumbersome, is free to the enrolled teachers. There are infrequent instances where questions

FIGURE TWO

REGIONAL EDUCATIONAL SERVICE AGENCY (RESA)*

A. Coordinates project-related activities

B. Arranges local college credits for teachers taking courses

C. Helps staff Project Advisory Council

SITE ONE

Has jurisdiction over Site Two and Site Three

a. Receives from studio via ATS-6
b. Receives telephone communications from Sites 2 and 3
c. Transmits to studio via voice and teletype (over ATS-3)

Site Two

a. Receives from studio via ATS-6
b. Transmits to Site 1 via teletype (over telephone lines)

Site Three

a. Receives from studio via ATS-6
b. Transmits to Site 2 via telephone (over telephone lines)

* The pattern is repeated throughout fifteen sites which are broken into five clusters of three sites each. One site always has jurisdiction over the other two and all communicate as above.

are transmitted by voice, rather than by teletype. The voice communication capability seems to be more important for administrative communications.

There are approximately 20-25 students per class at each of the fifteen sites. Most of the students are taking this course for graduate-level college credit. Gaining credits required for re-certification may be a major motive for participating in the program. The tuition charges are either waived, or reduced to a nominal amount during this demonstration period. The AESP sites are generally closer to the students than colleges offering comparable courses.

The format for the television lesson is straightforward instruction. The instructor lectures and uses film clips of Appalachian teachers using the technique he is describing, other visual aids, and panels of experts to present the content.

Following most of the lessons, there is a 15-minute preprogrammed audio review that makes unique use of the four audio channels that accompany the video picture. The participants each have a four-button "response pad" that actually selects the audio channel that they hear on a set of earphones. All the channels carry the same review material and multiple-choice questions. The students hear identical material until they push the button corresponding to their choice of answer to a multiple-choice question. They then hear, on the selected audio track, a description of the factors they should have considered in making their choice. Each answer choice has a different description that is appropriate to that particular answer. The student hears the one most appropriate to his choice and then the common text resumes.

There is a site coordinator at every site, plus a faculty consultant for every group of three sites. The site coordinator handles all the technical and administrative details, while the faculty consultant advises students and assists in evaluating their progress. There may be another staff member, helping to handle the teletype communications at the transmitting site.

All of the programming was produced by the production center at the University of Kentucky, Lexington. While not employing a formal "course team" approach, the production effort was characterized by close communication and cooperation between the educators and the producers. Some of the programming is now being distributed over terrestrial educational stations on a for-credit basis.

An internal evaluation group is performing studies of teaching effectiveness and of attitudes towards various presentation formats. The evaluation consists of pre- and post-course measures of learning, attitudinal ratings immediately following each broadcast, and some pilot testing of programming. Educational needs assessment data from a study conducted in Appalachia shortly before the satellite demonstration was available to the AESP during its planning.

Appalachian Region Veterans' Administration Hospital Project

The Veterans' Administration maintains a nationwide system of hospitals to serve eligible veterans of the U.S. Armed Forces. Ten of its hospitals, each located in the Appalachian region, are participating in a series of different experiments exploring the delivery of medical services and education via satellite. Five different uses are being investigated; the satellite is available approximately two and one-half hours per week. The Veterans' Administration (VA) has contracted with the Foundation for Applied Communication Technology (FACT) to handle administration and coordination of the experiments, as well as to design, produce and distribute the experimental programming.

A needs assessment in the participating VA hospitals resulted in a long list of topics named as the areas of greatest interest or need. Following the selection of the topics, specific objectives and faculty coordinators were chosen for each program. The programs fall into five different formats: (a) video seminars, (b) out-patient clinics, (c) Grand Rounds, (d) teleconsultations, and (e) computer-assisted instruction.

Video seminars constitute the bulk of the experiment. The audiences are physicians, or nurses or other health professionals. Approximately 20-30 minutes of each program is devoted to a pre-taped presentation on the issue of the day, following which the lecturer answers questions from the audience for half an hour. Attendance at the seminars is voluntary; there is no formal registration or credit structure. Some learning measures are taken for the evaluation of the program, but individual achievement is not being assessed. Each video seminar is an independent program, not part of a cumulative curriculum. Each is usually accompanied by a short booklet summarizing the content of the session and providing background material.

Out-Patient Clinics are very similar in format to the Video Seminars, except that the intended audience is out-patients and their families and the goal is to provide patient education.

Grand Rounds includes live presentations of patients or of case histories, originating from the studio, rather than from the remote hospitals. Following the presentation, the two-way audio capability is used for discussion and for questions and answers. The audience includes physicians, nurses and other health professionals.

Teleconsultations are basically the same as Grand Rounds, except that they "originate" in a remote hospital. The hospitals cannot transmit live video, but they sometimes mail a videotape for the studio to broadcast at the beginning of the consultation; during the consultation they use "slow-scan" video ("still" video pictures transmitted over an audio channel, such as a telephone, which take about one minute to fill the screen). In this way, they can present X-Rays, electrocardiograms, case histories and other pertinent data about a patient. All the hospitals are able to receive the slow-scan after it is rebroadcast by the studio. Experiments are being conducted with both black-and-white and color slow-scan. The remote hospitals tend to present cases they think are interesting, rather than cases in which they want a consultant's advice. Thus, the "teleconsultation" portion of the experiment might more properly be called "Remote Grand Rounds".

Two computer-related experiments are being conducted. One is a computer program that includes a patient's "work-up" (history taking), a simulated diagnosis of electrocardiagrams, a simulated diagnosis and treatment of an emergency patient, and a probability game involving diagnosis of a patient with a history of certain persistent symptoms. The other computer experiment is a nursing course using CAI.

A thorough summative evaluation is being conducted. Feedback for formative use is collected through informal telephone surveys of participating hospitals.

Alaska Indian Health Service Project

The Indian Health Service (IHS) project in Alaska is the only one to focus exclusively on health care delivery. Because the task differs from the educational projects, the organization and procedures followed are somewhat different.

Teleconsultation

The Tanana Service Unit, a large administrative unit in Central Alaska, has for several years participated in a radio satellite health care experiment. Daily communication between local health aides and an Indian Health Service doctor has been established using ATS-1. The health aides, usually natives, are selected by their communities and receive a few months training. They return to their villages, equipped with a manual and a drug kit, to provide what are usually the only health services available. These health aides discuss their patients with the doctor at a specified time each day on the satellite radio. They can make emergency calls at any time, if they must have immediate advice or order in a plane to evacuate a critically ill patient. The health aides usually operate out of their own homes. Many have now been on the job for several years.

Two of the larger villages in the previous experiment have community clinics, staffed by nurses as well as health aides. These two clinics draw patients from the surrounding areas and have become the focal point of a new telemedicine experiment. Both clinics have been equipped with television cameras and transmitters, and consultations can now be carried out on live video.

The doctors at the Tanana Service Unit's field hospital and specialists at the Anchorage Native Medical Center are available for consultation. The field hospital is about 250 miles from Anchorage and can be reached only by air or river boat. Both clinics are well over 100 miles from the field hospital, and are equally hard to reach.

Typically, the nurse or health aide in the remote clinic presents a patient to the field hospital doctor on the video; sometimes the remote doctors present patients to the specialists in Anchorage. Equipment for transmitting electrocardiograms and chest sounds is available, if needed. The consulting physicians can question the nurse and the patient, study the transmitted data, and view X-Rays made at the remote clinic. If they need to, the consultants can transmit video to the remote site in order to demonstrate activities to the nurse and the patient. However, only one site can transmit at a time; when the doctor can see the patient, the patient cannot see the doctor, and vice-versa.

Three sites (Galena, Fort Yukon and Tanana) can transmit video over the system. Anchorage can monitor the system, but cannot transmit video. The Fairbanks clinic originally had the capability to transmit video but was not able to use its equipment because of personnel shortages. The equipment was subsequently "cannibalized" to provide spare parts for use elsewhere.

The privacy of medical encounters can be protected with a system of "scramblers" and "de-scramblers". The scrambler distorts the transmitted signal in such a way that it is unintelligible to any receiving station lacking a de-scrambler.

Health Information System

A second portion of the IHS demonstration involves the implementation of a computerized medical record system for out-patients. The system is called the Health Information System (HIS) and was originally developed by the Indian Health Service and Bell Aerospace for use on an Indian reservation in Arizona. In HIS, health care providers fill out specially formatted records of each out-patient encounter. The notes they make are coded and entered into the computer system, which adds them to the individual patient's file. This system helps to overcome a severe problem in Alaska, where patients often go to many different places to get care, and it is difficult to obtain records from other places. Health care providers receive bi-weekly printings of the records of the patients who live in their area. In the original experiment plans, health care providers who have access to a computer terminal would be able to request an individual's medical record from the computer in Arizona via the ATS-1 satellite and get an immediate print-out of his medical history and recent problems. However, equipment problems delayed the implementation of this feature.

Alaska Education Project

The largest of the projects in Alaska is run by the Governor's Office of Telecommunication (GOT). It is primarily an educational project, with programs for primary school children and in-service training for teachers. It also produces other programs, such as a topical evening show for adults.

The two primary school programs and the topical evening program were designed with the help of "Consumer Committees", which advised on format and content. The Consumer Committees are composed of parents, native leaders, teachers and administrators.

Seventeen sites are participating in the demonstration (Site list: Appendix C). Each village can receive the video signal and transmit an audio signal back via ATS-1. A part-time "utilization aide", recruited from the community, is present at each site. The aide's job is to make sure that things run smoothly, turn the set on and off, align the antenna when necessary, collect data, distribute project information and supplies to participants, and publicize coming events.

Primary School Programs

The topic areas for the primary school programs are language development and health education. The language development program, called BOLD for Basic Oral Language Development, is directed at five, six and seven-year-olds. It attempts to increase proficiency in spoken English through the use of repetition drills directed by the studio teacher. The teacher interacts on camera with a robot and two "space creature" puppets, trying to teach them English. She also directly prompts the students watching on television to vocalize responses. Simple materials such as balloons or plastic spoons are used in the drill exercises. A set of such materials is provided to the teacher at the remote schools.

Each program is 20 minutes long and is followed by a ten-minute interaction period. The main program is pre-taped and transmitted from Fairbanks, but the live interaction portion uses a different teacher and is transmitted from Juneau. The interaction is used to conduct a roll-call of the sites for comments and questions, and to rehearse the drills.

A total of 32 programs has been produced in this series, entitled "Amy and the Astros". They are broadcast each Monday and repeated each Friday. Teachers receive a "Lesson Guide" that includes advance lesson preparation activities and suggestions for teaching techniques.

The other primary school program, "Right On", is a course for eight, nine and ten-year-olds on health education. It is transmitted immediately before the language development course. Thirty-two programs have also been produced in this series. Instead of repeating Monday's broadcast on Friday, films on health-related topics, purchased from outside sources, are used for the Friday broadcasts. The programs produced especially for the series have a 20-minute presentation followed by ten minutes of interaction. The commercially produced films can fill the entire half-hour; there is not necessarily an interaction period following these films.

The content of "Right On" is presented primarily in a semi-dramatic format involving dialogue between a native health aide and puppets of two animals common in Alaska, a moose and a beaver. There is no active solicitation of student responses during the pre-taped portion of the program.

In-Service Training

Two in-service training programs are being used. One program provides training for local community library personnel. It employs a correspondence course prepared previously by Loyola University, plus interaction between the remote students and the studio teacher. The course can be taken for three units of college credit. The students complete written assignments, participate in the televised interaction sessions, and attend workshops.

The second teacher in-service training program offers a package series of programs on motivating students and responds to specific educational needs of the remote teachers.

Public Programs

These programs are designed to appeal to a broad range of people, rather than a narrowly defined or specific audience. There are two projects in this category, "Alaska Native Magazine" and "Politalk".

"Alaska Native Magazine" is an evening program for adults. The topics for the program are selected by a "Consumer Committee" and the program is hosted by an Alaskan Native (an Eskimo). The format includes extensive use of film clips; mini-documentaries, and news features from the participating sites. The intended audience is the entire adult Native community; two of the ATS-6's audio channels are used for simultaneous translation of some of the program content into two native languages. Viewers at a particular site can choose which language they want to listen to, but everyone at the site must listen to the same language, because the sound is played through the speaker on the television monitor.

Interaction with the Native Host and the members of the panel is possible at any time during the broadcast, but most interaction occurs when the moderator solicits reactions from the remote sites. Each week, the program is broadcast for an hour, about half of which is expected to be devoted to interaction and responses from the panel. There will be 32 programs in the series.

"Politalk" is an interactive talk show emphasizing legislative activity and political developments in Alaska. It is conducted by Alaska's Department of Community and Regional Affairs, and features interviews with state legislators and bureaucrats, during which remote viewers can ask questions. It is a half-hour program, broadcast periodically during the legislative session.

Washington-Alaska-Montana-Idaho Regional Medical School Project

The Washington-Alaska-Montana-Idaho Regional Medical School (WAMI) is an experimental program in medical education. It is headquartered at the University of Washington in Seattle, Washington, the only medical school in the region. It has the goals of increasing the number of medical school positions available to the region's residents and of improving the distribution of medical personnel by encouraging physicians to choose rural communities and specialties where the greatest needs exist. WAMI has instituted a diverse program of experimental activities on the ATS-6. These programs fall into two classes: a university phase and a clinical phase.

University Phase

The university phase activities are parallel to, or integrated with, activities normally undertaken without the satellite. The University of Washington has arrangements with four other universities in the region under which students can take part of their first year of medical school at those universities. (10) Students in this program at the University of Alaska, Fairbanks, receive part of their classroom instruction from University of Washington faculty via the ATS-6 satellite.

These classes are the only ATS-6 educational transmissions able to make use of full duplex video; that is, a professor in Seattle sees the students in Fairbanks at the same time as the students see the professor.

Approximately 12-15 students in Fairbanks take the satellite classes. There is a microphone for each two students, and they interact freely with the professor over the ATS-6's high-quality audio channels. The television classes comprise that part of the content of the course that requires specialty expertise not available at the University of Alaska. A smaller number of lectures are transmitted from the University of Alaska to the University of Washington.

Administrative uses are an important use of the satellite link between Fairbanks and Seattle. Some of the administrative uses to which the system is being put are: coordinating and planning conferences between WAMI personnel at both locations; admissions interviews for the selection of new WAMI students; discussions between WAMI faculty teaching parallel courses at the two sites; and follow-up student counseling.

Computer-aided evaluation (CAE) is being experimented with via teletype terminals in Alaska that are linked to a computer in the continental United States. In the CAE project, students in Fairbanks punch in answers to study course questions printed out by the teletype. The computer responds with information about the correct response. At the end of the session, the computer calculates a summary score for the program. The CAE experiments are "piggybacked" onto the satellite when it is being used for educational or administrative interaction. This can be accomplished because the other programs use the video channel and one of the audio channels, leaving three audio channels free that can be used for CAE.

The final use for the ATS-6 communications link in the university phase is for medical consultations. Patients are presented by Fairbanks physicians to specialists in Seattle. Students in the WAMI program are present for instructional purposes during such consultations.

Clinical Phase

As a part of the medical training intended to encourage physicians to practice in those areas of greatest need, WAMI maintains relationships with community clinics to which students go for one to three months for training. One of these clinics, at Omak, Washington, has been equipped with ATS-6 hardware. The ATS-6 satellite link is used to help monitor the progress of students at this clinic and to promote educational exchanges between the faculty of the medical school and the clinic staff.

The major component of the student evaluation activity is case presentations by students: A student studies a patient's problem and progress over a period of time, and then makes a formal presentation to the faculty to demonstrate his skills in diagnosis, dealing with the patient and treatment planning. In the past, faculty from the medical school had to travel out to the remote clinics to review these presentations; the use of the satellite makes it possible to avoid this travel.

Students are also evaluated in administrative conferences, in which the university faculty and the local instructors "get together" via satellite for summary evaluations of students, as well as for planning curriculum changes or other administrative needs.

Educational programming is being provided for the physicians and other health care personnel at the remote clinics. A varied fare of lectures, discussions, and other formats are used to present content of interest to physicians, students and less highly-trained staff in the clinic. The lectures include the use of interaction for questions and comments. Other programs are more like dialogues or information exchanges; some use the "Grand Rounds" format in which patients are presented by physicians and discussed by their colleagues as a form of continuing education.

The final clinical use of the satellite is for medical consultation. Patients at the remote clinic are presented in a manner similar to that used by the Alaskan Indian Health Service project. Many of the consultations are devoted to psychiatric problems.

OBSERVATIONS

Introduction

In many w s, this demonstration was a technological solution oking for a social problem. This is not necessarily a bad thing, if a country can afford either the costs or the errors that may result. In very large programs, the risks are proportionately large and planners will probably want to use all available information to minimize the risks. Hopefully, the lessons learned from the U.S. experiences will benefit others who are considering satellites.

There are many issues that could be raised about the planning and operation of projects using satellite communication. This section will describe some of them in the areas of public response, hardware, field support, management, software, and other considerations. It reports our observations of things we feel may be of interest to planners.

The projects are sometimes called "demonstrations", sometimes "experiments". Dr. Clifford Block (11), who commissioned this study, distinguishes between the two in the following manner: A project may be called a demonstration when those undertaking it are confident that it will work. One of its purposes is to show others that it can work. In an experiment, one compares alternative ways of doing something, or tests a hypothesis by setting up control groups. Experiments are much more difficult to set up in large, real-world contexts than in "laboratory" situations.

Planners and managers of the HET projects confidently expected the technology to perform well. Most felt that the time span of the project was too short to measure any educational benefits to the audience, much less differences between the effects of different approaches. Appropriately, they labeled the project a "demonstration". In addition to demonstrating the viability of the technology, they hoped to demonstrate that ways of linking organizations and overcoming institutional inertia could be found.

Limits on Interpretation

There are several important caveats to be observed in interpreting the specific comments we make. Because some of the most valuable lessons are to be learned from the difficulties that the projects encountered, the focus is primarily on the problems they had. Readers should not conclude from this emphasis that the projects are being criticized. The people associated with these projects worked with great dedication under circumstances that were never optimal and that sometimes were extremely adverse. They showed us every kindness and openly discussed both problems and successes. The projects were visited shortly after they began operation. Much of what was observed may be related to the "start-up" difficulties that any project would experience.

There are a number of ways in which these projects are not representative of operational projects or the kinds of projects that might be undertaken in less-developed countries. Because these were demonstrations of the feasibility of mounting an operation such as this, rather than designed to accomplish a specific goal, they suffered delays and difficulties in defining for themselves just what it was they were going to try to achieve.

The life-span of the projects was very short. The knowledge that they would cease to exist after ten months of operation probably affected the planning of the projects and the amount of cooperation they were able to enlist. It certainly had an effect on available manpower resources. In some cases, it meant that staff time and energy was devoted to trying to find some means of continuing the programs past the termination date of the satellite.

The cost data for these projects is not generalizable; there is little of it available at this time. Monies came from many different sources and agencies and the final accounting balance has not yet been struck. Also, it is doubtful whether what is available would be meaningful to planners of operational systems (especially those designed from the start for the delivery of educational and social services) or to planners in other countries.

The scale of the demonstration project was much smaller than would be reasonable for an operational venture. Thus, while the unit costs for the hardware were higher than might be expected if large quantities were to be manufactured, the total costs of a large system will be higher. The same is true of costs for developing software or programs; although these were here high in per-student or per-hour terms, the total cost of software will be higher for the number of programs required for any large-scale system. Further, costs quoted at this stage do not include such elements as long-term maintenance and repairs. The costs incurred by various sites for the purchase of optional ancillary equipment are rarely included. (The costs to the National Institute of Education, which totalled $16.7 million, appear as Appendix G. These are not the total costs of the educational components of the ATS-6 project, nor do they reflect the costs of the health experiments. They are offered only to serve as a rough indicator of orders of magnitude.)

The cost of the ATS-6 satellite is estimated at $180 million for development, test and construction; $25.4 million for launch. Any costs for ATS-1 and ATS-3 would be additional. It must also be noted (and this is one reason actual costs are difficult to derive) that there are 17 experiments over and above the HET ones on board the ATS-6; costing out HET's proportion alone would be an extremely complex, if not impossible, procedure. The ATS-6 satellite is heavy and bulky, and requires a larger and more costly launch vehicle than might be needed for a non-experimental satellite. In short, these costs do not reflect what it would cost to build a satellite that would satisfy the needs of an operational system doing similar tasks to those attempted by the ATS-6 demonstration.

Further, an operational satellite would probably not be, as was the ATS-6, a single-channel delivery system. One advantage of a satellite is that it is easier, within certain limits, to add additional channels than is the case with a ground-based system. The ATS-6 project did not explore the advantages of multi-channel capability.

The expense for the HET's use of the satellite is hard to estimate because the satellite's cost includes a large research and development effort and costs for the other experiments on board. The costs of the ground equipment are unrepresentative in other ways. That equipment was essentially hand-made in small quantities by manufacturers willing to risk venture capital in the hope that the demonstration would create a potential market. Costs now being quoted for similar equipment for planned future systems are higher than were costs for this project. At least part of this problem is due to inflationary trends.

There were many hidden costs in these projects of which LDC planners should be aware. Many facilities, such as roads, school houses, telephones, and power supplies, already existed. In some cases equipment, such as video tape recorders and television sets, was purchased by the remote sites. Personnel and assistance were sometimes donated by other organizations. Retraining teachers was not the major cost factor that it has been in some LDCs.

Format

We will not present detailed descriptions of problems and successes of the projects; the settings of the projects are too different from one another and from the situations in less-developed countries for that to be useful. We will present findings that have valuable generality. For each finding, an example or two of how this finding emerged in the HET projects will be cited. Generally, the examples refer to only one project or instance; it should not be assumed that the problem appears across all the projects. Some comments deal with issues about which the HET projects were not designed to yield information, but which are important to LDC planners.

Many of the problems reported here have been corrected, as these projects learned from their own experiences. These same lessons are important to other planners, so they are included.

Observations are set off from the text and underlined. A brief key word index precedes the section reporting observations, and the full set is listed at the end of the section.

Key Word Index of Observations

Public Response

Audiences in the United States have no difficulty accepting the satellite technology.

Across the system, people seemed to like it far more than not. The "Executive Report", put out regularly from Denver, stresses this point. (12) Such factors as "program interest", "utility for classroom", "(will the program) prompt future discussions?" are all rated high on questionnaires submitted by the project headquarters for the Rocky Mountain STD.

Our findings confirm that "people like it." There is little doubt that project audiences are aware that they are participating in a "cutting edge" project being closely watched by U.S. educational authorities and by a wide variety of foreign experts. This probably contributes to their enthusiasm. However, "acceptance" is not the same as educational effectiveness. In reference to another recent U.S. project on educational television that was also very well accepted, science educator and physicist, Dr. Jerrold Zacharias, was recently quoted as saying, "One must distinguish between popularity and whether kids learn anything." (13) He was, in the same article, paraphrased to the effect that, given the uneven history of educational innovations, he would make no premature predictions.

One must also consider that many services are being provided at no cost, services which teachers or school systems would otherwise have to pay for on their own.

Hardware

Planning

In the ATS-6 projects, system design was determined by technological considerations, rather than health or educational needs.

System planning, including design of the hardware, should be based on the needs of the users. The existence of the technology might stimulate experiments in its use, but the goals, context, and the content of the program must determine what combinations of media are used, not vice-versa. In this case, however, the projects were in the position of finding uses that would demonstrate the capabilities of a technology that had already been chosen. The satellite had already reached the final contract stage for the experiments other than the HET, and the HET demonstrations were added on at the last moment.

For example, the two-way capability was available technologically but the planning was not concerned with whether to incorporate it into an educational system but with how to incorporate it. As a result, the experiences of the HET projects are of little value to planners who must decide whether to incorporate it and, if so, how it could be used to achieve maximum learning benefits.

Interaction, as we viewed the use of it in many of the projects, was frequently counterproductive to program goals. Students were often bored by the interaction and stopped paying attention during it. This was, in part, because of the poor technical quality of interactive reception and in part because the planned uses of interaction were somewhat contrived.

The frequency clearance problem, which precluded use of the ATS-6 for most of the audio return links, surfaced at a late date; it required improvisations in equipment design that caused such severe technical difficulties that operational use of interaction was often impossible. The problem arose because the audio uplink frequencies that the ATS-6 was designed to use were under the control of another government agency, which refused because of its own very real need for the frequencies, to relinquish them to the demonstration. This required using the ATS-I and the ATS-3 satellites, which have much lower signal qualities. It is not the fault of the ATS-6 that the interactive voice transmissions are often totally unintelligible to the listener; this is a result of the other satellites being used. The retention of interaction under these conditions is another example of the technology "driving" the system. If the intent was to learn about the educational value of interaction, it could have been more cheaply tested using ground technology.

<u>Planning for satellite delivery of education or social services must take into account existing technological systems and future considerations.</u>

Here, no attempt was made to seek out alternative technologies that might serve the same educational/developmental needs as well, better or more cheaply. The satellite was "there" and had to be used by a certain date. Had comprehensive planning been undertaken, the project might have had time to dwell on what the educational needs were.

This need for comprehensive planning exists at two levels: not only must a communication system for education be planned as part of an educational system, but also as a part of a nation's communication network. An operational system would undoubtedly wish to take advantage of what is in place, not only because it may have already been fully paid for, but also because it is one which people are likely accustomed to using and accustomed to maintaining. The reason this was not done in the ATS-6 projects is probably traceable both to fiscal and time limitations and to the mandate to demonstrate the new technology.

The frequency requested for the ATS-6 was one close to that used for radio astronomy. Claims of potential interference have been made and undoubtedly will be further pursued in any future attempts to create an operational system. Operational system planners will have to consider such alternative uses of communication resources in formulating their programs. There is some possibility for interference between ATS-6-like satellites and tropospheric-scatter broadcasting systems; that problem may be most acute in Africa. (14)

Comprehensive planning might also take into account, given the limitations of satellite scheduling (particularly if a single satellite is transmitting to several time zones) that a need for storage devices throughout the system might exist, so that efficient use can be made of the time available for program transmission, or so that the material being transmitted can be recorded for future use.

<u>The question of who has priority in the system must be dealt with in the planning process.</u>

At first glance, this does not sound like a hardware problem, but it surfaced most dramatically in an engineering context. Not only did the technology seem to be "driving" things, technicians were, as well. This seemed to operate to the detriment of the remote communities. In hardware planning, a system should be devised by which users can get technical help when they have serious problems. If the system is to meet the needs of people in remote localities, it must be oriented towards those needs. Everyone in the system must know who comes first and the hardware and operational protocols must be designed to further that end. This may require some sacrifice of technical fine-tuning.

Design

Very specific details of the user's environment must be taken into account at the design level.

Not enough attention was given to the way in which remote schools are constructed. In one instance, the school house was so small that it was impossible to separate the children by appropriate age groups to view the programs. The net result was that all of the children (ranging from five to twelve years of age) watched the programs intended for five to seven-year-olds and eight to ten-year-olds. This caused discipline and attention problems. Much of what educational effect the programs might have had was lost as a result.

In another location, the receiver and talkback equipment were in one room in a school; the transmitter for the talkback unit was located in the health aide's home some distance away in the village. There are no telephones. Each time a program was to be received, someone had to be sent to the health aide's home to turn on the transmitter. In an area where winter temperatures often reach 50° below zero Fahrenheit, that is no small task.

Some difficulties resulted from the fact that the amplification of the signal at the antenna was only sufficient to travel through one hundred feet of cable. Thus, the antenna location, in some cases, limited in which classrooms the receiving set could be located. This was not necessarily consistant with the best location from the point of view of using the set with pupils.

The antenna must be realigned, in some sites, between the school program transmission hours and the evening hour for adult programs. A hand-crank was provided for this purpose, except in Alaska, where this function was performed with an electric remote control unit. The ones ordered were not suitable for sub-zero temperature and they continually stuck.

In one school visited, the TV receiver was located in one room; the equipment for interaction was 250 feet down the hall. The separation of the two units created nearly insurmountable obstacles to interaction, because the person speaking on the radio at the school could not hear the studio's response on the television set.

The antenna design originally called for the dishes to be made of six petal-shaped segments, to be bolted together on the site. A design change was made, however, and they were delivered in four, rather than six, segments. This made little difference to most of the system. In one case in Alaska, it required that the segments be delivered in a larger and more costly aircraft. Designers need to take account of factors such as these.

<u>Consideration must be given to the fact that equipment will not always be used by engineers, and that engineers may not be readily available when needed.</u>

The core equipment was designed for ease of use, but the peripheral equipment and the improvisations that had to be made for interaction caused serious problems that had not been anticipated at the design level.

In many cases the instructions were not suitably written for non-technician users; there were places where there were no labels affixed to the myriad of wires and switches. This would pose few problems to the trained engineer or technician but it must be remembered that this system was for the use of teachers, community coordinators and students.

Some equipment was probably too complicated for the uses to which it was put. There are, for example, persistent problems with the motorized antenna position changers in Alaska, the digital coordinators and the data transmissions. There are trade-offs between the complexity of equipment and its reliability and ease of use by laymen.

There are also "under-design" flaws. There are often problems with echoes caused by the half-second delay in transmitting to the satellite and receiving a sound back. The radio switch could have been designed to eliminate this problem. In one project, the engineers wired the ATS-1 sound so that it came out on an open speaker in the studio and was then picked up by panelists' microphones and refed out for transmission over the ATS-6. This resulted in the further degradation of an already poor sound quality; the audience could often not understand what was being said.

On the whole, the ATS-6 equipment behaved reliably. (It was all brand-new during this experiment.) A good policy for repairs might be to furnish a check-list of things for local staff to do to try and isolate the source of the problems, and then trade the inoperative part for a working one by mail. Or, there should be some spares on-site.

Manufacturing and Delivery

Ample lead-time is a necessity.

The lead-time required would likely be greater in LDCs because much of the material would have to be imported. This might be true for technical personnel, as well.

Units were delivered late, some without cables, and some with reverse polarization of antenna feeds. It was discovered after installation that the crystals that had been specified caused cross-talk on adjacent channels. Time was required to correct this condition. Data terminals for the health care system were late in arriving, and suffered from a persistent interface problem that delayed their use. The medical telemetry devices were also installed behind schedule.

If problems of this magnitude occurred even with good local manufacturing capability, good communications and transportation, it seems likely that LDCs will experience similar problems. There are apt to be communications and transportation problems that exacerbate the "normal" problems of importing parts, such as difficulties with currency and currency conversion and with customs duties and regulations.

A generous stock of spare parts is essential.

There was a critical shortage of spares in these projects. The lack of spares frequently required sending a technician to the site, which is more expensive than sending out a replacement part by mail. Some equipment had been custom-built for the demonstration and the stock of spares could not be increased at a reasonable cost after the initial production run. Given the short duration and the experimental nature of the project, maintaining a large stock of spares was not seen as necessary. This would not be the case for an operational project.

Special attention must be paid to adverse climatic conditions and the possibility of vandalism.

Some evidence regarding adverse weather conditions has already been offered. We know of no cases of malicious vandalism, but in at least two situations, part of the antenna was bent by students climbing on it. Protection of the equipment seems a prudent course to follow.

Installation and Training

A "decentralized" approach to installation seems to have been effective.

The field engineers of the Rocky Mountain STD recommend that a "decentralized" approach to installation, using several teams and multiple equipment depots, be utilized. An approach to this problem would most likely be highly country-specific; it would depend on available technical manpower resources, including decisions as to whether or not to depend on expatriate help.

It is essential to train people in the use of the equipment.

The engineering components of the ATS-6 projects regret not having trained people in, for example, such relatively simple functions as fuse replacement. The problem was not an incapacitating one in the United States because communication networks and trained technicians are available. In Alaska, the level of technology did tend to exceed local capabilities, but it was easier to reach those villages than would be the case with similarly remote villages in other parts of the world.

In one situation in Alaska, a teacher was willing and able to take on the job of re-wiring the location of a badly placed talkback unit. He had the tools as well as the know-how; that condition may not prevail in LDCs. The LDC may have to develop a manpower pool for such functions. Supplying a manual for the operation is a necessity, but almost certainly will not be enough. There will have to be training sessions and some capability for getting "talk-through" help in making adjustments. There was one instance, a dramatic illustration of what a satellite link can do, when a teacher in Alaska, north of the Arctic Circle, received "talk-through" help via a voice contact, over the ATS-1 satellite, from an engineer associated with the PEACESAT project, located in Wellington, New Zealand.

Equipment procurement should probably be centralized.

Solutions are likely to be country-specific, but we offer the suggestion that centralized purchasing would provide technical compatibility, would make for easier repairs, and certainly should offer economies of scale. In general, ATS-6 project equipment was supplied from a central point. However, in some projects, some sites had to supply their own color TV monitor ($400.00). Video tape recorders ($1,600.00) and tape stock ($2,500.00 for enough for the life of the project) had to be purchased by the Rocky Mountain sites if they wanted to record material for future use.

Field Support

Staff level support at remote sites is imperative to the successful functioning of the program.

All of the ATS-6 projects used some measure of field staff support to see to it that things ran smoothly and to enhance the attainment of the program goals. This is likely to be an important - and difficult - point for planners, however. The role of the support person or local teacher is often very subtle, as is the relationship between such people where there are several charged with on-site responsibilities. The cost of such personnel, whether paid for by the project or locally, may account for a significant portion of a project's costs.

There are at least two distinct levels of field support activity in these programs: one is facilitative, one substantive. At the facilitative level, the tasks include seeing to it that the equipment is functioning at the appropriate times; instructing others in the use of the equipment; distributing public information about the programs and schedules and getting people to attend; building relations with local groups or figures to ensure local approval for the project; and providing feedback and reports to the project managers about the acceptance of the programs, the functioning of the equipment and suggestions for changes.

At the substantive level, the tasks are oriented towards increasing the attainment of the program goals. In educational projects, these might typically include: conducting preparation sessions prior to the broadcasts and review sessions afterwards; coordinating supplementary educational activities (which might be aimed at localizing the content of the lessons); and independently presenting a portion of the course's content.

Clearly, there is an overlap between the two functions. Not all of these tasks must be performed in every project; they are cited to give a sense of the range of tasks. The same person can perform both roles, if qualified, and some of the tasks mentioned can be assumed by the programming itself. There is considerable flexibility in assigning these tasks to the project's center and to its receiving sites. There are trade-offs in effectiveness and cost against the demands of the situation. The major point is that not all of the tasks can be performed by the center.

Some of the tasks will have to be undertaken in the remote sites. The primary example is that of reviewing and reinforcing the program content, a need consistently demonstrated in educational technology and media projects. The instruction alone, without interaction, interpretation, and reinforcement, is not sufficient to produce learning and behavioral changes. There must be some local teaching or review. For LDCs, this is a critical question, because field support is expensive, and it is sometimes difficult to get trained personnel to work in remote communities.

There are several factors contributing to the need for an on-site instructional assistant. We concluded from our observations that, regardless of the availability of interaction, the need for having a local expert is greater when the audience at the site is larger, when the goals of the program are more explicitly educational, when the audience is less motivated, when the subject matter is more general, when the educational level is lower, and when the audience is younger.

In classroom situations in primary schools, the need for a local teacher is greatest. In the small classes of medical students, using a large amount of two-way interaction, able to see and be seen by their professor, there may be little or no need to have an on-site instructor for that content material.

Field support personnel must be trained to do their jobs.

The level of training required will, of course, vary with the nature of the course, but the use of highly-trained persons may not be necessary if proper support is provided by the project headquarters. For the most part, the in-school educational programs relied on the already highly-skilled classroom teachers to perform their role of interpreters of the transmitted information without any additional training. Less formal educational programs tended to omit the use of an on-site person, although the facilitative responsibilities were already covered in these sites by people employed primarily to assist with other programs being directed to the same community. Some community members' training consisted of little more than a short session on how to operate the equipment and file the required reports.

In the LDC context, we feel it worth raising the question as to whether any single individual, in a remote site, would have sufficient training and the necessary qualifications to be able to cope with several streams and levels of in-school instruction and with several streams of content directed to adults and dealing with development information. Given the fact that, for a wide variety of reasons, the least well-trained teachers are usually found in the most isolated areas, this question needs to be seriously addressed.

The practice of medicine in Alaska, for example, illustrates why the skills available at the remote site level are a major factor.

Prior to the use of the ATS-6 experiment, the Indian Health Service in Alaska has used HF radio and the ATS-1 satellite for a voice-only medical care support system. In remote Alaskan villages, local residents who have been given a few months training in diagnosis and treatment provide medical care, supported by radio consultations from physicians. Those patients whose problems are beyond the skills of the local health aide must be evacuated to a hospital. The decision to evacuate is based in large part on the level and quality of the care that can be provided on-the-scene. The value of the telecommunication link is that it makes it possible to support the field workers and find out when patients are in need of evacuation. Without at least the audio links, health services in bush Alaska would be severely degraded. But the limiting factor in the program is still the level of skill available in the field, rather than some characteristic of the medium.

The Rocky Mountain project, which broadcast an average of eight hours per week to each of its sites, expected utilization personnel, who did not have any substantive responsibilities, to spend two to four hours per day, or about 15 hours per week, on their satellite-related duties, which included both public information and report-filing. They found that many of the site coordinators felt that that was an under-estimate of the time they actually spent on the job.

Liaison between the project and the local users and interested parties is an important function performed by the field personnel. Most of the projects made a point of either going through local or already existing organizations to recruit or hire their field personnel or hired local residents to do the job. Those field personnel who seemed to be most aware of, but not necessarily involved in, local political arrangements seemed to function better than those who were outside of that arena. As testimony to the importance of the local person in that situation, the projects' management reported that they felt that a good deal of the differences between their more and less successful sites were attributable to the job done by the field personnel.

Strong support and feedback needs to be provided to field personnel.

We observed a very close relationship between the amount and the detail of the information provided to the field staff and the acceptance of the program by the local users. Most of the projects provided at least minimal information about the programs that were to be broadcast. Local teachers were critical when they felt the information was too vague to be of value to them in planning accompanying or complementary class activities. In some cases, the field support persons were the critics, reporting that they were sometimes inadequately informed of what the broadcast schedule and topics were to be. The issue of communication between the project management and the project users is one that produces a great deal of emotion, and one that has a direct effect on the users' attitudes and participation.

The teachers, in particular, were susceptible to resentment if they felt they were not being well-enough informed. Their position in these projects was usually as a person whose teaching routine was being disturbed by the introduction of a new - and temporary - curriculum change. They often expressed the feeling that they were being asked to modify their practices at considerable extra work for themselves for a program over which they had little or no control, to which they had little or no input, and which would soon be discontinued. It is not surprising that teachers in those circumstances might feel some reluctance to commit much effort to the course. Teachers also noted that they did not have enough time to incorporate the supplementary activities, because of the satellite scheduling and the press of other courses.

Sometimes such feelings seemed to be the result of failures at the project level to distribute information. Sometimes they were due to failures at the local level to share available information. Sometimes it was because of a lingering attitude of resentment for failures that had since been rectified, but had created an atmosphere of alienation. The kind of information supplied to the field was usually not too detailed, and the response of the local users indicated that the more detailed it was, the happier they were. Teachers' guides containing schedules and synopses of forthcoming programs are an absolute minimum; the more additional activities and resource suggestions they contain, the more likely they are to have a positive effect on the students' learning, provided they are used. Newsletters and field staff conferences were used by some of the projects with good results, judging from the attitude of the participants.

The existence of a communication channel and a person to contact at project headquarters can make a positive contribution to overcoming the problems resulting from inadequate information. Although it does not seem to have been tried extensively in the ATS-6 projects, it may be necessary for the headquarters to initiate contact with its field staff on a regular basis to solicit feedback from them. A mail channel could be used for this purpose, but it is slow and is biased against those who do not communicate well in writing. (This entire problem area requires the most careful attention of the LDC planner, because of mail delivery problems and the skills level of the person at the remote site.) This is one of the ways in which such a voice channel for general administrative use would be valuable. An informal - but regular - telephone or radio contact between the field staff and the headquarters, and among the field staff, would have the additional advantage of providing the opportunity for serendipitous discoveries about how things are working.

Management

Planning

A clear definition of project objectives is a critical necessity from the outset.

This is needed for several reasons. The first is to guide decision-makers. The second is to avoid that situation in which the technology begins to "drive" the system. Careful and detailed study of needs, both actual and perceived, is also required. Then the technology can be harnessed to serve the program objectives. It should be noted, as well, that the technology should be controlled and operated by those whose primary concern and task is the accomplishment of the program objectives.

Planning should be solidly based on local needs.

In the ATS-6 projects, there was really not time for adequate community involvement, because of the short leadtime from the decision to place HET experiments on board to the launch date. The content areas were chosen before the creation of consumer committees. The system design should strive to accommodate the users' needs and practices, not impose upon them, if it is to be fully effective. There were some surveys undertaken; it seems likely, though, that the determination of what areas to program was not a function of these, but a response to federal priorities and the availability of federal funds. Some needs, such as the need for medical communications in Alaska, are obvious, but they still require study to know how to program for them. Surveys require lead-time and they should not simply be affirmations of pre-conceptions via a marketing approach.

The Appalachian Regional Commission had a recently completed needs study before it was necessary for them to make operational plans; the RESAS and the production center already existed. Had this not been the case, they estimate they would have needed an additional one-and-one-half year planning period to develop the essential community information, input and involvement.

<u>Overselling the benefits of a high technology delivery system can create problems.</u>

It is, from a management point of view, desirable to kindle people's imagination, at the early stages of the project. But the possible negative effects of disappointing expectations must be considered. Here, the promises may have been too extreme; most likely everyone was caught up in the excitement of this new venture. Reading early documents provided us with the impression that there were no problems in the coverage areas that the satellite programs and the social services delivery system would not alleviate. Allowing this to happen in an LDC may well produce the effect Prof. Daniel Lerner has often decried when he talks about "the revolution of rising frustrations."

<u>Planning for the development of personnel resources is essential.</u>

Long lead-time will be required to train staff for any high-technology level, especially if it requires sending trainees out-of-country. This is not only a matter of time, but of added cost. It is highly probable that needed skills will not be available in an LDC. (Indeed, they may be in short supply in developed countries. For one thing, the technology is new; not too many people anywhere have developed skills to handle it. As satellite projects proliferate, the shortfall may be even greater.)

The effect of the time-line for implementation of a satellite system on the planning of programs is worth considering. Once the decision to have a satellite has been made and the contracts signed, it is a reasonable surety that within "X" years, a satellite will have been built, successfully launched and orbited. In the case of the ATS-6 this means that programs were rushed to completion to meet a launch date; there was little time to pretest them, to make the sort of adjustments one would wish to make in an operating system. The time factor applies to both hardware and program development. In the U.S. case, it was possible to recruit qualified individuals to plan curricula, write scripts, produce programs, design engineering, install equipment, conduct research and evaluation, work as site coordinators and manage the projects. This may not be the case elsewhere.

The planner might wish to consider the benefits of designing a system that is implemented in progressive steps. It might start with existing radio and television systems, which can provide a training ground, both before and after the implementation of a satellite system, for a wide variety of skills and resources. An existing system can also be used to test programs that will, later, be transmitted via satellite.

Internal Coordination

A method of creating interdisciplinary cooperation must be devised and implemented from the outset.

One of the major problems of an enterprise such as the ATS-6 project is that those who come from different academic and professional disciplines must be forged into a smoothly working team. This is perhaps the hardest task of all. Involved in the process are businesses and professions that are not accustomed to working together and that must develop a common vocabulary. In some countries, where broadcasting or primary school teaching is a low-prestige occupation, but being an engineer or a college professor is not, developing a common approach will be a lengthy, difficult and even costly task. (Costly since many LDCs may require expatriate help to smooth and ease the process.)

The clarity and commonality of goals and priorities contribute to this process. An interface must be maintained between those designing and producing the programs, the project management, and the teacher and community levels. In-school programs must be seen as useful by teachers. Teacher resistance can readily be intensified, perhaps even to the point of paralyzing the workings of a system, if the system design is not appreciative of what it is the teacher really does - and where - and when. The ultimate control of even the most elaborately designed system is in the hands of the teacher; he has an "off" switch. No amount of legislation or regulation can keep that switch turned "on", that set plugged in and working.

<u>There is a need for clear, simple lines of responsibility.</u>

In one project, curriculum design and scripting were done in one city, production and broadcast in another, and the interaction was transmitted from still a third city. Not enough provision was made, either in the budget or in the diffuse way management authority was exercised, to see to it that these three elements met often or meshed. The use of a second studio and transmission facility for the live interaction increased the difficulties.

Communication problems and the ambiguity of the locus of authority meant that the programs that were produced often did not conform to the curriculum designer's intent, and the interactive teacher often stressed other points than those that the designer thought important. In some cases, the interactive teacher even contradicted points made in the pre-taped program.

One project had three major phases: planning, developmental, operational. Problems became worse during the transition from one phase to another. Lines of responsibility between broadcasting and engineering, between production and content were blurred. At one time, when one project was dealing with two different content areas, they seriously considered having separate field workers for each area. This would have created even further diffusion of the lines of responsibility, and undoubtedly confusion at the field worker level.

<u>External Coordination and Relations</u>

<u>Relations with sponsoring agencies must be clearly understood and goals must be clear at all levels.</u>

This was not the case in the ATS-6 projects. The interest of some of the participants, at the federal and project level, was primarily in a demonstration of the feasibility of inexpensive ground stations, not in educational programming. This caused some shift of emphasis away from educational goals. NASA had still another set of goals. (Appendix D) Different components within the projects sometimes had conflicting goals. This is not to suggest to the LDC planner that different components may not need or have different goals, but rather to suggest that the differences and relative priorities must be clear to all concerned. Then implementing and achieving the goals can be far more cost-effective and cost-beneficial.

The project should develop links with existing institutions.

It is not absolutely necessary to locate the project within an existing organization, although most of the ATS-6 projects were so located. What does seem important is to have good relations with bodies already in place. Most of the institutions running the projects already had ties to the federal, state and local governments, and to regional and local organizations. If these ties hadn't existed or if, for example, the Federation of Rocky Mountain States and the Appalachian Regional Commission hadn't existed, they probably would have had to be created. There wasn't the time or money for the ATS-6 projects to build institutions or linkages de novo. To the management of a totally new project, the extent of linkages to existing entities represents a series of trade-offs. Close relationships to them are probably time-savers, perhaps even money-savers. Against that must be viewed institutional resistance to change. Determining trade-offs is not an easy or simple process; the approach to it is, again, most likely situation-specific.

Innovative projects must have consistent high-level support.

What is at issue here is not only money, although consistency of funding is a major factor. The startup period for innovation is a stressful, even a painful one. Knowledge of firm, high-level support is a benefit to morale, and cushions management (and all levels of personnel) through the inevitable day-to-day setbacks. High-level support can cut through administrative bottlenecks, bureaucratic delays and resistance to change. At the time some of the ATS-6 projects were facing a change in sponsorship from one federal agency to another, they also had to face Congressional actions affecting funding for all such experimental projects. The absence of consistent, high-level support created tensions, uncertainty, delays in procurement, and problems with staff recruitment. The tasks to be accomplished were difficult enough without the added burden.

Software

The software, sometimes called courseware or programming, presents the educational content. Ultimately, the software is the key element in any educational technology or media education project. All the rest - researching, planning, the technology itself, the management and field support, are basically steps (albeit critical steps which require extremely careful planning) necessary to arrange the delivery of the software.

Curriculum Design

User input must be obtained at the earliest stages of the curriculum design.

Decisions about what topics to include, how to structure the curriculum, and how to present the information can best be made with extensive knowledge of the conditions and sentiments that will be encountered in the field.

There are a number of ways to go about getting the kind of information that will be useful for planning activities. One technique that was attempted in the ATS-6 projects was needs assessment. Planners of the project used several methods of gathering data about the field situation. They looked at existing data about the skill levels of the population and the penetration of communication media and social services in the area. They administered questionnaires to people who might be affected by the project. They went into the field to conduct interviews with local leaders and residents. In some of the projects, advisory councils composed of leaders and experts were formed; in others, consumer committees consisting of representatives of the affected groups were established. Groups such as these were to advise project planners about the needs and perceptions at the local level, to make suggestions, and to react to suggested courses of action presented by the planners.

The fact that such groups are established does not ensure that worthwhile information is gained. Often the user groups have difficulty in expressing themselves or even thinking of things that would be helpful. For example, in one project, the user representatives helped choose a program format involving extensive use of puppets and other techniques that may not have been entirely appropriate to the educational objectives of the programming. The reason they favored this particular format seems to have been that it was the one most similar to one of the few examples of well-publicized and popular childrens' programming with which they were familiar. Trying out suggested characters and techniques with the participation of user representatives might have led to more relevant and beneficial programs.

As a case study of the difficulty user groups have in specifying a service that they would like but currently do not have, one might look at the experience of the Materials Distribution Service in the Rocky Mountain project. The Materials Distribution Service was one of the most popular programs of the entire project. The teachers told us they liked it for a number of reasons. It was very convenient, because the videotape recorder was simpler to use than a projector and screen. They knew exactly when a given film would arrive (via satellite), so their lesson plans were not upset by late mail deliveries. The videotape format made it easier for just one or a few children to watch the program. There was always the chance that something they had not ordered specifically to show to their class would be found to be relevant and could be incorporated on short notice. And finally, they mentioned the fact that they were able to build up a large library at relatively low cost because the project was subsidizing film purchases. Given all these advantages, one would have expected the teachers to be asking all along for such a service. But the Materials Distribution Service was not much discussed in the needs assessment and planning period. It was only added to the experiment as an afterthought.

In some cases where planners conducted "needs assessments", they seemed to be conducting a "market survey" instead. A needs assessment ought to start out with as few preconceptions as possible about what it is that the project ought to deliver. A market survey seeks to find out whether people will accept what planners have already decided to do. It is not surprising to find this pattern. Since most projects will be initiated by an entity that already has a plan, there is a tendency to focus on a market approach.

Information-gathering activities should cover a broader range of topics than just perceived needs. These early efforts are an excellent time to collect data on the actual characteristics of the environment (such as the numbers and ages of students in a classroom, the sizes and numbers of classrooms in a school, the lighting, the acoustics, the school's daily schedules for classes and meals, the availability of electric power) and on the skills levels and attitudes of the intended audience. One project failed to assess the entry level skills of the students its program would reach and badly undershot the actual abilities of the students. As a result, the students were bored by the program and their time was felt to be wasted.

<u>Supplementary activities and materials have a significant role to play in an educational media system.</u>

A certain amount of local interpretation and review is necessary, especially in more formal educational contexts. Planners consistently seem to underestimate the importance of these activities in their concentration on the technological aspects of the education system. Because the programs are designed to fill most or all of the class period for that broadcast day, teachers have little opportunity to prepare their classes for the content of the coming program before the transmission, or to review the material and try to clarify any points that are not fully understood after the transmission.

In one project the students enter the classroom shortly before the beginning of the transmission and view the program. At the end of the transmission, they have time to fill out a short evaluation form on the day's programs before they have to leave. In another project, a second program began immediately after the first, which precluded any review of the first or preparation for the second. This was caused by the decision to fill the entire time with programs, rather than by educational considerations. Some of the programs do attempt to include a review at the end of the broadcast, but little can be accomplished in the short time available. We feel that the educational potential of the programs is severely curtailed by this decision.

Equally as important as these review scheduling considerations is the systematic use of supplementary activities and materials to reinforce and enlarge on the content of the television segments. In the teachers' guides created for some of the programs, suggested projects and techniques for relating the course content to the specific local conditions were included. Teachers praised the intent of such materials, but noted that because the course designers often seem not to have been aware of the constraints under which they were operating, teachers often had no opportunity to implement the suggestions in their classes. Course designers must also ensure that the opportunity for use is planned into the overall schedule.

Supplementary materials ought to include some printed summary or expansion of the program content, so that the student has a permanent record of the course's material. Workbook format review or drill exercises can make a valuable contribution to the student's learning experiences. In many cases it is necessary for the project to supply supplementary resource materials if the students are to have the opportunity to pursue the subject beyond the minimum level.

One of the adult formal education projects reports that they find it necessary to supply each of the students with an individual copy of each of the reading assignments. Their experience has been that unless each student has his own copy, the material will not be read. That same project also supplies a moderately-sized library of supplementary materials at each cluster of their remote sites.

Another of the projects, this one directed at an in-school audience of young children, supplies a set of materials to be used in drill exercises directed by the television teacher. Unfortunately, some of the remote sites are not able to use the materials. The target audience shared classrooms with many students of different age groups. The materials are supplied in sufficient quantity for the students of the correct age group, but the teachers are not willing to pass out the materials unless all of the students can have them, because of the probable social and discipline problems.

<u>Instruction via the satellite should be integrated into existing curricula.</u>

The ATS-6 educational programs focus on subject areas that are not part of the traditional curriculum in most of the schools. This is a deliberate choice, based on the assumption that schools would be more willing to cooperate with a program that does not require changes in established practice. However, such an approach entails a cost that should be explicitly considered by planners of educational systems. A project that expects to tackle a broader range of topics as a more permanent component of the educational system would undoubtedly choose a more integrated approach.

In the cases where the televised instruction is used to supplement a course taught partly through traditional means, the necessity for good coordination between the two portions of the course becomes obvious. In the courses that use this approach, the coordination is provided in part through satellite conferences between the instructors for both the television and the traditional portions of the courses. When many remote sites are involved, more channel capacity and a more institutionalized approach would be required, but the principle would be the same.

<u>Rigid scheduling of the programs has some drawbacks.</u>

People at some of the remote sites report that a serious problem associated with the rigid schedule imposed by the satellite is the inability to interrupt a broadcast to seize an opportunity to develop a class's interest or to clarify a confusing point. This is particularly frustrating to teachers. They point out that, of the things done over the satellite, only the interaction absolutely requires the real-time use of the satellite. The programs could be distributed by mail on videotape casettes, or recorded locally when transmitted over the satellite. Then sites could fit the programs to local schedules and interrupt individual programs at will.

When asked whether they would be willing to give up the interaction in order to gain local control of scheduling, they give mixed replies. Many feel that if the interaction were better organized, it might be worth giving up local scheduling control in order to have it, but they do not find the current structure that valuable. The projects concerned with medical care delivery also find the rigid schedules very constraining. They would prefer an "on-demand" availability.

There may be some advantages to rigid scheduling. Sites may be more likely to use the programs than if the scheduling were a local option. However, project planners might not wish to permit such latitude in a system.

Software Production

The production of video software requires more time and effort than many planners expect.

Representatives of literally all the agencies involved tell us they now feel they paid too little attention to the software component of the educational system. They underestimated the amount of effort and lead-time required to produce good instruction. This is not to imply the projects had not anticipated that production would be a major part of their activity. Indeed, most projects committed the lion's share of their budgets and staff to the task. But the internal and external constraints are very large. One project was able to resolve various institutional problems and proceed with production only some weeks before they were to go on the air. Another well-funded project, with its own moderately well-equipped studio, was able to complete an average of 20 minutes of production a day. And this was only possible by running the studio virtually around-the-clock. The producer felt that with a larger, better equipped studio, he would have been able to produce one hour of finished programming a day.

The scripting and production effort must involve people from all relevant disciplines.

The process of designing curriculum and producing video lessons is not an easy one. The vocabularies and experiences of the educators are quite different from those of the people involved in production. Yet, the two groups must cooperate intimately in order to put together programming that is both pleasing and educationally effective. Some of the projects modeled the organization of their production groups after the system used at The Open University in Great Britain, in which "course teams", consisting of content specialists, educators, script writers and production staff, work together from the very beginning to design and produce a finished course. They find that in this approach, the content people learn to take production factors into account, and the production people become committed to the educational goals of the project. We feel that this approach is much more successful than one that separates the functions either in time or in space or in organizational units.

The production effort must have clear objectives and priorities.

The objectives of the production groups are not limited to the task of producing programs. Rather, the goals must be thought of in terms of producing changes in the students. These goals must be quite clear so they can be a guide to the course team. They must also be held in common by the entire production crew, to avoid a situation we frequently witnessed. The people associated with the content of the program did not have a clear enough idea of what effect they wanted the program to have on the students. As a result, they could not give adequate direction to the people involved in the technical side of production, who fell back on their professional training for guidance and tried to produce programs that were of high technical quality, regardless of educational effectiveness. The situation must be fostered in which the production staff is committed to educational effectiveness. The opposite priorities prevail in most of the projects we observed; the production groups seem to value professional "polish", and their goal prevailed in light of the educators' unclear goals. Very seldom did the projects apply standards of educational effectiveness by testing a program on representative students to see whether it achieved its intended goals. Only a clear statement of goals and an explicit ordering of priorities that is shared by the entire staff can rectify this situation.

Every effort must be expended to ensure that the programs actually produce the desired results.

The preparation of instruction for a mass distribution system differs in a critical way from classroom instruction. The programming must be as effective and efficient as possible in attaining its educational objectives, because the waste caused by an unsuccessful or inefficient program will be very large. The investment in the distribution system can only be justified if the programming that is distributed works, and works well. Ineffective programming for mass audiences wastes not only the investment in the distribution hardware, but also the time of a very large number of students. It is sometimes forgotten that, especially in the context of the LDC economy, student time has a dollar value. The cost and effort required to produce very effective programming is high, but it is spread over a very large number of students. Program designers and producers must be certain that a program actually works before it is distributed.

The ATS-6 projects were unable to do this: they had little lead-time to produce programs at all; they were not broadcasting to a mass audience and could not amortize any extra production costs over a large number of students; they saw their goal as demonstrating the feasibility of a satellite distribution system, not demonstrating educational techniques. The projects did strive to produce good programming; but they had to produce programs on short notice and in a context where speed and quantity was more important than quality. In many cases their funding was too limited.

Some of the projects did what they could within these constraints. They distributed some scripts to educators before the actual production of the program. They sent early videotapes out for review by educators, but rarely were they able to assemble representatives of the intended audience to view programs and provide feedback. None of these activities can substitute for a systematic policy of showing the programs to students, preferably at an early stage in their development, and testing the students to see whether they actually learned what the program was intended to teach. Then the program can be revised until it succeeds in teaching that content, and possibly without dramatic increases in the cost of production.

This general approach would reveal road-blocks to learning that could be corrected. We observed lessons in which the vocabulary level of the script was far too high for the majority of the class, and in which crucial points in the content were obscured by the dramatic or humorous format. There were programs in which some content was presented far too briefly when other, less important points were overemphasized.

One of the projects, which is repeating most of its course material in a second semester for a different set of students, is using information that it gained in the first semester to revise a small number of its programs. This may be a reasonable way to evolve programs of quality, particularly if several cycles are possible. Ideally, there would have been a budget for pre-testing and revision prior to the first broadcast.

A second problem was with the kind of information that the project had collected about their programs. It was almost solely concerned with what the students liked and disliked about the characters and format of the presentation, not with whether the content was being learned. Such attitudinal information has limited usefulness for guiding revisions of the programs, although it can be valuable for making other changes in project operations. The learning measures consisted primarily of a final examination given at the end of the semester, which might tell something about whether students had learned anything from the course, but would not provide much information about where or how to revise programs that had failed to convey the content.

Other techniques were also used by the projects for gathering data and getting feedback about how their programs were succeeding in the field. One project, which had a relatively limited number of sites, made an informal telephone survey of the sites after each broadcast. Most projects received reports from their field personnel on a regular basis. Some called regional meetings of the field people to let them share their experiences with each other and with project management. In one program, traveling consultants, who had substantive responsibilities for instruction, were de-briefed by the producers to get information about how well the programs were working.

Format and Presentation

The primary determinant of the presentation format for instructional programming must be educational, not aesthetic, considerations.

There was a strong tendency in some projects to adopt a "dramatic" or "entertainment" approach for the presentation of the course content. We were convinced by what we observed in these projects that in most cases the use of dramatic vehicles for presentation, the inclusion of humor, the use of elaborate sets, color, and slick production techniques and the attempt to "keep the audience entertained while they are learning" were irrelevant to the intended effects of the instruction. While it is true that users will not watch dull programs for long, interesting programs can be produced without color and slick techniques. Neither color nor slick techniques will make a dull program interesting. In many instances we felt that the use of such approaches could degrade the educational effectiveness of the program. We do not argue for the complete exclusion of such techniques, but rather for making them subordinate to educational goals.

The use of dramatic vehicles has other drawbacks beyond the fact that it can actually impede learning. More preparation time and a higher level of performing talent is necessary to produce dramatic material. It also requires that a significant portion of the broadcast time be devoted to activities that establish and maintain the dramatic flow.

One producer told us that the content density in many of the segments he produced was kept deliberately lc', in order to slow the pace of instruction and add levity to the process. There may be merit in low content density that is based on empirical evidence, but we doubt that the best way to keep the density low is to use the available time to sustain an irrelevant drama or to provide a stage for humorous skits. This time could more profitably be used for review sessions, or for making it possible to transmit a greater diversity of programs in a fixed amount of satellite time. In another project, the local coordinator reported that the lectures transmitted to the college level students at her site were "over produced" and that the use of elaborate visual aids prepared by the graphics department seldom added much instructional value when compared to simple chalkboard drawings.

Attempts to adopt formats from other contexts can be counter-productive.

The projects whose audiences were in-school youngsters all seemed to want to emulate programs like "Sesame Street" or "The Electric Company" in the use of very slick, fast and humorous sequences. The budgets and time for research, development and production of the ATS-6 programs are nowhere near that available to the well-known national shows. The ATS-6 projects conducted almost no research in the development of their programs; the nationally produced shows relied very heavily on empirical measures of success in their program development. It does not seem reasonable to try to imitate the techniques of a program that had an hourly program budget many, many times larger.

Different audiences and subject matters require different approaches.

We noted differences between audiences in what features they seemed to like and in what approaches were most appropriate for different topics. The broadcast length that was tolerable was different for different audiences. One series of programs for eight to ten-year-olds that ran for 20 minutes without prompting any active response exceeded the attention span of the students. In a similar series of programs that did prompt the students to make active responses during the pre-taped portion of the instruction, the audience of five to seven-year-olds was not ready to sit through a 30-minute broadcast and interaction session.

Young students reported liking the characters portrayed by puppets much better than those played by real actors. Both younger students and college graduates told us that they liked the use of film-clips shot "out in the field" to show real examples of the things being talked about in the course. Adult audiences in Alaska seemed to enjoy the segments that were filmed in the villages more than those made in the studio. Panel discussions seemed to draw mixed reactions, probably depending on the individual's interest in the topic of discussion. In appropriate contexts, such as the medical education programming, the use of "talking heads" was positively received. In a number of cases involving attempts to interject humor into the programming, it seemed that the production center's sense of humor was not understood at the remote sites. For example, actors would do a part parodying a well-known figure and the audience would miss the humor entirely, perceiving the actor's behavior only as strange. In another instance, a character modeled after a sportscaster with a very distinctive style was used. The programs were broadcast to an audience not overly familiar with television and they did not understand why the character's mannerisms were so affected.

One course was essentially a correspondence course using video lectures in both satellite and videotape forms. They found that one of the virtues of correspondence courses--self-pacing by the students--was lost to the rigid schedule of the satellite. Attendance nearly doubled at continuing professional education courses for teachers when arrangements for teachers to get graduate credit for the courses were made. The basic lesson for planners is that there is no single approach that is good for all circumstances.

<u>Software may have to be adapted to accommodate local and cultural differences.</u>

The ATS-6 projects in the United States do not shed much light on the extent to which it may be necessary to adapt programming to fit local conditions or cultural differences. To begin with, the question of what is localization must be sharpened somewhat. One way to localize would be for the project's central studio to produce different versions of the programs that it feels are adapted to fit the differing circumstances. Consumer committees, such as were used in

Alaska, can contribute significant advice and guidance. Another method is to transfer some control of the system to the remote sites by giving them choices among different programs or by structuring the systems so that scheduling can be done by the remote sites. Still a third type of localization could be accomplished by turning some production responsibilities over to the remote sites, either for local use (as is the case for many of the suggested supplementary activities) or for rebroadcast to some or all of the sites.

The ATS-6 projects make very few concessions to localization or to the concept of minority programming needs. Across the breadth of the projects, there are many cultures and a fair amount of linguistic diversity. There are also sizeable differences both in socioeconomic strata and in life-style.

One program especially adapted to local culture needs and the needs of minority audiences is the "Alaska Native Magazine". It uses a discussion format with inserted film clips made in the local sites and it addresses "Native" issues. It seems well-received by all audiences, including the non-Natives who view it. This same program incorporates the projects' only use of multiple language programming, by broadcasting simultaneous language translations into two Native languages on the ATS-6's extra audio channels. There are several factors, though, that make it difficult to draw any firm conclusion from this experience. To begin with, everyone has to listen to the same language. Almost all of the audience speak English and many do not speak their Native languages. Secondly, the presence of whites who speak only English may inhibit requests to listen to a Native language translation. Finally, the program topics are of strong interest to all Alaskans, Native and non-Native and to people of many different socioeconomic groups.

The Rocky Mountain STD programmed no special language or content for the wide diversity of minority groups within its coverage area, although it was careful to use actors from many of these groups. The rationale is that all of the students who view the programs are already being instructed in English in their schools. Schools with high proportions of Spanish-speaking pupils report no problems, either in language or content matters, related to cultural differences. There were no complaints received from any minority groups, relating to the absence of any specific minority group programming or minority language use.

We saw programs that failed because they were either irrelevant to local needs or culturally inappropriate.

One such program, purchased from an outside source, uses a cast of well-dressed and obviously middle-class children. They are shown climbing to the attic of an old Victorian-style house to rummage among things stored there; these "things" are used to illustrate the health-care lesson being taught. The film shows them walking up a very narrow, steep stairway, a visual "cue" to the fact that it is an attic being entered. We watched this program with children in a very isolated village. None of them had ever seen a Victorian-style house, nor an attic. They were mystified by this "funny" room and the collection of strange things in it; the content the film was trying to teach was obscured by their inability to identify the locale.

An example of localization by turning some control of program choice and scheduling over to the sites is found in the Materials Distribution Service. This was, as earlier discussed, very well received; perhaps because it was addressed to fairly limited goals. It might be difficult to administer in another or larger application.

Locally produced programs might have the most impact when used locally. On an Indian Reservation in the Rocky Mountains, we viewed the Denver-produced program with a group of children. The children were bored and restless. (In all fairness, similar reactions of boredom were observed, although perhaps not to the same degree, when we watched the same programs with non-Indians.) After the broadcast, we were invited to view a program the children themselves had made, using a portable videotape recorder. It was an interview with the local storekeeper (one of the few jobs in the community). The tape was an extremely amateurish, black-and-white production. The camera was so unsteady it was hard to watch the picture. The child conducting the interview shook from stage-fright and there were long pauses when he tried to get up enough nerve to ask the next question. The focus and sound faded in and out. The lighting was dim. But, within minutes after the start of the tape, the room had filled with students who had come to watch and who were (as we were) enjoying it immensely.

We do not recommend decentralizing production but wish to make the point that locally produced programs do have a certain strong appeal to local people. In a different project in which local productions were broadcast to a wider audience, the experience was not particularly reassuring. The programs, although of a nearly professional quality, were used by the local sites as an opportunity to "show off" their own skills and physical facilities and were not very enlightening for the rest of the viewers.

One producer suggested bringing in people from remote sites to appear in the studio as a way of localizing the productions. Another suggestion is that there be strong input from user groups to the central production staff.

There are clearly some points in favor of some localization; the amount of it and the approach used seem to be matters that are country-specific and situation-specific.

Interaction

It will be helpful to describe interaction and to consider the different reasons for using it before reporting our findings on how it was used. Interaction is simply the planned capability of the satellite to furnish two-way voice or voice and video channels between the production centers and the remote sites.

One mandate given the ATS-6 demonstrations was to make use of the interactive capabilities of the system; as a result, there is a wide variety of evidence on different uses. A main hope in using interaction was to increase the learning resulting from the educational programming, by clearing up any confusion resulting from the programming and answering program-related questions. A second major intention in incorporating interaction was to increase student motivation and acceptance of the system, by creating the feeling that the project is responsive to local needs. A third purpose was to provide a channel for administrative communication so that local problems could be solved, messages from management could be easily transmitted, efficient coordination of activities could be accomplished, and feedback from the sites could be gathered. Finally, some of the projects, such as administrative conferences and medical consultations, consisted only of interaction. The reasons for designing an interactive capability into the system are not mutually exclusive, and most projects used it for more than one purpose.

There were many technical difficulties in implementing the two-way interaction capabilities. These problems derived, in part, from the late implementation of a compromise system using older satellites with inadequate audio signal qualities, rather than a problem with any technology designed for these projects. These technical difficulties often made communication in the intended fashion unintelligible. Hence, interpretation of the evidence on interaction is difficult. But the important issues for planners of other systems are conceptual ones, concerned with whether the application of a particular type of interaction in a given situation is likely to succeed. When we give examples of the use of interaction, we will try to exclude the problems caused by poor signal quality and confine ourselves to the conceptual issues.

The most common way of using the interaction capability in the ATS-6 educational programs is to transmit a prepared program and follow it with a short interaction period during which the remote sites could talk with an "interactive teacher" in the studio. Only one person can speak at a time. He is heard by all sites. This approach is used for the educational programming directed to large groups of young students. In some cases, the "interactive teacher" tries to talk to all of the participating sites each day; in others, only a few sites out of the total are given the opportunity to talk on a given day.

The usual system uses one microphone per class of perhaps 30 students and one or two interactive teachers who answer questions from one site at a time.

<u>For large audiences of young students, two-way interaction with a studio teacher does not seem to contribute to educational goals.</u>

There are many problems with the approaches tried in these projects. First, the structure of the communication channel creates a bottleneck at the classroom level for funneling questions into the studio, and one at the studio where questions have to be taken one at a time. Second, because there is no time lapse between the program and the interaction, the sites have no time to discuss the material and formulate good questions. The questions are often quite specific and thus not of interest to the whole audience. Third, despite the fact that everyone can hear the questions asked by the other sites, questions are often redundant. It often seems that students ask questions not because they want to know the answer, but because they wanted a chance to talk on the satellite or they felt they were expected to ask a question.

Fourth, teachers consistently reported that their students did not pay attention to the interaction except when they were actively involved. The negative effect of losing the interest and discipline of the students by having them sit through the other sites' questions seemed to outweigh any educational advantages that their exposure to the other questions might have had. Some sites reported that they turned off the TV set during the interactions when they were not required to respond.

It appears that, if interaction is to be at all useful with younger students, they will have to have time to prepare their questions. The interaction will have to be available to each site for a much longer period of time, so that they can actually engage in a dialogue with the interactive teacher. Interaction might not have to be available on a daily basis. It should probably be organized so that sites do not have to listen to other sites' questions, although it might be valuable for sites to be able to talk to each other on occasion. Several sites told us they would like to use the interaction channel to talk to other sites.

<u>For adults, interaction for educational, medical or administrative purposes can be valuable if it is properly structured.</u>

Most of the instructional programs for adults also use pre-taped lessons that precluded the interjection of questions during the program. But, adults are much better able to articulate their questions and to pose questions of general interest. For these reasons, and because adults have longer attention-spans, they seem less bothered by sitting through the questions asked by other sites. The adult classes are also smaller in size and fewer in number, so the process of polling them is not so tedious.

In a project that broadcasts to hospital staffs, the management told us that they found it better to use more interaction in their pre-produced programs. They also reported a desire on the part of their sites to interact with each other directly, rather than just with the studio. However, the programming in this case was more of a sharing of experiences among already highly-trained and experienced professionals than an attempt to teach entirely new content. And, there were never more than ten sites involved, which holds the communications problems to a relatively low level.

One college class demonstrated that satellite interaction can come very close to duplicating a traditional classroom situation. This experiment uses two-way video to transmit live pictures of the students to the professor and of the professor to the students at the same time. There is only one small class involved, and each two students have a microphone through which they can interrupt with questions. Given the opportunity, they do interrupt frequently, and seem to learn from and enjoy the class. Unfortunately, there seems to be no reasonable way of replicating this situation in a mass system.

A possible solution to the problem of how to structure "mass" interaction so that it is valuable is tried in one of the teacher training projects. It has periodic interactive seminars along with its schedule of pre-taped lessons. Teachers' questions about the previous sessions are collected and transmitted to the studio before the beginning of the seminar. Staff at the studio screen the questions for redundancy and organize them for the studio instructor. In this way, questions of general interest get priority treatment. The satellite channel is available for students to transmit additional questions during the broadcast; these questions are also received by off-camera staff and thus do not interrupt the entire discussion, but can be given to the professor during the broadcast for a timely response. The advantage of an organization such as this is that it provides a mechanism for "filtering" the questions. The same result could be accomplished on a daily basis by providing more channels for the remote sites to transmit their questions over and not requiring that the questions be received or responded to "on camera".

Several projects tried unsuccessfully to incorporate sessions that relied exclusively on interaction. One tried to use a seminar format to have students discuss assigned readings. Their experiences in the first semester led them to modify the program to present content in a more structured way and relegate the discussion to a more supplementary role. The project still retained a strong emphasis on out-of-class assignments. Another project's attempt to devote one-third of its programming hours to interaction sessions in which students could engage in long interchanges with the studio instructors was abandoned; the reason seems to have been a combination of frustration with the poor technical quality of the transmission and with the problems resulting from the mis-match between the large audience size and the limited channel capacity.

In cases of administrative conferences and medical care delivery, the interaction does not serve as a <u>supplement</u> to educational programming, but is itself the point of the project. Several relevant comments can be made about these uses. The medical users find the restriction to fixed schedules confining. They need access to the system on demand at least for some of the cases they deal with. Perhaps a combination of scheduled availability and a limited demand-access would be best.

The two-way video administrative conferences are accomplished without much trouble, but there is no convincing demonstration of the necessity for video in meeting the goals of the conference. In fact, there were some instances in which the fact that the conference was held in the television studio (rather than over a telephone or radio channel that could be "phone-patched") interfered with the ability to come to a decision in the conference. The administrators were separated from their files and calendars and had to defer action on items that needed checking until they had access to their records.

A communication channel for interaction for project administration is imperative.

The use of audio channels for administrative communication is critical to the efficient running of the project. The purpose of the interaction is usually to exchange relatively mundane, but nevertheless critical pieces of information, such as answering questions about equipment adjustments, scheduling of coming programs, late delivery of expected supplies, and provision of feedback from the remote sites to project management. Many of the problems in the ATS-6 projects are directly traceable to failures of administrative communication. When people in remote sites criticized their own projects, the issue of communication between the local and central staff was one of the first things they mentioned. We conclude that the provision of a channel for administrative communication is essential for the smooth functioning of a satellite system, especially in areas that are not well served by more conventional communication channels.

Interaction can have good and bad effects on student motivation and acceptance.

Interaction can exert fairly powerful influences on students' attitudinal responses to the educational programs, but in both positive and negative directions. We saw many instances in which the post-program interaction bores or alienates the students. Yet, some teachers who play videotapes of the satellite broadcasts later in the day for other classes think that the classes that receive the programming with the live interaction are more involved in the course. No doubt some of the motivating force will erode as the newness of the enterprise fades, but we can not dismiss the possibility that fostering a sense of participation in the local classrooms will be a positive force. On the other hand, unless the interaction is carefully structured and adapted to the specific situation, it can have very deleterious effects. We do not see significant differences between audio and video channels in their ability to create this sense of involvement; in this context, the cost-advantage of audio would probably be a deciding factor in any case. But, we would like to see more research on the use of the mails or of occasional inter-personal contacts (such as with local tutors or itinerant teachers, or in regional meetings). As supplements to regular administrative communication over the satellites, they may provide some of the positive aspects of interaction more cheaply, or more effectively, or both.

Further Considerations

This section contains discussions of some topics worth reemphasizing, and adds some items that did not fit into the previous structure. Formal evaluations and policy studies of the ATS-6 projects will be forthcoming in the next year from a variety of sources. These studies should be valuable resources for planners considering satellite projects. While this paper is concerned exclusively with the satellite projects in the United States, the limited focus should not be interpreted to mean that satellites for education and development are appropriate in every situation.

Planning

The kind of planning and changes necessary for introducing an educational media system can provide the opportunity to implement other reforms in the educational system or curriculum as well. Conversion of a traditional educational system to a media-based one might also "energize" the system, but the enthusiasm generated by the introduction of television may not be long-lasting.

Analysis and planning for complex educational and social service delivery programs that use sophisticated technology must be quite detailed. An LDC planning for a satellite system would have a distinct advantage over the ATS-6 projects because it would have time to conduct a comprehensive needs assessment beforehand, and could base its planning on the findings of the research. Such a study could reveal information about the learning environment and existing communication facilities that could be used in a hybrid system. The satellite design could then be optimized for the intended uses.

One decision area that may cause grave problems is that of who can be left out of a planned system. It may not be economically, or even technologically, feasible to provide services to the entire population. When the project is simply a demonstration, as was the case with the ATS-6, this is not a significant problem. But, in operational projects, the question of who is to be excluded may become a major issue. Serious consideration needs to be given to what the political implications of such a decision will be.

Some of the planning required is very long-term. For example, there is a danger that the frequencies that would be the most desirable for an operational satellite broadcast system may be allocated to other uses or other users before the demand in LDCs for them exists. This issue has serious implications for those who are not now planning satellite educational systems but who might consider them in the future. As it was recently expressed by Marcel Thue, Chairman of the French Frequency Committee, "The frequency spectrum should be treated as a permanent but limited natural resource, like water." (15)

A parallel problem is that a shortage of geostationary orbit parking spaces for satellites may develop first. The significance of this to the LDC planner, if preliminary analysis shows that a satellite would be desirable, is that he must take steps in the near future if he hopes to have space available at a time considerably distant. He must work in coordination with people planning other communications systems in his country, since interference problems may be generated that will only surface years from now. He must be in close contact with the various international agencies and bodies concerned with communications regulation. This may require involvement in a whole series of activities in which the country has never before been a major participant.

Technology and Costs

Cooperation between planners of satellite systems and people involved with terrestrial communication systems is important not only for avoiding interference, but also because any operational project would undoubtedly use a hybrid system to some degree. A hybrid system is one that uses combinations of satellite and ground-based communications in an integrated system.

Several approaches to "hybridization" might be employed. A system might use a satellite to distribute the programming, but incorporate a variety of media at the receiving sites. Or, one might re-orient existing commercial or government-owned communication media to provide the services. Still another approach would be to implement an entirely new satellite system for educational and other communications needs, perhaps paying for part of the educational channel by charging other users higher rates.

Projects would probably employ a "mix" of technologies, such as television, radio, telephones, traditional classroom instruction, or whatever is most culturally appropriate and cost-effective. Devices for local recording and storage of transmitted programs might be an important part of such a system.

One technology that might be a supplement or an alternative to television satellites is the "tethered balloon".

A transmitter is attached to a large balloon; the balloon is secured to the ground by a cable and allowed to rise to a suitable height. From there, a cheaper, less powerful transmitter can cover the same area that can be covered using a conventional high-powered transmitter and antenna. The hardware for this technology can be supplied "off the shelf", unlike satellites or ground station hardware, much of which has to be specially built. Tethered balloons can also interconnect telephone exchanges, transmit mobile radio messages, or pick up and retransmit distant television signals. The relative costs of the balloon system are believed to be advantageous if the area to be covered is small.

The cost data from the ATS-6 projects are difficult to apply to other projects. Costs of different items and services vary from country to country; elements taken for granted in the United States may be more or less costly or may not exist in LDCs. Labor costs may be lower, but the need for costly imports, for training, and for expatriate help may offset these. The cost of retraining teachers in a project can be significant. Resource material will have to be supplied for use with the television curriculum. If the system succeeds in upgrading the teachers' level of expertise, they may soon demand higher salaries. If a project is going to serve a large number of sites, the total cost of the receiving equipment will be large, even though the unit costs may fall.

Satellite projects can add some additional capabilities to an educational system; they can replace some, but not all, of the functions performed by traditional education. Some of the capabilities permit lower unit costs than before or displace costs previously incurred. But it seems likely that the total cost of the education system will be higher if it is partially based on educational satellite systems. In this sense, technologies such as this represent an add-on to educational costs. The value of an add-on must be judged by the value of the increased benefits it supplies.

Finally, planners must keep in mind that there will be some effects, both good and bad, that they cannot predict in advance. As Michael Oakeshot has said,

> *"Innovating is an activity which generates not only the 'improvement' sought, but a new and complex situation of which this is only one of the components. The total change is always more extensive than the change designed; and the whole of what is entailed can neither be foreseen nor circumscribed. Thus, whenever there is innovation, there is the certainty that change will be greater than*

what was intended, that there will be loss as well as gain, and that the loss and the gain will not be equally distributed among the people affected; there is the chance that the benefits derived will be greater than those which were designed; and there is the risk they will be offset by changes for the worse." (16)

LIST OF OBSERVATIONS

Public Response

Audiences in the United States have no difficulty accepting the satellite technology.

Hardware

Planning

In the ATS-6 projects, system design was determined by technological considerations, rather than health or educational needs.

Planning for satellite delivery of educational or social services must take into account existing technological systems and future considerations.

The question of who has priority in the system must be dealt with in the planning process.

Design

Very specific details of the user's environment must be taken into account at the design level.

Consideration must be given to the fact that equipment will not always be used by engineers, and that engineers may not be readily available when needed.

Manufacturing and Delivery

Ample lead-time is a necessity.

A generous stock of spare parts is a necessity.

Special attention must be paid to adverse climatic conditions and the possibility of vandalism.

Installation and Training

A "decentralized" approach to installation seems to have been effective.

It is essential to train people in the use of the equipment.

Equipment procurement should probably be centralized.

Field Support

Staff level support at remote sites is imperative to the successful functioning of the program.

Field support personnel must be trained to do their jobs.

Strong support and feedback needs to be provided to field personnel.

Management

Planning

A clear definition of project objectives is a critical necessity from the outset.

Planning should be solidly based on local needs.

Overselling the benefits of a high technology delivery system can create problems.

Planning for the development of personnel resources is essential.

Internal Coordination

A method of creating interdisciplinary cooperation must be devised and implemented from the outset.

There is a need for clear, simple lines of responsibility.

External Coordination and Relations

Relations with sponsoring agencies must be clearly understood and goals must be clear at all levels.

The project should develop links with existing institutions.

Innovative projects must have consistent high-level support.

Software

Curriculum Design

User input must be obtained at the earliest stages of the curriculum design.

Supplementary activities and materials have a significant role to play in an educational media system.

Instruction via the satellite should be integrated into existing curricula.

Rigid scheduling of the program has some drawbacks.

Software Production

The production of video software requires more time and effort than many planners expect.

The scripting and production effort must involve people from all relevant disciplines.

The production effort must have clear objectives and priorities.

Every effort must be expended to ensure that the programs actually produce the desired result.

Format and Presentation

The primary determinant of the presentation format for instructional programming must be educational, not aesthetic considerations.

Attempts to adopt formats from other contexts can be counter-productive.

Different audiences and subject matters require different approaches.

Software may have to be adapted to accomodate local and cultural differences.

Interaction

For large audiences of young students, two-way interaction with a studio teacher does not seem to contribute to educational goals.

For adults, interaction for educational, medical or administrative purposes can be valuable if it is properly structured.

A communication channel for interaction for project administration is imperative.

Interaction can have good and bad effects on student motivation and acceptance.

THE AUTHORS

Bert Cowlan is a consultant in education, communications and technology. Among others, he has served UNESCO; various U.S. Government agencies (The Bureau for Technical Assistance/Education and Human Resources, U.S. Agency for International Development; the Bureau of Educational and Cultural Affairs, U.S. Department of State; the National Institute of Education). Non-governmental consultation has been for the J. Henry Schroder Banking Corp. (for a study of cable television and ancillary devices); the (Iranian) Institute for Research and Planning in Science and Education; the United Nations Institute for Training and Research; the Systems Development Corporation; the Westinghouse Population Center. He has taught and lectured at the University level and has worked in Australia, Cyprus, England, Ethiopia, France, Germany, Iran and Thailand on various projects at different times.

Dennis Foote is completing his doctoral work at the Institute for Communication Research at Stanford University. He has been actively involved with the ATS-6 health and education experiments since mid-1972, when he participated for ten months in an early evaluation planning effort for the Rocky Mountain project. For the past year and a half he has been working on evaluating the medical teleconsultation experiments on ATS-1 and ATS-6 in Alaska. His previous experience includes research and development of instructional materials, consulting on instructional systems design and community development work in Brazil.

FOOTNOTES

1. From Arthur C. Clarke, in an article in the UNESCO COURIER of March, 1970. It was based on an address given to an international space communications conference. Mr. Clarke is the internationally-known science writer, widely credited as "the father of the communications satellite" because he had advanced the concept of one in a paper in Wireless World, in October, 1945.

2. From Dr. Carroll V. Newsom's article, "Communications Satellites: A New Hazard for World Cultures," in the April, 1973, issue of Educational Broadcasting Review. Dr. Newsom is retired vice-president of education, RCA and former president of New York University.

3. "Broadcast Satellites for Educational Development: The Experiments in Brazil, India and the United States." Bert Cowlan, Dean Jamison, Kenneth Polcyn, Jai Singh, Delbert Smith, Laurence Wolff. Prepared by the Academy of Educational Development under Contract No. AI/csd-2829 for the Office of Education and Human Resources, Bureau for Technical Assistance, U.S. Agency for International Development.

4. The satellite is called ATS-6 because it was the sixth to be launched in its series. Prior to launch, the letter designation "F" was used; once operational, the letter designation was dropped and the number is used.

5. Private memorandum, Cowlan to Foote, Baldwin, White, Love; 11 February, 1975. Based on telephone interviews with individuals involved at the time.

6. From Lawrence P. Grayson of the National Institute of Education, Washington, D.C. Article in "Journal of Educational Technology Systems," Vol.3 (2), Fall, 1974.

7. Op.cit. "Broadcast Satellites for Educational Development: The Experiments in Brazil, India and the United States.

8. "The World's Telephones as of January 1, 1972." A report from the American Telephone and Telegraph Co.

9. 2.8% of the children are 11 years old; 26% are 12 years old; 43%, 13 years; 19.6%, 14 years; 6%, 15 years old. The remainder, 2.4%, are older.

10. University of Washington, Seattle; Washington State University; University of Alaska, Fairbanks; Montana State University, Bozman; University of Idaho, Moscow.

11. Educational Technology Group of the Bureau for Technical Assistance/Office of Education and Human Resources, U.S. Agency for International Development, Washington, D.C.

12. A publication put out regularly over the signature of Dr. Gordon Law, Project Director of the Satellite Technology Demonstration, from the Rocky Mountain Region's STD headquarters in Denver, Colorado.

13. Dr. Jerrold Zacharias of the Education Development Center, Newton, Massachusetts, project director of a $4 million program series on mathematics, "Count Us In," which is funded by the U.S. Office of Education. Dr. Zacharias was quoted in an article by Robert Reinhold in <u>The New York Times</u>, 7 April, 1975.

14. Some existing tropospheric scatter systems already share the frequencies which are being contemplated for direct broadcast satellite use. Africa already has several "tropo scatter" systems in place and is planning or building more. This may impact upon any plans for direct satellite broadcasts to Africa, especially in the region south of the Sahara.

15. Quoted in <u>Intermedia</u>, the Journal of the International Broadcast Institute, London, England, Vol. 2, No. 4, 1974.

16. Michael Oakeshot, 1962. From an unknown British source.

APPENDIX A

THE INTERNATIONAL WORKING-LEVEL CONFERENCE ON THE USE OF SATELLITES FOR TELECOMMUNICATIONS SYSTEMS IN EDUCATION AND NATIONAL DEVELOPMENT

The call to the A.I.D. conference stressed that "...A.I.D.'s role...is not to endorse the merit of satellite technology over other communications media, but to facilitate exchange of information, problems and alternative approaches among those planning ongoing experiments or feasibility studies."

Among the geographic areas of the world represented at the conference were: Alaska; the Appalachian and Rocky Mountain regions of the United States; Africa, South of the Sahara (through a representative from the Ethiopian-based Economic Commission for Africa); the Andean Latin American countries of Colombia and Venezuela; the Arab States Region (through a delegate from the Arab League); Brazil; Canada; India; Indonesia; Iran and New Zealand. UNESCO, Paris, was also represented.

From both participant comments and other measures, the conference fulfilled its objectives; it met the need. The feedback has been gratifying in terms of the relevance of the activity to those who attended.

Three weeks after the conference took place (1), the ATS-6 which had been delayed, was launched. It became evident that more information was wanted by those who had attended the conference and by others who were at different points in their planning process. And, for that matter, information was being requested from those who wanted advice as to whether to plan at all to use satellites for education and development.

(1) May 3-10, 1974, Denver, Colorado, and Heber City, Utah.

APPENDIX B

CONTACTS MADE DURING THE COURSE OF THE CASE STUDY

The list which follows is of those to whom we talked at length during the course of the study. Contacts with many of the individuals named took place more than once. They are all owed a debt of gratitude for their time, their thoughts, their willingness to share. If we have left anyone out inadvertently, our most sincere apologies. Needless to say, any errors of fact or of interpretation are our responsibility, not theirs.

Virtually all major management centers, production centers, places at which scripts or ancillary materials were prepared, were also visited. The Fairchild Industries plant, where the ATS-6 had been manufactured, was visited. These visits were conducted at many levels of concern in the different geographical areas named. We saw people in State education offices, in library systems, in medical and health care systems and programs.

Contacts, which included many at the United Nations and its agencies, and at the International Broadcast Institute, were also consulted. We talked to the Syracuse University Research Corporation to share preliminary findings of their analysis and assessment study, to Practical Concepts, Inc. (who hold an evaluation contract), the Center for Northern Educational Research, to the Institute for Communications Research at Stanford.

Meetings of the Public Service Satellite Consortium, both in Denver and San Diego, California, provided an opportunity to interact and discuss perceptions of the project with a wide range of professionals interested in satellite technology, in satellites for education and development.

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APPENDIX C

LIST OF EXPERIMENTAL SITES

ROCKY MOUNTAIN SITES

KEY:
S = School
PBS = Public Broadcasting Service TV Station
RO = Receive Only Terminal
I = Intensive Terminal
MT = Master Transmitter
FRMS = Federation of Rocky Mountain States

Arizona

Fredonia	S	RO
Gila Bend	S	RO
Hayden	S	I
McNary	S	I
Phoenix	PBS	RO
Seligman	S	RO
St. Johns	S	RO
Tuba City	S	I
Tucson	PBS	RO

Colorado

Antonito	S	RO
Collbran	S	RO
Craig	S	RO
Denver	PBS	RO
*Denver	FRMS	RO
Meeker	S	I
*Monte Vista	S	I
Montrose	S	I
Morrison		MT
Naturita	S	RO
Pueblo	S	RO

Idaho

Boise	PBS	RO
Challis	S	I
Lapwai	S	I
McCall	S	I
Moscow	PBS	RO
Osburn	Cable head-end, serves Wallace, Kellog, Silverton	RO
Pocatello	PBS	RO
Salmon	S	RO
St. Maries	S	RO
Vallivue/Caldwell	S	RO

Montana

*Busby	S	I
Colstrip	S	I
Ft. Benton	S	I
Roundup	Translator	RO
Three Forks	S	RO
West Yellowstone	S	RO
Whitehall	S	RO

Nevada

Battle Mountain	S	RO
Carlin	S	I
Elko	Cable, head-end	RO
Ely	Translator	RO
Las Vegas	PBS	RO
Las Vegas	Into microwave system for transmission to cable head-end in Reno	RO
McDermitt	S	I
Owyhee	S	I
Winnemucca	S	RO

New Mexico

Albuquerque	PBS	RO
Cuba	S	I
*Dulce	S	I
Môra	S	RO
Penasco	S	I
Portales	PBS	RO
Questa	S	RO
Springer	S	RO
Wagon Mound	S	RO

UTAH

Blanding	S	I
Enterprise	S	I
Heber	S	I
Hyrum	S	RO
Kanab	S	RO
Morgan	S	RO
Panquitch	S	RO
Provo	PBS	RO
Salt Lake City	PBS	RO

Wyoming

Arapahoe	S	RO
Dubois	S	RO
Lovell	S	RO
Pinedale	S	I
Riverton	S	I
*Saratoga	S	I
Sundance	S	RO

APPALACHIAN REGION EDUCATION SITES

KEY: RESA = Regional Education Service Agencies
I = Intensive Terminal
RO = Receive Only Terminal

Alabama Group

Huntsville	RESA	I
Guntersville	RESA	RO
Rainsville	RESA	RO

Kentucky

*Lexington	University of Kentucky	RO

Maryland Group

*Cumberland	RESA	I
McHenry	RESA	RO
Keyser, W.Va.	RESA	RO

New York Group

Fredonia	RESA	I
Olean	RESA	RO
Erie	RESA	RO

Virginia Group

Norton	RESA	I
Stickleyville	RESA	RO
Boone, N.C.	RESA	RO

Tennessee Group

LaFolette	RESA	I
Coalfield	RESA	RO
Johnson City	RESA	RO

APPALACHIAN REGION

Altoona, Pennsylvania
Beckley, West Virginia
Clarksburg, West Virginia
Dublin, Georgia
Fayetteville, North Carolina
Mountain Home, Tennessee
Oteen, Virginia
Salem, Virginia
Salisbury, North Carolina
Wilkes-Barre, Pennsylvania

ALASKAN EDUCATION SITES

KEY: S = School
ES = Elementary School
UA = University of Alaska
OT = Governor's Office of Telecommunications
HC = Health Clinic
CH = Cable head-end
COMP - Comprehensive

Alaska

*Allakaket	S	I
Angoon	ES	I
Aniak	S	I
Chuathbaluk (1)	S	I
Craig	S	I
*Fairbanks	UA	COMP
Galena	S	I
*Juneau	OT	COMP
McGrath	S	I
Minto	S	I
Nenana	S	I
Nikolai	S	I
Petersburg	ES	I
Sleetmute	S	I
*Tanana	HC	I
Valdez	CH	I
Yakutak	S	I

Washington, D.C. (2)

	National Institute of Education	RO

(1) Also known as Russian Mission, and Little Russian Mission.

(2) The receiving unit in Washington, D.C. is simply a receiver; there is no participation from Washington in the programming.

ALASKAN MEDICAL SITES

KEY: H = Hospital
C = Clinic
MS = Medical School
RO = Receive Only Terminal
COMP = Comprehensive

*Anchorage	H	RO
*Fort Yukon	C	COMP
*Galena	C	COMP
*Tanana	H	COMP
*Fairbanks (3)	C	COMP
Seattle, Washington	MS	COMP
Omak, Washington	C	COMP

(3) Inoperative
* Sites Visited

APPENDIX D

TECHNOLOGICAL OBJECTIVES AND SPECIFICATIONS

NASA's view before launch was that a number of unknown factors made the entire planning process quite complex. Among them were:

- -The underlying communications technology, while well established, has never been applied in the manner contemplated for this overall project:

- -Never before have so many satellite earth stations, more than 100, been implemented across a 23-State region:

- -The project represents an ambitious attempt to create a user-based information system.

The primary technological objectives of the ATS-6 are: (1) to demonstrate the feasibility of deploying a 30-foot diameter parabolic antenna in space; (2) to provide a satellite with fine pointing (0.1), slewing (17.5 in 30 minutes) and tracking capabilities; and (3) to provide an oriented, stable spacecraft platform at synchronous altitude for advanced technological experiments to be selected by the Space Science and Applications Steering Committee. (1)

The ATS-6 weighs 3,090 pounds (1,402 kilograms) and consists of five major structural elements: a solar array, an earth-viewing module, a structural hub, a reflector support truss, and a reflector. It develops its power from an array of more than 21,000 solar cells. Excess power from these is captured in two batteries, which provide power when the craft is on the side of the earth away from the sun.

The earth-viewing module houses antennas and other experimental devices; contains the attitude control, propulsion, telemetry, and command mechanisms, as well as part of the power supply subsystems; and houses the signal receivers and emitters.

The structural hub supports the antenna/reflector and serves as the mounting surface for the solar array trusses.

The reflector is a structure which was deployed into a parabolic configuration 30 feet in diameter; it is the largest reflector yet carried into space.

This reflector concentrates signals so that they are so powerful they can be picked up by the relatively inexpensive ground stations. The satellite carried two high-powered transponders (operating in the 2,500 MHz range). Each transponder bounces a signal off the parabolic reflector to produce a southern beam and a northern beam forming a giant "footprint" on the earth. The size of the footprint depends on where the satellite is pointed. It is typically several hundred miles or more across. Each video transponder has four associated audio channels.

Another transponder enables Satellite Technology Demonstration engineers in Morrison, Colorado (near Denver) to monitor all transmissions. This unit produces a "global" beam capable of being received by the high performance earth station near Denver as well as NASA control stations in Rosman, North Carolina and Mojave, California.

The ATS-6 was assembled at the Fairchild Industries complex in Germantown, Maryland. Its on-board sensors, torquers and controllers are backed up by duplicate or even triplicate components. Its major subsystems were assembled and tested independently of each other.

(1) "The ATS-F Data Book," Goddard Space Flight Center, May, 1974.

APPENDIX E

TABLE OF EXPERIMENTS

Experiment	Type*	Major Objectives
Health, Education, Telecommunications (HET)	C	To evaluate a system that will permit relay of television programs through the satellite to facilities such as schools, CATV systems, and clinics.
Satellite Instruction Television Experiment (SITE)	C	To demonstrate relay by geosynchronous satellite of CCIR** quality television from a high-powered program transmitting station to small modified standard TV receivers located throughout rural India and to urban re-broadcast stations.
Television Relay Using Small Terminals (TRUST)	C	To advance state-of-the-art in space communications by demonstrating CCIR** quality wideband signaling between ATS-F and inexpensive ground stations.
Radio Frequency Interference (RFI)	C	Investigate C-band terrestrial noise sources (geographical/noise power distribution).
Millimeter Wave (MMW) (20 & 30 GHz)	C	Investigation of atmospheric propagation at MMW frequencies. Feasibility of the application of MMW communications systems.
Tracking and Data Relay Experiment (T&DRE)	C	To demonstrate technology necessary for an operational tracking and data relay satellite system.
Position Location and Aircraft Communication Experiment (PLACE)	C	To develop improved air traffic control communications and position location techniques.

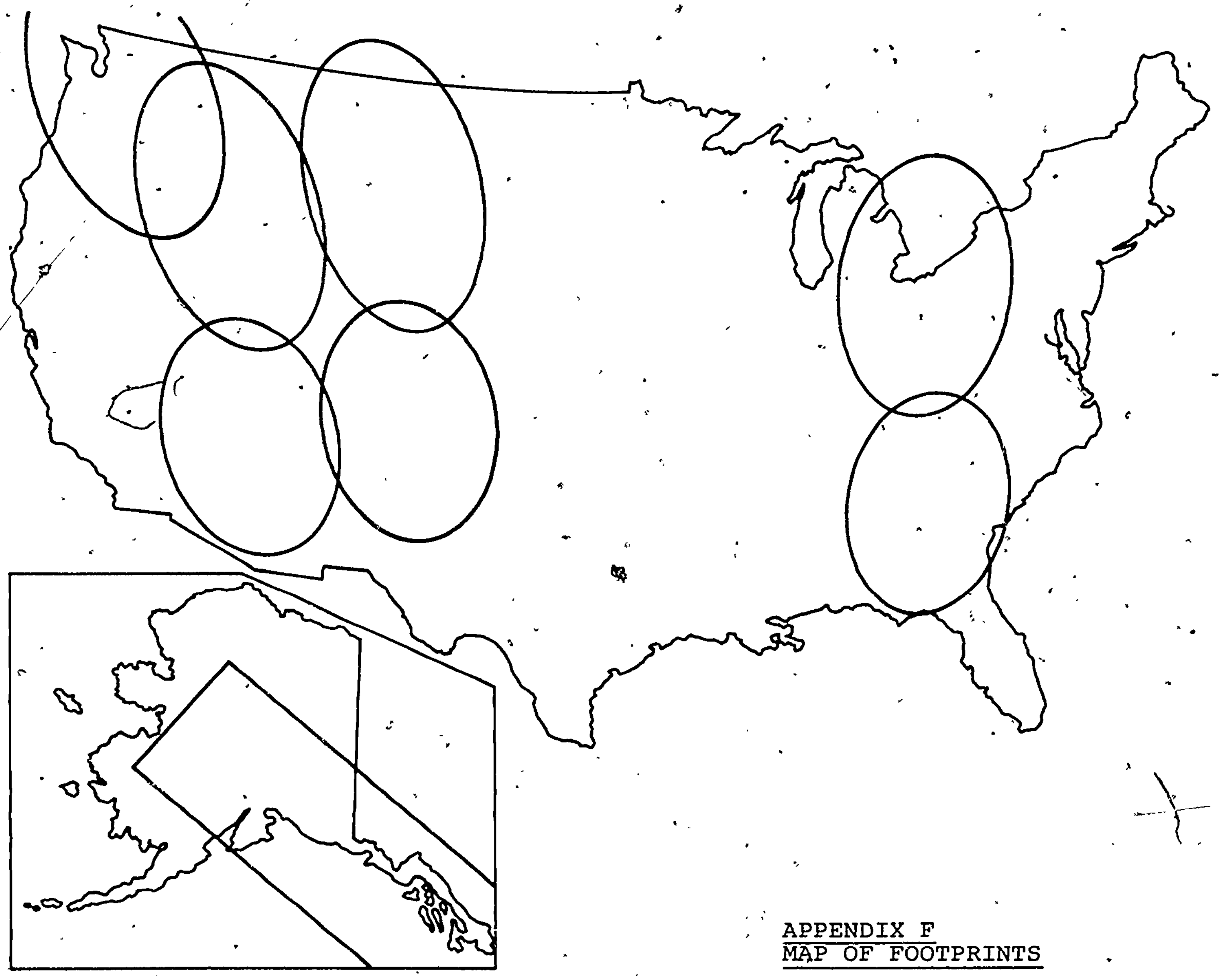
Experiment	Type	Major Objectives
Propagation (13- and 18-GHz)	T	Collect data on attenuation due to precipitation. Determine power margins needed in spacecraft communications systems.
Advanced Thermal Control Flight Experiment (ATFE)	T	To evaluate the performance of an advanced thermal control system and to demonstrate its effectiveness in stabilizing temperatures of spacecraft components.
Spacecraft Attitude Precision Pointing and Slewing Adaptive Control (SAPPSAC)	T	Investigation of ground computer controlled attitude control performance optimization.
Cesium Bombardment Ion Engine	T	Verify and obtain data on ion micro-thruster propulsion system. Demonstrate thrust vectoring for attitude control.
Quartz-Crystal Microbalance Contamination Monitor (QCMB)	T	To provide data on extremely small mass accretions on the surface of the spacecraft.
Interferometer High Data Rate Acquisition System (Ground Equipment)	T	To provide a tape containing all of the phase quantities measured by the ATS-F interferometer, for display of jitter in near real-time and for later analysis.
Television Camera	T	To monitor the condition of the reflector.
Spacecraft Vibration Accelerometers	T	To provide data for verifying basic spacecraft mode shapes and frequencies during flight.
Very High Resolution Radiometer Experiment VHRR)	M	Measure cloud cover. Determine wind field, ocean temperatures, earth resources.

Experiment	Type	Major Objectives
Environmental Measurements Experiment (EME)	S	Particle measurements. Magnetic field measurement. Solar cell degradation.
Radio Beacon	S	Ionospheric/exospheric electron content measurements. Study of ionospheric propagation effects.

This Table has been taken from "ATS-6 Mission/Design/Orbital Performance" by Fairchild Industries, the builders of the satellite.

* In the "Type" (of Experiment) column:
C = Communications; T = Technological;
M = Meteorological; S = Scientific

** CCIR - International Radio Consultative Committee.



APPENDIX F
MAP OF FOOTPRINTS

APPENDIX G
SOME COST DATA

National Institute of Education/Office of Education Expenditures for Education Satellite Experiments

Project Title	FY 1971 (OE)	FY 1972 (OE)	FY 1973 (OE)	FY 1974 (NIE)	FY 1975[c] (NIE)	Total[c]
Federation of Rocky Mt. States (FRMS)						
Education Program Development & Use	$35,673	$555,179	$4,541,994	$2,192,825	$1,519,222	$ 8,844,893
Site Hardware and Engineering	0	0	502,921	821,663[b]	350,485	1,675,069
Project Totals	35,673	555,179	5,044,915	3,014,488	1,869,707	10,519,962
Appalachian Regional Commission (ARC)						
Education Program Development & Use	42,050	34,924	220,000	1,249,115	801,164	2,347,253
Site Hardware and Engineering	0	0	101,762	373,022	270,175	744,959
Project Totals	42,050	34,924	321,762	1,622,137	1,071,339	3,092,212
Office of Telecommunications, Office of the Governor of Alaska (GOT)						
Education Program Development & Use	0	0	50,000	650,000	609,198	1,309,198
Site Hardware and Engineering	0	0	126,659	323,479	117,062	567,200
Project Totals	0	0	176,659	973,479	726,260	1,876,398
Satellite Evaluation Costs						
Design Contracts (3)	0	0	0	159,378	0	159,378
FRMS & ARC Evaluation Contract	0	0	0	100,000	345,228	445,228
Alaska Evaluation Contract	0	0	0	71,000	287,107	358,107
Rocky Mt. Formative Evaluation Contract	0	99,436[a]	116,102[a]	0	0	215,538
Project Totals	$ 0	$ 99,436	$ 116,102	$ 330,373	$ 632,335	$ 1,178,251
Grand Total	$77,723	$689,539	$5,659,438	$5,940,482	$4,299,641	$16,666,823

[a] Funded by the Office of the Secretary, Department of Health, Education and Welfare.
[b] Includes a carry over of OE FY 1973 hardware funds totaling $19,658.
Total of $1,499,506 in NIE funds expended for hardware in FY 1974.
[c] Estimated.

DN-AAA-036

ARC No. 380.3-C875

258/75