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ABSTRACT

This document responds to the Public Telecommunications Act of 1992 directing the Corporation for Public Broadcasting (CPB) to report on prospects for distance learning projects to assist rural schools. Based on a literature review, case studies, and two audio conferences with leading educators and distance learning providers, the report focuses on the most effective use of existing public telecommunication facilities to establish and implement distance learning projects in rural areas. Chapters cover: (1) the predicament of rural schools in providing quality educational programs; (2) the state of distance education today in relation to accessibility, distribution, interactivity, curriculum, teacher training, attitudes, effectiveness, and funding; (3) what distance education can offer rural areas; (4) overcoming financial and pedagogical barriers to serving rural schools with distance education; (5) six case studies of rural distance education programs highlighting the important roles of the Public Broadcasting Service and public television stations; (6) an overview of technologies that serve as integral components of proposed distance education programs; and (7) recommendations on distance learning services tailored to the needs of rural schools and on greater use of public broadcasting facilities in the provision of those services. This report contains 220 references, a listing of audio conference participants, and nationwide services in distance education. (LP)

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CORPORATION FOR PUBLIC BROADCASTING

Lifelines of Learning

Distance Education and America's Rural Schools

A report to the 103rd Congress
and the American people
pursuant to Pub. L. 102-356

RC 019149

CORPORATION FOR PUBLIC BROADCASTING

A Quarter Century of Quality Programming

Richard W. Carlson
President and Chief Executive Officer

March 4, 1993

The Honorable Walter J. Stewart
Secretary of the Senate
S-208 The Capitol
Washington, D.C. 20510-7100

Dear Mr. Stewart:

In accordance with Section 18(b) of the Public Telecommunications Act of 1992, Pub. L. 102-356, 106 Stat. 955, I am pleased to transmit to you the Corporation for Public Broadcasting's report on the most effective use of existing public telecommunications facilities to establish and implement distance learning projects in rural areas.

Sincerely,

Attachment

901 E Street, NW
Washington, DC 20004-2037
(202) 879-9800
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CORPORATION FOR PUBLIC BROADCASTING

A Quarter Century of Quality Programming

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President and Chief Executive Officer

March 4, 1993

The Honorable Donnald K. Anderson
Clerk of the House of Representatives
H-105 The Capitol
Washington, D.C. 20515-6601

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Foreword

In the Public Telecommunications Act of 1992, which reauthorized the Corporation for Public Broadcasting (CPB), Congress directed the Corporation to report on prospects for distance learning projects to assist schools in rural areas.

The amendment specifically required that "the Corporation for Public Broadcasting in consultation with other education program providers and users, shall report to the Congress as to the most effective use of their telecommunications facilities to establish and implement distance learning projects in rural areas. Such report should include, among other things, the costs and benefits of establishing national demonstration sites to study new distance learning tools and to evaluate the most effective use of current distance learning applications; and any incentives necessary to provide access to [public broadcasting] facilities for distance learning applications."

This report is the Corporation's response.

In preparation of this report, CPB was assisted by Satellite Learning Systems Corporation (SLSC), a consultant to many distance learning service providers nationwide, and particularly its president, Patsy S. Tinsley. In addition to their review of the published literature on distance learning, the preparation of case studies, and development of a comprehensive inventory of distance learning services in which public television is involved, SLSC convened two audio conferences with leading educators and distance learning providers outside public broadcasting. These discussions provided valuable guidance on barriers to the use of distance education in aiding rural schools, and possible steps to overcome those barriers.

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Executive Summary

The Plight of Rural Schools

Rural schools are at the heart of the rural community and are the lifeline to its future. Increasingly, rural school districts are on the brink -- geographically isolated, underfunded, and suffering from teacher shortages and a bare-bones curriculum.

As a result, rural school administrators find themselves faced with a Hobson's choice: Resist consolidation into larger schools and place their children at an educational disadvantage, or accept consolidation as the price for more educational resources and lose an integral part of their community's identity.

Dissatisfied with these options, rural communities increasingly are turning to a third option -- distance learning.

Distance Learning -- Education Lifeline

Distance learning, the linking of a teacher with students in separate geographic locations through communications technologies that allow for interaction between teacher and student, can provide a number of benefits to rural communities. First, it can forestall consolidation and preserve rural schools. Second, it can provide educational equity to rural schools by offering otherwise unavailable courses to rural students. Third, it can bring skills, information and technology to the community and thereby contribute to human resource development.

But Does It Work?

Conceptually, distance learning has much to offer rural America. Before embracing the concept, however, a critical inquiry is how distance education works in practice.

To answer that question, this report explores in detail such critical issues as school and classroom accessibility to distance education technologies, the status of existing distance learning transmission systems, the state of the distance learning curriculum and of teacher training relating to new technologies, current student and teacher attitudes toward distance learning, and its effectiveness as an educational tool.

Barriers to Distance Learning in Rural Schools

The telecommunications technologies necessary to bring distance education to rural America exist today. The challenge is to overcome the barriers to making what rural America needs from these technologies more accessible, more affordable, and more effective.

These barriers are numerous and multifaceted. They include such bread-and-butter issues as the need for increased funding, the availability of critical "last mile" connections that physically link rural schools to the interactive distance learning networks, and the availability of the classroom equipment that students need in order to see and interact with their distant teachers. They also include such core educational issues as developing new programs needed by rural schools, training local teachers and administrators in uses of the technologies, and resolving pedagogical concerns.

Special attention is given to barriers that are contributing to local public television not being able to more effectively use its facilities to provide distance learning resources to America's schools.

Building the Classroom of the Future

If distance learning demonstration projects are to go forward, they must incorporate certain building blocks, namely the cutting-edge technologies which provide the cost effectiveness, instructional effectiveness, and increased access and interoperability to carry distance education into the 21st century.

This report examines a number of technologies which would serve as integral components of any proposed demonstration project, any new technological infrastructure, and any new program or service. CPB then offers a series of specific recommendations for establishing demonstration projects integrating these technical building blocks with public telecommunications facilities to meet rural needs; and for beginning to address the access, cost, and effectiveness issues identified in this report. The Corporation then recommends additional incentives which are needed to overcome barriers the demonstration projects cannot directly address.

What Role for Public Broadcasting?

Public broadcasting has been a pioneer in using technology to improve public education. For decades, noncommercial educational broadcasting's contribution, in providing instructional resources for classroom teachers and for meeting the needs of adult learners at home through telecourse offerings, has been unparalleled. In addition, individual public television stations have taken leadership roles in their local communities and across their states in conceiving and implementing distance learning technologies and services.

This report examines six distance education projects involving public television stations across the country. These stations are effectively collaborating with other organizations within their states, and in some instances in other states, to overcome many of the barriers previously identified to bringing distance education to rural America. These studies assess how distance education is working in those states, and highlight the role the Public Broadcasting Service and public television stations can play in providing new infrastructure technologies and expanded distance learning services when the Telstar 401 satellite is launched and operational within the next year.

Models for Distance Learning in America's Rural Schools

Public broadcasting has a long record of service to schools and learners, and a strong tradition of promoting universal access to its services, particularly in rural areas.

It is the hope of the Corporation for Public Broadcasting that this report will open lines of communication, among public broadcasters, educators, state school officials, other providers of educational and communications services, and the Congress and Administration, to deliberate how best to foster the growth of distance learning in rural schools.

CPB proposes that Congress consider a wide variety of steps that can be taken to encourage distance learning services tailored to the needs of rural schools, and to foster greater use of public broadcasting facilities in the provision of those services, including the following measures:

- Make distance learning projects that involve public broadcasting a priority within the Public Telecommunications Facilities Program in the Commerce Department;

- Continue and increase funding of the Star Schools program;

- Commission a task force to coordinate the many governmental authorities with jurisdiction over distance learning and focus on teacher certification, course acceptance, and broad, affordable access to instructional software and programs.

- Fund teacher training to encourage acceptance and adoption of distance learning methods by classroom teachers.

- Authorize national demonstration projects to study and evaluate effective rural applications, with projects that show promise to:

-- incorporate multiple interactive technologies to support a variety of subjects and learning environments;

-- encourage teleconferencing service providers (such as computer conferencing and audiographics conferencing) to partner with existing broadcast facilities;

-- use a range of "databack" enhancements to audio "talkback" teleconferencing technologies;

-- combine advanced technology with advanced teaching strategies, inquiry-centered classrooms, and explorer teams--and measure the effectiveness of doing so;

--broaden the subjects taught and groups reached (including the disabled and/or underachieving student) by distance education; or

-- encourage the sharing of resources and teachers among schools through short-distance learning projects and build technical capacity to supplement local offerings with resources distributed nationally;

Public broadcasters are ready and willing to assist Congress in exploring the potential for the kinds of services and demonstration programs described in this report.

The Predicament of Rural Schools

Rural America -- Communities on the Brink

Rural communities play a vital role in American life, comprising 24 percent of the U.S. population and 28 percent of the nation's labor force (Office of Technology Assessment [OTA], 1991).[1]

Increasingly, America's rural communities are communities on the brink. A recent demographic study (Longworth, 1992) spells out harsh facts and portends a precarious future.

In the period 1950-1988, more than 1,000 U.S. counties experienced at least one year of natural decrease. Of the counties experiencing declines, 95 percent were rural. In 1979, 184 of some 3,000 U.S. counties reported a "natural decrease" in population -- *i.e.*, more deaths than births. By 1988, the last year for which figures are available, that number had risen to 508.

The natural decrease is not attributable to the rural birth rate. Fertility rates among rural women are 13 percent higher than the national average. The decline is attributable to young families moving out. In 1960, the counties that had been showing a natural decrease had 2 million residents in the 10-to-19 age group. Ten years later, only 1.2 million of those people (now 20-29) remained.

The region bearing the brunt of the decline encompasses East Texas, Oklahoma, Kansas, Nebraska, northern Missouri, southern Iowa, northern Minnesota, Wisconsin, and the Upper Peninsula of Michigan. Counties there have experienced 10 to 20 years of continuous decline. Close behind are counties in southern Illinois, Indiana, and the rest of Iowa, where the collapse of the farm community precipitated three to nine years of continuous decline.

As these trends persist, rural communities may find themselves falling below the population thresholds needed to sustain local public services, such as hospitals and schools.

The Challenge Facing America's Rural Schools

In a report on the future of rural America, the U.S. Office of Technology Assessment (OTA) found that the future of rural communities is tied inextricably to the future well-being of their rural schools. However, OTA found that these rural schools were increasingly endangered, buffeted by both internal and external forces:

> Shifting economic and demographic patterns have left many small and rural schools with declining student populations and even more limited financial and instructional resources. At the same time, States have increased requirements for curriculum, graduation, and teacher training, and colleges and universities have toughened entrance requirements. Solutions such as school consolidation or transporting students or teachers have often been stretched to their geographic limits; these approaches are also disruptive and politically unpopular. The local school is at the heart of the community in most rural areas. If the community is to thrive and grow, so too must the school (OTA, 1991).

Rural schools comprise a significant portion of the nation's K-12 education infrastructure. According to the U.S. Department of Education, approximately three-quarters of the nation's 15,579 school districts can be classified as small (enrollment of fewer than 2,500). These districts enroll over 20 percent of the nation's students. Further, more than half of these small districts are further classified as *rural* districts. There are some 6,000 rural school districts in the United States (OTA, 1989) and 22,000 rural schools (Jordan, 1992).

These small, rural districts, in addition to being geographically isolated, often suffer from shortages of qualified teachers, insufficient funding, and limited course offerings, especially advanced courses. Ensuring equity among schools and school districts is difficult enough as a task of making resource allocations to balance different economies of scale. It is that much harder when the task is to balance the impacts of scale differences in population density and geographic distance.

For example, a survey of school districts in Texas disclosed that small school districts offer only about one-third of the courses available in larger districts throughout the state. Worse, rural districts in Texas offer only one-quarter of the courses available in the state's populous areas (OTA, 1989).

The situation in Mississippi is equally alarming. Mississippi ranks 49th in the number of students taking advanced placement (AP) classes. State education officials attribute this to the state's largely rural environment, which makes it difficult to attract and retain qualified teachers to teach the AP courses (Green, 1992).

Consolidation -- The Educational Battleground

Faced with limited curricular offerings in rural schools, many school administrators have sought to optimize the distribution of scarce economic resources by consolidating rural and geographically isolated schools. In some instances, the pressure is exerted indirectly, through common statewide standards for course offerings or graduation requirements, or through the influence of college entrance requirements across many states.

A number of states have been extremely aggressive on the consolidation issue. For example, in its proposed 1994 school budget, the Illinois Board of Education proposed a 138 percent increase in financial incentives to encourage rural schools to consolidate (UPI, 1992).

The consolidation movement frequently runs counter to the wishes of rural communities intent on preserving their schools. The result is a classic case of conflicting priorities. State education authorities see consolidation as the most efficient use of tight education dollars. Rural communities, on the other hand, view their local schools not in terms of efficiency but in terms of civic identity and the continued survival of their communities. For the overwhelming majority of rural communities, their schools are their lifeline to the future (OTA, 1991; OTA, 1989). Norman Crampton, author of the recent book, *The 100 Best Small Towns in America*, notes: "The high school is the primary social center in small towns. ... The high school is the identity of the town, and if it loses its high school, it has already lost everything else." (Walsh, 1993).

This conflict has provoked a number of bitter disputes in rural communities across the nation. Some examples:

- In Tower, Minnesota (pop. 502), enrollment at the small rural high school dropped to 130 students. Tower was forced to consolidate after voters rejected a referendum that would have raised taxes to add courses and to extend the school week from four days to five. Opponents fear the demise of the high school will lead to the demise of Tower itself. They opposed putting their children on schoolbuses for the 40+ mile round trip to the consolidated schools. According to one resident, the consolidation issue split the town "down the middle. You had fathers not talking to sons, brothers not talking to brothers" (Doyle & Hotakainen, 1993).

- In Effingham, Illinois, the school district was forced to drop the agriculture curriculum because it could not provide "high-level" subjects such as agribusiness and futures marketing. "And this is a rural, farming community," the superintendent said. "If you can't produce from your own center, your community is going to wither and die." The school district also may have to drop four foreign language classes it can no longer support on its own (United Press International, 1992).

- In Austin, Texas, state auditors released a report denouncing excessive costs and inefficiencies in some Texas school districts. The audit report took aim at small school districts, finding that they cost more to operate and cannot provide as broad an education as larger districts. The report's strongest recommendation was school district consolidation, especially the consolidation of small rural schools (Langford, 1992).

- In Custer County, Montana, rural school districts geared up to fight what they termed "forced consolidation" of their small schools. The local superintendent said that if the local schools were closed, some students would have to travel 120 miles roundtrip to Miles City to attend school (Jill, 1992).

As these examples underscore, rural school districts are increasingly faced with a Hobson's choice. If they resist consolidation and attempt to preserve their rural schools, they put themselves (and their students) at a competitive disadvantage in terms of curriculum and faculty hiring, exacerbating urban-rural educational disparities. If they accept consolidation as the price for obtaining the same advantages and resources as the larger school districts, they must give up an integral feature of their community's character and, they fear, the key to the community's future (OTA, 1989). The predicament was summed up by one rural Minnesotan after the community's school was swept away by consolidation: "How can we expect other people to come up here? You have to have a future, and a school is a big part of that" (Sinker, 1992).

Dissatisfied with these unpalatable options, educators and rural school districts have sought at least a partial solution to this predicament, one that would allow them to preserve their rural schools while offering their students the advantages and resources which otherwise would be available only through consolidation. Increasingly, they are looking to distance education.

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[1] Throughout the text of this report, citations to source materials will be cited by the name(s) of the author(s) and the date of publication, e.g., (Bradshaw & Brown, 1989). The full citation is included in the bibliography appended to this report.

The State of Distance Education Today

"Distance education" in its broadest sense is the linking of a teacher and students in separate geographic locations. For purposes of this report, distance education is defined as the linking of a teacher and students in several geographic locations via technology that allows for interaction, with a portion or all of the learning interactions occurring in real time, and it is largely a new phenomenon (OTA, 1989).

The earliest form of distance education in the broadest sense, the mail correspondence course, dates to the 19th century. But recent advances in telecommunications and information technologies have spurred concomitant expansion in distance education. Since the mid-1980s, technological advances such as video conferencing by satellite or over optical fiber -- which allows two-way visual interaction between teacher and student -- have spurred the development of modern distance education, in which the interactive communication between teacher and student, and between student and student, is greatly enhanced (OTA, 1989).

Dist ce education was viewed originally as a means of preserving rural schools by forestalling consolidation, and as a means of providing specialized subjects to geographically remote schoolrooms. As distance education has expanded, additional populations have been served.

Today, distance education reaches children in urban schools, students in universities and community colleges, community centers, libraries and homes (Bell, 1991). Distance education also offers remedial courses and GED (high-school equivalency) programs to school dropouts, as well as job training and continuing education programs for adults (Benson 1988).

This chapter addresses issues that are critical to the success of distance education, including:

- accessibility -- can schools access the available resources?
- distribution -- how is distance education being delivered?
- interactivity -- can students and teachers communicate adequately?

- curriculum and teacher training -- what's available?
- attitudes -- what do students and teachers think?
- effectiveness -- does distance education work? -- and
- funding -- how is distance education being paid for?

Accessibility -- Can Schools Access Available Resources?

One of the basic objectives of distance education is to provide educational access to otherwise unserved populations. A major factor is the accessibility of communications and information-processing infrastructure to the people who could use them to take advantage of available programs, information resources, and instructional services.

The news in this regard is mixed.

On the plus side, a survey of the nation's 125,000 elementary and secondary school buildings, 3,000 colleges and universities, and 6,000 libraries identified a minimum of 55,000 sites capable of receiving educational information resources delivered by communications technology (Weinstein & Foster, 1992).

What is traditionally known as instructional television (ITV), or the passive viewing of educational television programs to supplement classroom instruction, provides the foundation of what has become interactive-instructional television (I-ITV), or distance learning. Information pertaining to the use of instructional television in the classroom is also relevant to establishing a foundation for what we know about other uses of television in the classroom, including distance learning.

Currently, all 50 states have public television stations. In 1987, 80 percent of the states reported using instructional television for supplementary instruction, and only 45 percent provided distance education to their high school students (Quinn & Williams, 1987). Happily, the trend is growing. Usage of both instructional television and distance education is increasing. A more recent CPB study found that 97 percent of teachers now report having access to instructional television or video in their classrooms, and that nearly 80 percent have used these technologies to supplement their teaching (CPB, 1991). This is despite the fact that the same study found that the average school has one television set for every four classrooms; one videocassette recorder for every seven classrooms; and virtually no telephone jacks (which are required for computer networking and audio talkback in distance learning classes) in classrooms (CPB, 1991).

The widespread availability and increased use of television for instruction has exposed increasing numbers of students to television and video as part of their curriculum. A conservative estimate is that 24 million students received some portion of their instruction through television and video during the 1990-91 school year (CPB, 1991).

A 1992 study by the Public Broadcasting Service (PBS) on trends in the use of technology in schools revealed not only an increased use of distance learning programming, but also an increased priority for distance learning by state technology leaders (PBS, 1992). The study found that schools in each of the 50 states currently use programs offered by major satellite-based distance learning networks. In each of the 48 contiguous states, resources from two or more networks are used. The study also revealed that close to half of the state technology leaders consider distance learning to be one of the most important emerging technologies in the school market (PBS, 1992).

Not surprisingly, there is a direct correlation between the cost of the distance learning technology and the student population served. In the 60 percent of states using higher-cost technologies, high school students are the predominant target audience. In the 20 percent of states in which public television is the principal source of supplemental instructional programming, most programs are directed to elementary schoolchildren (Quinn & Williams, 1987). This suggests that the types of distribution infrastructures in place may have a direct bearing on the focus -- and the future -- of distance education in a given state.

Distribution -- How Is Distance Education Being Delivered?

A key benefit of distance education is its ability to bring limited educational resources to large numbers of individuals in geographically dispersed locations. The distribution capacity of educational technology can facilitate or inhibit the effectiveness of distance learning. The choice of technology also dictates the cost of a given program. However, no single mode of technological distribution is best suited for distance education (OTA, 1989). In fact, commonly used distribution technologies are not mutually exclusive of one another--they are frequently integrated to provide a given district or a given school maximum utility of its investment in equipment.

One of the key factors in selecting a delivery system is its match to the size and type of geographic area to be served. The most commonly used technologies include:

Terrestrial microwave -- Instructional Television Fixed Service (ITFS) typically offers one-way video (either transmitted point-to-point to receivers at specific schools or "broadcast" to receivers at schools throughout a service area). Thus, it is often used to rebroadcast satellite-delivered programs from a hub to remote sites. The one-way video may be enhanced by audio or data return via telephone lines or ITFS radio transmission, or two-way point-to-point configurations of microwave technology sometimes permit any site to send and receive instruction. Although ITFS microwave is limited to a broadcast range of 20 to 60 miles and requires a line of sight, the range can be extended by connections to long distance transmission systems. (Barker 1991; OTA, 1989). Another terrestrial microwave technology, known as Operational Fixed Service (OFS), is used exclusively for two-way, point-to-point transmission. ITFS and OFS microwave are commonly the technologies of choice (where frequencies are available) for short-distance learning networks.

Coaxial cable and optical fiber--Cable allows one-way, point-to-multipoint local area distribution of audio, video, and, sometimes, data. Some two-way interaction is possible from a receive site back to the cable distributor, but the reliability and technical quality of the "return" signal is often problematic, particularly with the older, small-capacity systems typical in rural areas. Like satellite, cable systems are widely available. However, they have capacity limitations and are susceptible to downtime caused by technical difficulties and audio interference. Systems using fiber optics offer significantly increased capacity and provide full two-way capabilities. Cable has traditionally been used to distribute entertainment and educational video to households, while optical fiber has been used to provide the increased bandwidth required for some (primarily non-entertainment) video, voice, and data services. As the cost of fiber drops, it will increasingly be used to provide short-distance learning services (*i.e.*, within a district or neighboring distícts in a sub-state region) and some statewide transmission services.

Satellite -- Like ITFS, satellite technology is primarily used for point-to-multipoint distribution of programming. Unlike ITFS, satellite signals are distance insensitive, allowing for the most cost-effective nationwide coverage available of any distribution technology. Programming is typically full-motion, one-way video. Students view the instructor, but the instructor does not view the students, and students do not view each other. (With the availability of low-cost compression technology, some networks are beginning to use satellite transmission as a way of bypassing the public switched telephone network for two-way videoconferencing.) Telephone talkback is the most common form of interactivity, and is sometimes supplemented with one-way or two-way distribution of data (to computers, printers, facsimile machines, keypad response systems, etc.). Options for interactivity are expected to grow with the increasing use of very small aperture terminal (VSAT) technology for the return of data and voice communications from schools to distance learning program providers via satellite.

Public switched telephone network-- The public switched telephone network includes the regional Bell operating companies (RBOCs); long-distance carriers such as AT&T, MCI, and GTE; and numerous local independent telephone companies. A variety of transmission technologies are integral to this public telephone network -- including both wireline technologies like copper wire and optical fiber, and wireless technologies like terrestrial microwave and satellite links. The public switched telephone network provides both analog and digital services on a dial-up and on a leased-line basis, depending on the service requirements, the region served, and the availability of suitable facilities (*e.g.*, digital services are not as readily available in many rural areas as they are in urban areas).

Many telephone companies have recently announced dramatic programs of investment in new technological developments, and the advent of digital transmission of cable television has also drawn the interest of cable system operators in providing switched telephone service over their cables. The prospect of both new investment and new competition may offer a dramatic expansion of services that could be used to provide distance education.

Distance learning services which typically use public switched telephone lines include audioconferencing, audiographics, videophone conferencing, computer conferencing, and integrated telephony/desktop teleconferencing. Videoconferencing typically requires more transmission capacity and, therefore, is provided by dial-up or leased wide-band/high speed digital circuits. Two-way, fully-interactive (videoconferencing) instruction via public switched telephone network technologies enables students and teachers at all sites to see and hear one another simultaneously. It most fully simulates the classroom environment, but it is also the most expensive, and is generally limited to a relatively small number of sites interconnected at a time (Bradshaw & Brown, 1989). Telephone network services are also commonly used for short-distance learning networks, at least partly because they usually involve calls only within a single local calling area.

Notwithstanding the proliferation of communications technologies being used in distance learning, true student accessibility ultimately depends upon "last mile" connections that are not inherently components of many distribution technologies or of large-scale distance education services, and upon the availability of the classroom equipment that is required for display of programs or information resources and interaction with teachers and fellow students at distant locations.

Interactivity -- Can Students and Teachers Communicate Adequately?

A key component of distance education is the ability of geographically dispersed students and teachers to interact (receive and send transmissions), usually in real time, over various delivery modes.

Interactivity is critical both to the success and to the quality of distance education. Educational activities must be interactive to support students' needs for quick and easy two-way communication and to sustain their interest by allowing discussion, questions, negotiation, clarification, and arriving at meaning (Barnard, 1992; Pea & Gomez 1992). A U.S. Navy study of the most commonly used distance learning technologies found that the most successful technologies are fully interactive -- providing two-way video and audio, or one-way video and two-way audio (Simpson & Pugh, 1991). The Public Broadcasting Service (PBS) found in a more recent study that interactivity and connectivity are considered so essential to successful implementation of distance learning services that 24 states have launched organized efforts to install telephone lines in classrooms (PBS, 1992).

Interactivity is especially important in primary and secondary classrooms. Young students (grades K-12) value interaction more highly than adults. For example, a recent K-12 study of student-teacher interaction found that students who interacted with the on-air instructor more than once a week performed better, enjoyed the course more, and felt more a part of the class than less frequent interactors (Threlkeld, 1992). The Midlands Consortium Star Schools Project found that even though students who viewed the classes on videotape instead of with live interaction did as well on tests as those who viewed them live, the students viewing them on tape gave their courses lower overall satisfaction ratings (MCSSP, 1990). Similarly, fewer than half of the students in a Satellite Educational Resources Consortium (SERC) Star Schools study thought there was enough interaction with the teacher. Many of these students also reported learning from live interaction with students in other locations (TLC, Inc., 1989).

Curriculum and Teacher Training -- What's Available?

Although accessibility, transmission and interactivity are important characteristics of the communications media in a distance education program, those communications media are only conduits. Notwithstanding the current interest in the transmission aspects of distance education, the quality of the information being transmitted and the ability of the instructor to use this new teaching tool to its fullest are two critical components of any successful distance education program.

1. Curriculum

In contrast to the rapid technological changes in distance education, the subjects being taught and the grade levels for which they are taught have shown relatively little diversity. In a recent study, PBS reported 53 credit course offerings by satellite-based distance learning networks serving public schools during the current 1992-93 school year; of these, 27 are high school foreign language course, 6 are high school mathematics courses, and 6 are high school science courses. The remainder are miscellaneous language arts, health, economics, art, and social science courses, of which only 6 are for elementary and middle school students (PBS, 1992).

The Star Schools projects have primarily served high school students. The

Midlands Consortium offered language arts and foreign languages, as well as a series on college entrance and scholarship examinations and other enrichment programming (MCSSP,1990). SERC offered foreign languages, mathematics, statistics, and economics (TLC, Inc. 1989). However, the TEAMS project provides science and mathematics enrichment to students in grades 4-6 and related programs for their teachers (Lake,1992).

Current distance learning resources apparently fall somewhat short of the needs in K-12 science instruction, which is moving to an activity-based, project-enhanced curriculum, in which students engage in projects spanning an extended period of time and must investigate resources outside the classroom as well as in it. Current uses of telecommunications technologies to support science education are asynchronous and text-based, and students generally lack access to the tools of real-world scientists. K-12 science teachers do not have resources or time to create the appropriate environment of collaboration, communication, and social interaction that are integral to these subjects (Pea & Gomez, 1992).

2. Teacher Training

Training of classroom teachers is a key component of effective distance education. Teachers must be educated about the relationship between learning and technology (Dede, 1991; Barker, 1991; Bradshaw & Brown, 1989). In addition, they must be trained both in facilitating interactivity and in operating the technology (Barnard, 1992; Moore, 1989; OTA, 1989; Batey & Crowell, 1989).

If distance education is to succeed, the technology must be integrated into the curriculum as a means of enriching the on-site learning experience (Threlkeld, 1992). However, if classroom teachers are not educated in the use of distance learning and its tools, they cannot adequately integrate the new technologies into their classrooms (OTA, 1989; Kitchen, 1987). In the absence of this knowledge base, teachers may simply use distance education materials without adapting the curriculum to fit instructional goals (Gagne, 1992).

The training of on-site facilitators is also an integral part of teacher training. Teachers who function as on-site facilitators of distance-delivered courses provide a critical link in distance learning (MCSSP, 1990). Seventy-five percent of students participating in the SERC Star Schools program reported that the presence of a facilitator (teacher or volunteer) enhanced the learning experience (TLC, Inc. 1989). Facilitators who adopt an instructional role (as opposed to a more technical role) have been found to have a significant impact on individual student success (Threlkeld, 1992).

The absence of adequate training and early involvement of teachers in the distance learning process can be fatal. One study of why districts discontinue distance learning programs cited the failure to involve local educators in the planning process, which prevented their acceptance of the technology (Threlkeld, 1992).

Teachers are eager to learn to use new technologies. In a recent study, 57 percent of teachers wanted additional training in ITV. However, their needs are not being met. Only 25 percent of the respondents seeking training received such instruction, and only 11 percent had received training within the previous three years (CPB, 1991). Newly graduated teachers have fared little better. A 1986 study found that only 37 percent of universities even offered instruction in the use of live, interactive television as an educational tool (OTA, 1989).

Training is also needed for the "presenters," or on-air instructors, in distance learning services. Too often, instructors are called upon to present material with little thought given to the ways in which the communications media dictate use of quite different instructional strategies.

Attitudes -- What Do Students and Teachers Think?

As important as the quality of the instructional materials is the attitude of students, teachers and administrators toward distance education.

1. What Students Think

Educators tend to believe that students must be mature, self-disciplined and motivated to use distance learning effectively (Quinn & Williams, 1987). For that reason, distance learning has primarily been targeted toward highly motivated, academically excellent students. Some researchers suggest that these students would succeed and show improvement regardless of the instructional quality of distance learning (Jordahl, 1989). Nevertheless, an understanding of the attitudes of students who currently are succeeding in distance learning can serve as a basis for the development of programs to serve other populations.

In general, students enjoy distance learning (OTA, 1989). An Illinois study found that 80 percent of the students exposed to distance education through an interactive cable television system felt positively about the experience (Robinson & West, 1986).

Students report similarly positive attitudes toward satellite programming. Sixty-one percent of students participating in the Alabama Star Schools project reported they were very glad they took the course by satellite (31 percent stated that they were somewhat glad). Eighty-five percent of the students said they would recommend the satellite course to others (Wilson, 1991). This positive orientation toward distance learning has reportedly caused students to become more highly motivated about their education (Kitchen, 1987).

However, the format in which the program is presented may influence student attitudes. For example, a California study found that while students had positive feelings about distance education, they preferred live interaction to phone-in, delayed conversation (Threlkeld, 1992). In Hawaii, 75 percent of the students in the Hawaii Interactive Television System found the interactive video and taped delay video classes to be more difficult than traditional classroom instruction due to the total lack of interaction with the instructor (Barker & Bannon, 1992). As a result, HIT students preferred on-site instruction over distance education (Barker & Goodwin, 1992).

2. What Teachers and Administrators Think

The attitude of teachers and administrators toward distance education has a significant influence on the success of the programs (NEA, 1992; Threlkeld, 1992; OTA, 1989). Generally, their view is positive.

A survey of 25 K-12 teachers using interactive computer communication networks with their students found that the computer-based activities were successful and popular among both teachers and students (Fowler, 1992). This attitude is less prevalent among administrators. In the same study, nearly two-thirds of the principals surveyed stated that their superintendent supported the use of instructional television, but only half of the teachers reported encouragement from their principals.

Typical of the concerns cited by teachers and administrators over the implementation of distance education are two reported in a study of four California school districts using satellite-based instruction: loss of control of course content and scheduling conflicts between satellite and campus-based courses (Threlkeld, 1992).

Effectiveness -- Does Distance Education Work?

Distance education in K-12 applications is in its infancy. Historically, distance education has been used extensively only in higher education and in military and business training. Accordingly, the bulk of the research on the effectiveness of distance education has focused on adults. This effectiveness research has been consistent. It shows that when used in *adult* education, there is no significant difference in effectiveness between distance education and traditional classroom teaching (OTA, 1989).

Whether this conclusion extends to the K-12 setting is as yet unproven. Few long-term evaluations have been done, due in part to the newness of distance education at the elementary and secondary school levels (OTA, 1989). The paucity of research on the effectiveness of distance education in K-12 classrooms is underscored in a 1991 review of distance education effectiveness studies. The review identified and examined 127 distance education studies. Only two addressed elementary and secondary school students (Dillon & Blanchard, 1991).

1. Program Effectiveness

Although effectiveness research in the K-12 setting has been limited, studies have shown distance education to be at least as effective as traditional classroom education both quantitatively (comparative test scores and grades) and qualitatively (student attitude, level of communication between schools, and parent participation) (Barker, 1991; Simpson, 1991; Moore, 1989; OTA, 1989; Kitchen, 1987; Whittington, 1987; Robinson & West, 1986; Eiserman & Williams, 1984). Although a number of distance learning programs have failed, they did so for reasons other than the quality or effectiveness of the distance learning software, such as inadequate advance planning and coordination to sustain the introduction of the new technologies (Threlkeld, 1992).

Again, the experience with instructional (one-way) television can provide some guidance. An early survey of 421 studies conducted before 1966 evaluating the effectiveness of ITV in both adult and K-12 environments is revealing. Sixty-three of the studies found instructional television to be a more effective learning tool than conventional teaching, 308 showed no significant difference between the effectiveness of ITV and conventional teaching, and 50 found conventional teaching to be more effective (Chu & Schramm, 1975). Significantly, the survey suggested that instructional television was more effective for younger students than older ones.

Similar conclusions were reached in a number of recent *distance education* studies:

- In a survey of principals and students at 30 rural schools subscribing to the TI-IN Satellite Network under the federal Star Schools program, nearly three-quarters of the principals rated the quality of instruction as very good or excellent. Students were generally supportive, although nearly two-thirds of the students found satellite classes harder than classroom instruction (Barker, 1988).

- An assessment of three two-way video projects in Utah found that students learned as well as students in traditional classroom settings. One instructor reported that students improved their speaking skills by being on camera (Bradshaw & Brown, 1989).

• A study of a high school German class taught by satellite which employed a five-credit university-level curriculum found that the participating high school students reached the same level of achievement in one year as university students, and that the ACT (college entrance test) scores at one participating school improved almost 40 percent over previous graduating classes which had not had access to the satellite instruction (Wohlert, 1991).

• A survey of school coordinators participating in the Satellite Educational Resources Consortium (SERC), a partnership of 19 state departments of education and state public television networks, gave the distance learning network high marks. More than 98 percent of the respondents said they would recommend that their schools continue to participate in SERC (although nearly 80 percent felt that the SERC programming was most appropriate for advanced students) (TLC, Inc., 1989).

• An evaluation of the Midland Consortium Star Schools Program (MCSSP), which consisted of schools in Alabama, Kansas, Mississippi, Oklahoma and Missouri, found no significant difference in student test scores between students in distance learning and conventional settings. The evaluation found that students from poor school districts, districts with high minority populations, and at-risk students learned effectively using satellite technology (MCSSP, 1990).

Although these studies are limited in number and scope, they suggest that distance education can be instructionally effective in the K-12 classroom. Little is known, however, about with which class formats distance learning is most effective.

However, concerns remain about the use of distance learning across diverse age groups and academic subjects, and among young learners with lower maturity and short attention spans (Benson, 1988). Despite these concerns, very little is known about the effect of age, maturity or intelligence on the effectiveness of distance education.

2. Cost Effectiveness

While their number is limited, some studies of the cost-effectiveness of distance education in K-12 applications (including studies of the projects funded under the federal Star Schools program, as well as other national and regional programs,) have found that K-12 schools are beginning to realize the cost benefits of broadly distributed distance education (LeBaron, 1991; Moore, 1989; Bradshaw & Brown, 1989; Jordahl, 1989).

Similarly, in schools where the enrollments are too small to support advanced placement (AP) or foreign language courses, distance education has been found to provide the course at a fraction of a classroom teacher's salary (Jordahl, 1989). For example, the Hawaii Interactive Television System pooled students across eleven schools on five islands, making it fiscally possible to deliver AP calculus (Barker & Bannon, 1992).

However, assessing cost-effectiveness is problematic. For example, the report of the Midlands Consortium Star Schools Project concluded, "There is no way to appropriately assess the value (financially, academically, socially or politically) of the support received ... as a result of the funding received from the Star Schools Project" (MCSSP, 1990).

3. The Intangible Benefits of Distance Education

While every school must gauge the desirability of distance education in terms of both program effectiveness and cost effectiveness, the bottom line for many schools participating in the distance education projects is that some courses simply wouldn't exist without access to distance education.

For example, OTA reported in 1989 that in Texas, large districts offered their students an average of 209 courses; small and rural schools averaged 54 courses (OTA, 1989). The state has used distance education to help rectify this glaring disparity, and is currently establishing its own satellite-based network.

Distance education also offers a number of intangible benefits. For example, the technologies employed can help in the creation of programs that stimulate interest, generate questions, simulate problems and encourage discovery (Fabris, 1992). Similarly, the use of telecommunications enables students to develop technological literacy, communications skills, collaborative skills and thinking skills as they learn to search for, retrieve, process, analyze and interpret data (Roberts, 1992; LeBaron, 1991).

Funding -- How Is Distance Education Being Paid For?

Funding is a major concern for the future of distance education. The need for distance learning technologies and programming has been established. The bottom line, however, is that the cost of establishing and sustaining distance education are clearly prohibitive for many school districts, bearing in mind that funding must be sufficient to cover not only equipment and supplies, but also programming, teacher training, and equipment maintenance (NEA, 1992).

Current sources of funding for distance education include: federal government funds, state-run educational improvement funds, school district general funds, and donations from corporations and foundations. Federal government funding represents about 35 to 40 percent of all funding available for distance education hardware and software (Blaschke, 1992). State government funding of distance education is insufficient. The Council of Chief State School Officers reported that only 42 percent of the states had funding programs to start and sustain distance education (Lemke, 1992).

The U.S. Department of Education's Star Schools program has been a key federal government funding program for distance learning. In addition, many of the Department's programs which address concerns of equity, access, advancement, and special populations could be directed toward distance learning if the Department were encouraged to remove impeding rules and regulations. These include: Chapter 1 (assistance to educationally deprived children in elementary and secondary schools); Chapter 2 (the Federal, State and Local Partnership for Educational Improvement); Title III of the Higher Education Act; the Fund for the Improvement of Post-Secondary Education; the Language Resource Centers program; and the Technology for Education program (Krebs, 1991; OTA, 1989).

Other federal government agencies that have funded distance education include the National Telecommunications and Information Administration and the Rural Electrification Administration, which fund public broadcast facilities and rural telephone facilities respectively; and the National Aeronautics and Space Administration and the U.S. Department of Agriculture, which provide curriculum development projects for distance education (Salomon, 1992; OTA, 1989).

What Distance Education Can Offer Rural America

Technological advances have been critical to the development and expansion of distance education, but the more important spur to the growth of distance education in K-12 applications has been the need of the education community to provide courses for underserved or advanced students. This need has been intensified by increased standards for high school graduation; more demanding college admission requirements; and shortages of qualified instructors in mathematics, science and foreign languages (LeBaron, 1991; OTA, 1989).

Although these shortages and challenges affect virtually all school districts throughout the nation to some degree, it is the geographically isolated, rural schools, particularly in smaller districts, that have felt them most deeply.

From its inception, distance education has been viewed by states as serving two complementary purposes which are critical to rural America:

First, distance education can serve as a stopgap to preserve rural schools and to forestall consolidation (Ohler, 1991; Jordahl, 1989; Benson, 1987; Quinn & Williams, 1987).

Second, distance education can serve as a vehicle to meet new curriculum requirements and increase the equity of access to quality education through the distribution of teaching resources into rural schools where qualified teachers in specialized areas may be scarce (NEA, 1992; Hefzallah, 1990; Bradshaw & Brown, 1989; OTA, 1989; Kitchen, 1987). A major focus has been to offer access to state-mandated curriculum and advanced placement (AP) courses to schools with low enrollments (Quinn & Williams, 1987). Another major focus has been the offering of courses needed by students to meet the increased entrance requirements of colleges and universities.

Distance education is critical to rural communities because it reduces the importance of time and space, two factors which disadvantage rural areas (OTA, 1991). In addition, distance education has the capability of enhancing rural education by bringing otherwise unavailable (and financially unattainable) teachers and subjects to geographically remote schools (NEA,1992).

The benefits that distance education brings to the rural school are extensive. First and foremost, distance education facilitates educational equity among disparate school populations. However, distance education can also:

- increase the quality of instruction
- promote self-sufficient learning
- support and enhance curriculum development
- provide timely access to otherwise unattainable information
- facilitate interdisciplinary and collaborative teaching
- offer access to superior teachers
- offer access to resources in distant libraries, museums and universities
- educate students in the use of new technologies
- help geographically isolated students overcome their sense of isolation
- foster interactivity between schools and faculties
- increase community/school linkages, and
- provide a global context to the student's education.

(Roberts, 1992; Council of Chief State School Officers, 1991; Ohler, 1991; Hefzallah, 1990; Batey & Cowell, 1986).

Distance education brings more than the three R's to rural communities. As discussed above, in many rural communities, the benefits of distance education go beyond "educational equity" to the very survival of the communities themselves (OTA, 1991; OTA, 1989; Kitchen, 1987).

Small communities are finding it increasingly difficult to overcome their isolation and small population bases in seeking the skills, information and capital required for economic development. Telecommunications technologies can serve as a major impetus in reducing and overcoming these barriers. The global shift to an information-based, service economy suggests that communities without these technologies will wither (OTA, 1991).

The resources available via these distance learning technologies address needs far beyond those of the community's schools. Existing programs provide live, interactive instruction ranging from non-credit informational and continuing education programs, to complete credit courses and degree programs. Among those professionals served by technology-delivered resources are doctors, nurses and long-term care specialists; bankers, financial managers and accountants; engineers and computer scientists; public school, college and university educators; agribusiness workers; law enforcement and security officers; firemen, and emergency medical personnel; and more. It is easy to see why distance education is the linchpin in the future of rural America.

Barriers To Serving Rural Schools With Distance Education

The telecommunications technologies necessary to bring distance education to rural America exist. What is lacking is the capacity and determination to integrate those technologies with the educational needs of rural school districts.

The barriers to bringing distance education into rural schools are numerous and multifaceted. They include such familiar "bread & butter" issues as the availability of:

- classroom equipment that students need in order to see and converse with their distant teachers and with other distant learners

- funding to defray the schools' ongoing costs of accessing distance learning services for their students, and

- critical "last mile" connections that physically link rural schools to interactive distance networks.

They also include such core educational issues as:

- matching new distance learning programs or service to what is needed by rural schools

- training classroom teachers and administrators in how to use communications and information processing technologies, and

- resolving pedagogical concerns.

"Bread & Butter" Issues

Lack of Equipment in the Classrooms

One of the greatest barriers to increased use of distance education is the lack of a *flexible* base of communications infrastructure in classrooms, and within school buildings and school districts. In some instances, schools are devoid of even the simplest and least expensive communications technologies. For many potential end users, lack of standardization is the least of their problems. They simply lack the equipment in their schools to receive distance education programs. Most classrooms lack the basics of distance education, including such rudimentary "last mile" technology as phone lines to connect them to the distance learning infrastructure.

The average school has one television set for every four classrooms and one VCR for every six classrooms. Virtually no classrooms have telephone jacks, which are vital to interactive programming. Further, most lack the technology such as telephones and computers to interact with the distance education teacher, or presenter. (For example, 99 percent of California classrooms lack wiring for telephone service; the ratio of students to computers is 20:1).

Incompatibility of Technology and Equipment

The lack of standards to assure the compatibility and interoperability of communications and information processing equipment is a major impediment to both providers and recipients of distance education. The lack of compatibility inhibits more rapid adoption of new technologies and slows expansion of existing services to new users. Lack of compatibility is also critical in the following areas:

- satellite frequencies
- database access
- teleconferencing
- computers, modems and associated software
- encoders and decoders for satellite programming

This problem becomes increasingly critical with the development of multi-state networks, and of interactive programs that depend on the integration of a number of technologies for maximum usefulness.

Inadequate Funding

The lack of stable, dependable funding for distance education at any level (including that of students and teachers in the schools) severely limits the development of resources for provision of distance learning services to rural schools. There are limited resources to support:

- classroom equipment
- infrastructure and "last mile" distribution
- program development
- adaptation of existing facilities, or
- technology development.

But seed monies to set distance education initiatives in motion are not augmented by follow-on funding to support continuing programs and services, so there is also a shortage of funding at federal and state levels to defray on-going costs such as:

- schools' fees for use of distance learning services, and
- service providers' royalty payments for use of copyrighted material in distance teaching.

In some instances, network service providers have obtained "soup-to-nuts" funding for distance learning services on a pilot or demonstration basis. A regrettable side effect of this kind of start-up funding is that classroom teachers and local school officials are left with little evidence that would justify funding for continued access to the services on the basis of actual classroom benefits. Schools have not yet become accustomed to re-programming funds budgeted for other activities in order to take advantage of distance learning offerings.

Inadequate "Last Mile" Communications Infrastructure

Some distance education networks today are a little large interstate highways, but with only a handful of access ramps leading to America's rural communities. In some instances, the available infrastructure simply does not "fit" well with the distance learning service most needed by a school or particular class.

The existing infrastructure often tends to be more suitable for a school or district that needs to "import" instructional services from outside the area, rather than one that needs to "share" local instructional talent a little more broadly within the immediate area. The latter -- which is often what is meant by the term "*short-*distance learning" -- can be particularly frustrated when the networks of communications infrastructure have been created for some entirely different purpose and are undergoing a kind of "adaptive re-use."

If users and providers seek to circumvent barriers to national services (such as time-zone scheduling bottlenecks) by originating short-distance programming in their own areas, they encounter a second set of barriers (depending on the local transmission technologies that ae most cost-efective) -- lack of program origination equipment, lack of access to satellite uplinks, microwave channels, or even sometimes to cable head-ends, lack of local expertise to assist in planning services, and unavailable satellite transponder time.

The lack of an easily accessible infrastructure is especially telling for rural schools, which rely most heavily on interconnecting with one another and actually form communities around educational programs that will enable them to achieve the economies they need as an alternative to consolidation. In rural areas, the model of distance learning that seems most suited to the community infrastructure is that of resource-sharing within a fairly contained area.

Educational Issues

Distance Learning Programs Not Matched to Rural Needs

Most distance education services have been developed to meet specific needs, such as existing nationwide shortages of qualified high school teachers in mathematics and science, and in some foreign languages. Some of the most successful adult, continuing professional education services have flourished by addressing the specific needs of businesses and professional firms for frequent updating of employees' knowledge without the efficiency losses of costly and time-consuming travel away from the workplace.

Relatively little has been done, however, to specify the exact needs of rural schools and to develop distance learning services designed to meet them. Among the issues on which little is actually known from experience is the social benefit to be gained by students in a nationwide classroom-without-walls, and the extent to which distance education permits teacher-sharing within a district or small sub-state region, or the benefits of teachers' telecommuting.

Inadequate Teacher Training

There is a widespread lack of understanding on the part of classroom teachers regarding the mechanics, the uses and the potential of distance education. All too often, teachers and administrators lack the training to use the technologies effectively.

To use distance education effectively, local teachers need a firm grounding through pre-service programs and in-service programs so that they can effectively integrate distance education into their classroom curriculum, utilize interactive technologies (such as phone lines, keypads, computers and on-line databases), and facilitate maximum participation by local students in distance-delivered instruction.

Yet, as described earlier, training is too often unavailable for experienced teachers, and newly graduated teachers are not being offered the basics in their schools of education. Just as there are significant training needs related to classroom teachers or teachers' aides adopting distance education services, there are equally important training needs for the presenters or instructors who originate the distance teaching in mastering the fundamentals of teaching over television

Pedagogical Barriers

Many educators do not integrate distance education resources into their schools' curricula, on grounds that the programs themselves are of unproven pedagogical quality.

Current models of distance education, critics argue, do not always comport to learning theory. In some cases, distance education departs from it. These critics argue that distance education decreases individual instruction, inhibits teacher-student interaction, relies on traditional assessment techniques, and doesn't provide an opportunity for extending time on task -- all of which, they argue, run contrary to what good learning theory says is the best environment for learning. (Of course, some researchers believe that almost all *traditional* classroom teaching *also* runs counter to that same learning theory.)

Further, they cite a dearth of research on the quality of the programs offered, and stress that providers must establish the effectiveness of their programs before they are adopted in their school districts. They call for further research and proof-of-concept testing of distance education programs before they are used in their classrooms.

Some teachers, concerned that technology will replace the classroom teacher, are resistant to distance education efforts. In addition, some teachers fear that many distance education services are developed by people who are not themselves educators and have no understanding or appreciation of how learning works. A sense that the programs are being imposed by administrators who supervise the teachers, or by rules about mandatory curricula that were established in a distant educational bureaucracy, creates an us-versus-them reaction, which serves as a barrier to the integration of distance education into the curriculum.

Distance Education In Action -- Six Case Studies

Distance education is a valuable resource for economically strapped and geographically isolated rural schools. As documented earlier in this report, rural schools have always found it difficult to provide students with instruction in special or advanced areas, a situation that has been exacerbated in a time of tight education budgets.

Distance education offers the promise of instruction in courses where no classroom teacher is available, and makes courses economically feasible when only a handful of students in a rural school need them to meet graduation or college entrance requirements. Through staff development and graduate level course offerings, distance education can also offer the promise of educational training to teachers and staff in isolated, rural areas, so that they, too, can meet their own professional goals.

These, then, are the promises. How is distance education working in practice?

The Role of Public Broadcasting

Public broadcasting has been a pioneer in the use of technology to improve public education. Since its years as educational television in the 1950s and '60s, public television's contribution in providing instructional resources for classroom teachers and for meeting the needs of adult learners at home through telecourse offerings is unparalleled. Public television's educational programming reaches more than 29 million students in 70,000 schools, making it the number-one provider of classroom programming.

In addition, individual public television stations have taken leadership roles in their local communities and across their states in developing and implementing *distance learning* technologies and services.

At the regional level, individual public broadcasting stations have formed consortia and cooperatives that have been the leaders in distance programming. For example, more than 5,000 high school students in 23 states have access to advanced mathematics, science and foreign language courses through public broadcasting's

Satellite Educational Resources Consortium, which is described in detail in one of the case studies later in this chapter. Significantly, about 60 percent of SERC subscriber schools are rural schools (including rural schools in Mississippi and Alabama that participate under the auspices of the U.S. Department of Education's Star Schools program).

Public television also has in place a computer service called Learning Link, which connects 20 PBS stations with students and teachers on a national basis.

Finally, at the grassroots level, growing numbers of public television stations are at the forefront in bringing distance education to geographically isolated schools in their states.

In this chapter, six distance education networks are examined, in Hawaii, Iowa, Ohio, Utah and South Carolina, as well as the multi-state Satellite Educational Resources Consortium (SERC). Some of these programs have established track records; others are in their infancy. Each involves one or more public television entities that have achieved success in meeting the needs of geographically or economically disadvantaged schools and communities through collaboration with public education, higher education, state agencies and/or other key organizations within their states.

The studies presented assess how distance education is working in those states -- and how it can work -- for the benefit of America's rural schools.

The Public Broadcasting Service will also play an important role in how distance learning will work in the future, because of the decision that Congress made in 1988 to invest $200 million in a new generation of satellite distribution and interconnection capability to bring public television's services to the American people. AT&T's Telstar 401 satellite will transmit both public television's services and the complementary services of a large number of independent distance learning networks, making a significant step toward easy use by classroom teachers of a wide variety of distance learning program services. When the satellite is launched and becomes operational within the next year, new infrastructure technologies will be in place and expanded distance learning services will be possible.

Hawaii Interactive Television System (HITS)

Before the mid-1980s, students tucked away in schools in tiny, distant villages across the Hawaiian Islands were easily overlooked. To enroll in upper division, graduate, and professional classes offered by the flagship University of Hawaii campus in Honolulu, citizens living on islands other than Oahu had to make expensive round trip flights to Honolulu each week. The mid-1980s brought a new *rallying cry across the state--a cry for educational equity and for educational excellence.*

The solution chosen for Hawaii's distant learners was a statewide interactive television network based on both point-to-multipoint and point-to-point microwave technologies. The first classes were delivered in 1987. Today, the HITS network spans the most unusual geographic situation in the United States to bring remote students, faculty, and state workers into the mainstream of thinking, learning, and problem solving.

Leading a Coalition for Change

Department of Education science resource teacher Patty Miller reaches about 1,500 students (and their local in-classroom teachers) in each of the eight "hands on" science classes she teaches every day. These live, televised, 60-minute lessons are created and transmitted by a unique infrastructure of collaboration. The University of Hawaii provides the studio-classroom for these 5th and 6th grade Kidscience classes; Hawaii Public Television, through its HITS, provides transmission to cable headends on the six islands of Kauai, Oahu, Molokai, Lanai, Maui, and Hawaii; the cable companies provide delivery into the schools on their educational access channels; and the state Department of Education provides the teacher, her production crew, and, of course, the kids. In an unprecedented classroom event last year, the Kidscience students were simultaneously linked in a live conversation with an amazing set of voyagers: those at sea on the Polynesian voyaging canoe Hokulea, and those aloft on the space shuttle Columbia.

Ask what the greatest surprise has been in implementing this technology solution to Hawaii's educational problems, and the response will most likely be the degree of cooperation achieved among agencies and institutions that have either had no experience or little success in working together effectively. Interagency and public/private partnerships have developed in unexpected ways among organizations in the state. The state Public Broadcasting Authority works with a variety of state supported agencies to deliver educational and instructional programming to Hawaii's people, as illustrated in **Figure 1**. Through collaboration with such groups as the Business Roundtable, the Chamber of Commerce, cable TV operators, the legislature, the state Board of Education, the University of Hawaii, and the Department of Education, Hawaii Public Television has been able to effect a powerful coalition for facilitating change in education by linking people at all levels on all of Hawaii's Islands.

Expanding Technologies for Expanding Services

The Hawaii Public Broadcasting Authority operates both the KHET, Channel 11 open circuit broadcast channel that is carried by all Hawaii cable companies, and the HITS closed-circuit television network, which delivers signals among all six islands.

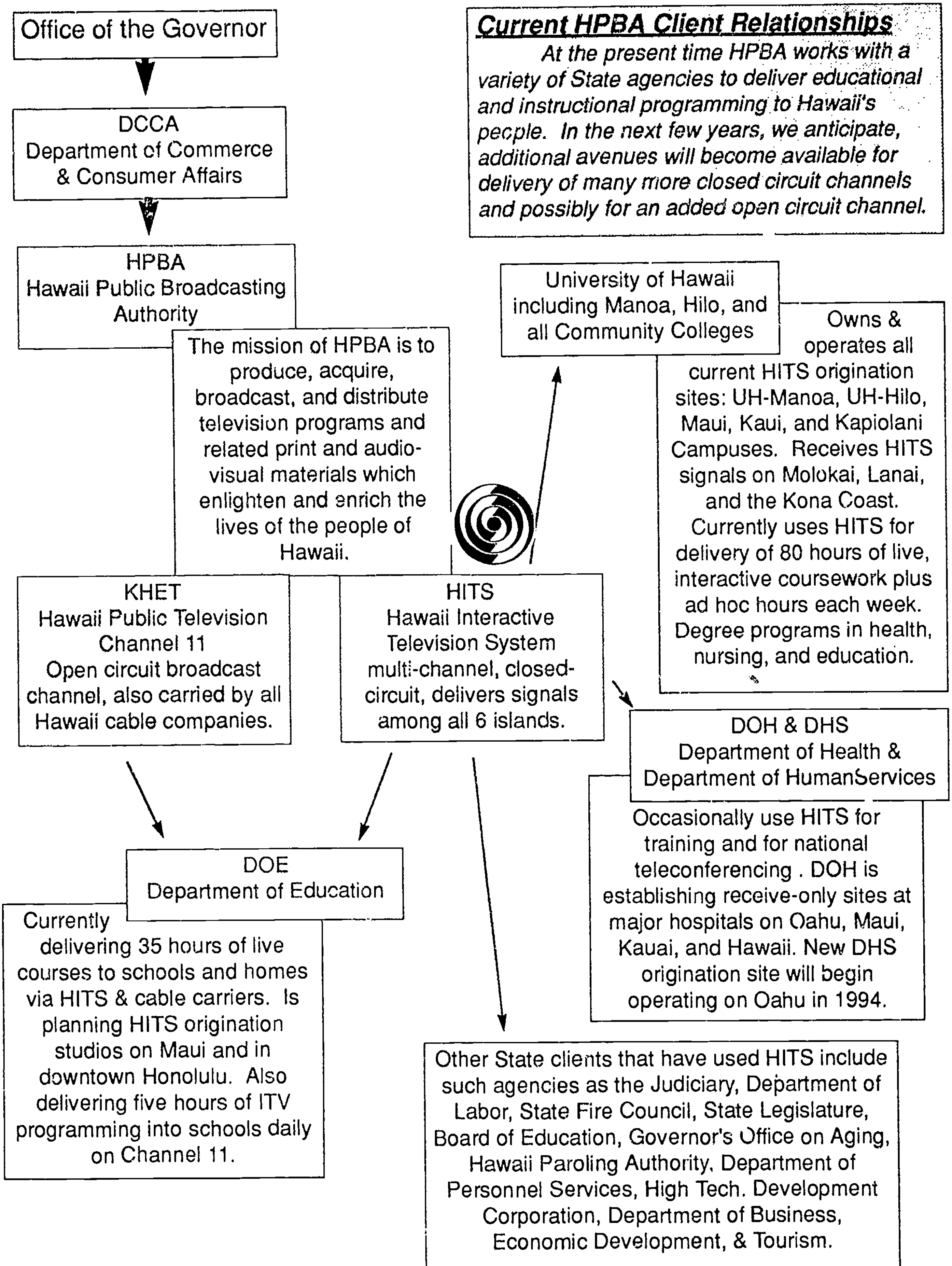

Office of the Governor
DCCA
Department of Commerce & Consumer Affairs
HPBA
Hawaii Public Broadcasting Authority
The mission of HPBA is to produce, acquire, broadcast, and distribute television programs and related print and audio-visual materials which enlighten and enrich the lives of the people of Hawaii.
Current HPBA Client Relationships
At the present time HPBA works with a variety of State agencies to deliver educational and instructional programming to Hawaii's people. In the next few years, we anticipate, additional avenues will become available for delivery of many more closed circuit channels and possibly for an added open circuit channel.
University of Hawaii including Manoa, Hilo, and all Community Colleges
Owns & operates all current HITS origination sites: UH-Manoa, UH-Hilo, Maui, Kaui, and Kapiolani Campuses. Receives HITS signals on Molokai, Lanai, and the Kona Coast. Currently uses HITS for delivery of 80 hours of live, interactive coursework plus ad hoc hours each week. Degree programs in health, nursing, and education.
KHET
Hawaii Public Television Channel 11
Open circuit broadcast channel, also carried by all Hawaii cable companies.
HITS
Hawaii Interactive Television System
multi-channel, closed-circuit, delivers signals among all 6 islands.
DOH & DHS
Department of Health & Department of HumanServices
Occasionally use HITS for training and for national teleconferencing . DOH is establishing receive-only sites at major hospitals on Oahu, Maui, Kauai, and Hawaii. New DHS origination site will begin operating on Oahu in 1994.
DOE
Department of Education
Currently delivering 35 hours of live courses to schools and homes via HITS & cable carriers. Is planning HITS origination studios on Maui and in downtown Honolulu. Also delivering five hours of ITV programming into schools daily on Channel 11.
Other State clients that have used HITS include such agencies as the Judiciary, Department of Labor, State Fire Council, State Legislature, Board of Education, Governor's Office on Aging, Hawaii Paroling Authority, Department of Personnel Services, High Tech. Development Corporation, Department of Business, Economic Development, & Tourism.

Figure 1

A four-channel, statewide, full-motion, interactive television network, HITS is currently becoming a six-channel system. Hawaii Public Television designs, operates, and maintains the network. HITS uses a combination of terrestrial microwave, both Operational Fixed Service (OFS) and Instructional Television Fixed Service (ITFS), to provide one-way video/two-way audio, as well as two-way video distance learning services to the entire state.

Technical planning for the network began in 1984, and was funded by the legislature in 1985. In 1987, the first classes offered via ITFS began on Oahu.

The University of Hawaii, the network's major client, currently owns and operates all studio-classrooms equipped for HITS transmission, located on university campuses across the state. In addition to handling 80 hours each week of university courses, university crews also produce HITS programming for the departments of Education, Health, Human Services, and Personnel Services. More television classrooms and channel capacity are required to meet the state's diverse education and training needs, and additional sites are being constructed as funding allows.

The network currently uses audio talkback as the primary means of interactivity. This is supplemented at some schools with a videotext terminal--a small and relatively inexpensive, self-contained dumb terminal/modem unit for communicating with instructors, as well as with students in other schools, via a simplified electronic mail system. A student can transmit no more than a line or two of text for display on the instructor's screen, but the videotext terminal is very inexpensive (less than $400) and is currently used to support science instruction and provide supplemental classroom activities for students.

HITS is currently exploring options for adding an electronic keypad response system to the network as a more efficient and effective way to monitor and assess learner progress. Audio interactivity alone is considered too limited since, regardless of the number of telephone lines and audio bridge ports provided, only one student can actually speak with the instructor at a time. HITS instructors, as well as management, believe it is interactivity that creates the synergy and immediacy that serve as catalysts for learning among students. Ideally, the technologies employed to allow for interactivity should be selected to address the individual learning styles of students; however, in reality, budgetary constraints greatly limit the options.

To accommodate the need for increased channel capacity among its clients, HITS is converting their four-channel backbone microwave system to a six-channel system by use of alternating-field technology on two of the original four outgoing channels, and is doubling the capacity of transmission paths from neighbor islands to HITS master control.

HITS has expressed an intent to follow the lead of PBS and South Carolina ETV, preparing to use digital compression as a means of expanding their ITFS system channel capacity. However, management believes that budgetary constraints will make such a move impossible for the next two to four years. HITS management will make the final decision, based in part on the availability of increased programming being planned by PBS on Telstar 401.

Programming for Equity and Cost-Effectiveness

Because HITS was initially funded by the state legislature in 1985 to effect greater equity and more cost effective training of state workers, any agency, institution, commission, or other organization supported by the state legislature is automatically a potential client for the network.

The University of Hawaii, the state Department of Education, and the state health department consume the largest volume of broadcast time on the network. Most university degree programs currently offered via HITS are designed to meet the state's critical needs in education and health care, and include degrees in health, nursing, and education.

Hawaii's state education department currently uses an HITS/cable connection to deliver 35 hours each week of locally-produced courses and information programs to students, staff, and the public. The most challenging is the live Kidscience class that reaches 12,000 students and 500 teachers each week. The course is planned to be consistent with the recently adopted national standards for teaching science, and supports six national goals for education. Use of the televised and interactive Kidscience model enables the education department to strengthen the science skills of elementary teachers across the state.

HITS is in its third year of cooperation with the state education department to provide Advanced Placement calculus to high school students. Daily, about 50 high school students study A.P. calculus for high school credit with a master teacher from Maui. The class meets five days a week, for an hour each day. Though teacher training is not a formal component of the class, it has been a significant by-product, allowing some schools to drop the on-air program when resident teachers feel their skills have been sufficiently upgraded by viewing the TV course. As students learn by observing and immediately replicating experiments, so do the teachers. Using this model enables the network and the Department of Education to strengthen the teaching skills of advanced mathematics teachers in local schools. In addition to programming on HITS, Hawaii Public Television also delivers five hours of traditional instructional television programming into schools daily via the KHET open-broadcast signal.

The Department of Health and Human Services has become one of many state agencies to occasionally use the network for training and for teleconferencing. Other examples include the state Department of Personnel Services, which uses the system internally for training, and the state judicial department, which teaches driver education via the system.

Funding

HITS received initial funding of $4 million from the legislature in 1985, and continues to be supported entirely by the state government. To date, the state has invested about $7 million in the network for land acquisition, planning, design, construction, transmission facilities and equipment, and other related expenses.

The operating budget for fiscal year 1992 was approximately $367,500, of which about $272,500 was for personnel (covering nine full-time employees and one student worker), and the remaining $95,000 was for oper‹ ·ions. Program development costs are all carried by the University System, the Department of Education, and other programming agencies.

This year, the network has joined with the state's digital teleconferencing system to apply for its first federal funding, seeking a Public Telecommunications Facilities Program award from the National Telecommunications and Information Administration for a digital/analog bridge to interconnect its two transmission systems.

Iowa Communications Network (ICN)

The Iowa Communications Network --an "information highway of the future" -- is an investment in technology that is expected to pay dividends to residents for decades in terms of governmental efficiency, economic growth opportunities, and educational equity and excellence. The responsibility to plan, establish, and operate the statewide network to meet the educational telecommunications needs of Iowa resides with the Iowa Public Broadcasting Board.

A Collaboration for Meeting Needs

Planning for a statewide educational telecommunications network in Iowa began in late 1986. An increasing number of educational institutions in the state were, at that time, beginning to use interactive instructional technologies to meet local and regional education needs. Members of the Legislative Council decided coordination of these local and regional technologies would provide the foundation for a statewide network. A formal plan for the network was developed and adopted in the fall of 1987. That year, the General Assembly assigned responsibility for implementing a statewide network to meet educational needs to the Iowa Public Broadcasting Board. T' ›oard is specifically charged by the General Assembly to plan, establish, and op‹ ate educational radio and television facilities, and other telecommunications services including narrowcast and broadcast systems to serve the state's educational needs.

The General Assembly also created the Narrowcast Advisory Committee to represent the needs of the network users, to make recommendations regarding system requirements to the Iowa Public Broadcasting Board, and to insure educational needs of users are met. Committee members include representatives of each of the state's educational sectors, including universities, community colleges, area education agencies, public schools, the Department of Education, and the Department of Economic Development.

A construction contract was awarded in 1991; construction of the ICN is proceeding on schedule, and the first phase is expected to be fully operational by October of 1993.

Information Highway of the Future

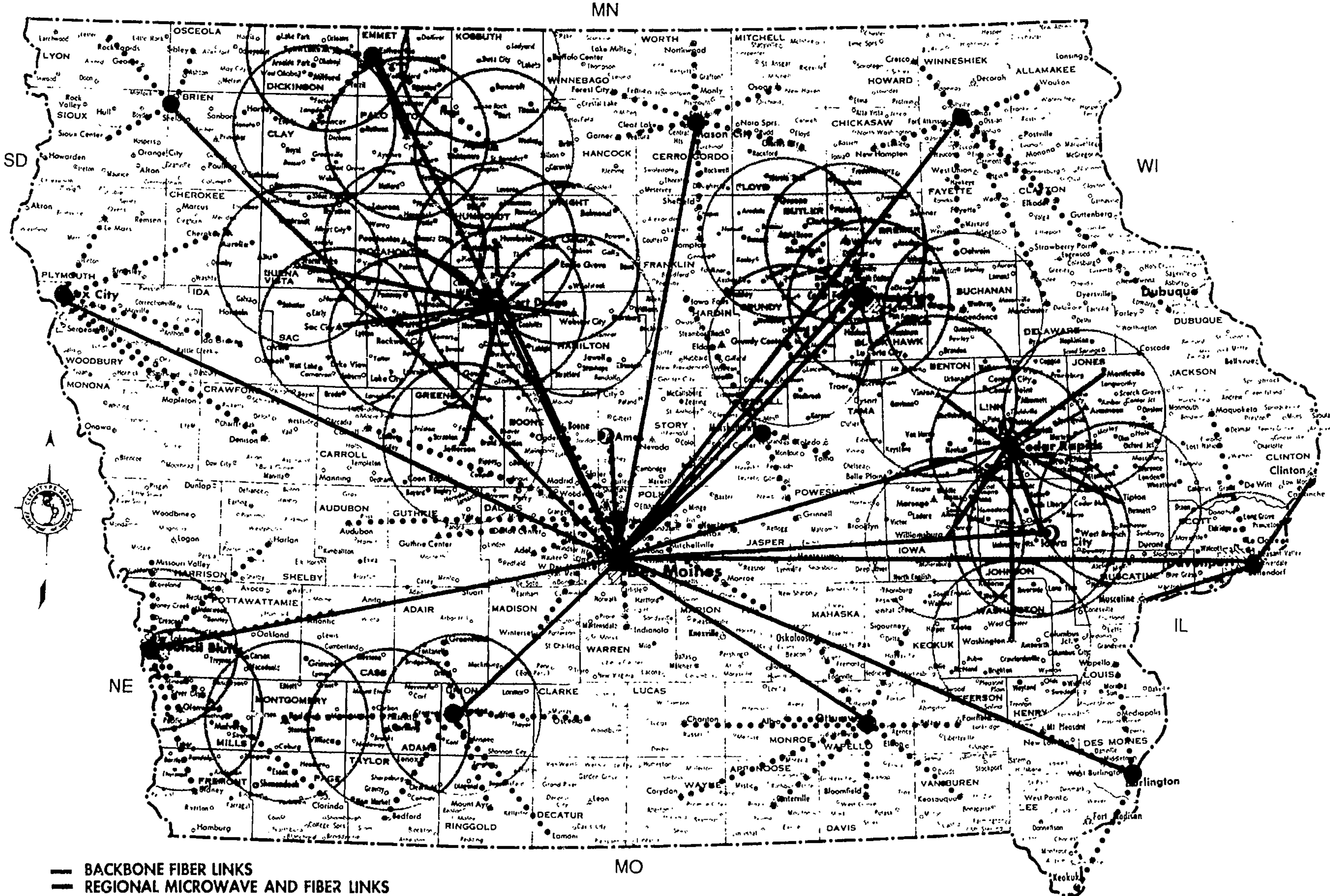
With over 2,600 miles of fiber optic cable connecting user sites at schools, colleges, universities, libraries and government offices across Iowa, ICN will be the largest and most comprehensive network of its kind in the nation. **Figure 2** represents the completed system configuration as currently planned.

The network originates from a central control facility at an armory on the Camp Dodge National Guard base near Des Moines. The first part of the network includes fifteen regional centers located throughout the state at community colleges and at three public four-year universities, and direct links to Iowa Public Television and the state Capitol complex. The Iowa Public Television studio classroom is equipped with two television monitors at the front of the room, microphones on each table, and a video camera for sending images across the state. As many as 48 simultaneous channels of two-way, full-motion video are included in plans for the initial phase.

A second phase of development will consist of 84 separate fiber optic links from the respective regional centers to each of the remaining counties. It will connect each of the regional switching centers (at community colleges) to one site in each county in the geographical area which they serve, with as many as 12 simultaneous two-way, full-motion video channels. Each of these county sites will be equipped with dedicated telecommunications classrooms to be used by any of the state's educational institutions. The first two parts of the network are to be completed by Fall 1993; a third and final phase will provide last-mile access to local schools and other educational institutions.

ICN's end-to-end fiber optic digital transmission technology is designed to provide full-color, full-motion, interactive video transmission; error-free data transmission; and sharp and clear voice communication. Comprehensive data transport capability is a prime design feature of the network. The user-driven system will accommodate both analog and digital data transmission at speeds ranging from 1,200 bits per second to 2.4 gigabits per second. It will also provide the

ICN/Iowa Educational Telecommunications Network



- BACKBONE FIBER LINKS
- REGIONAL MICROWAVE AND FIBER LINKS
- REGIONAL FIBER LINKS
- REGIONAL MICROWAVE LINKS
- INSTRUCTIONAL TELEVISION FIXED SERVICE
- REGIONAL SWITCHING CENTERS
- NETWORK SWITCHING CENTER
- SATELLITE UPLINKS

Figure 2

substantial bandwidth required for high resolution graphics, image transfer, computer-aided design, and telemedicine applications. Advanced broadband transmission technology will allow a single digital circuit to take the place of many standard telephone lines--a single fiber optic circuit will be able to accommodate 32,256 times more telephone traffic than a current copper circuit. And the network's videoconferencing capabilities will enable state agency and educational users throughout the state to meet any time via full-motion video--without ever leaving their own communities.

The three-part fiber optic network will be augmented with a four-uplink satellite network--with each of the four uplinks across the state tied to the fiber network to allow any of the 105 fiber endpoints access to the uplink facilities. Satellite downlinks will be located at each of the 15 regional centers, from which signals received via satellite can be distributed throughout the state using the fiber network.

Programming Instruction and Information

Iowa Public Television provides high-quality educational programming for pre-schoolers, school-age students, and adult learners. During the school year, the television network broadcasts 115 different K-12 commercial-free series from 9 a.m. to 3 p.m. each weekday. The involvement of schools and participation of students in live programming is also a priority of Iowa Public Television. Currently in its fifth season, *Student Voices* is a series to encourage teen-agers to discuss difficult questions with both adult and teenaged "experts" on air to share ideas and propose solutions. Last year alone, students from 78 different school districts and 89 different schools participated. To meet the needs of adult learners, telecourses are broadcast throughout the year, providing an opportunity for home viewers to earn college credit in cooperation with community colleges and universities throughout the state.

Through ICN, Iowa Public Television will move into a new era of providing programs to enrich the lives of the people of Iowa and enhance educational opportunity throughout the state. With access points in each of the state's 99 counties, a network end-user site will be within a 20 minute drive of any resident of the state when the network is completed. The network configuration is designed to provide all Iowans with ready access to the resources of the state's major learning centers, libraries, and government agencies.

Priority uses of the network will include enabling the state's colleges and universities to extend their campuses to reach smaller communities, as well as specialized target groups, with graduate and post-graduate courses. Educational institutions will also be able to provide businesses with programs designed to help them with their day-to-day business operations. Required courses for continued certification will be available in local communities for doctors, lawyers, teachers, accountants, and others. State agencies will be able to conduct seminars and personnel training through the system. The network will offer librarians and library boards access to high-speed data transmission services. And to meet the needs of local schools, elementary and secondary schools will share resources and programs for more efficient use of limited resources. Teachers of specialized courses, not available in rural communities due to low enrollment and limited demand, will be able to teach from their home community to any interested students in schools throughout the state. And ICN will enable teacher and student to interact, just as they do in a traditional classroom.

Planning for instruction to be offered via the network is coordinated by the Narrowcast Advisory Committee under guidelines adopted by the General Assembly for use of telecommunications as an instructional tool. In addition, the state Board of Education is studying options for the coordination of school calendars and schedules. Area education agencies across the state are assessing both technological and educational needs among the schools within their regions; they are charged with establishing both short-range and long-range plans. To support teachers' use of the telecommunications infrastructure to meet their students' needs, the Department of Education awards grants to school districts, area education agencies, and institutions of higher education for staff development and training. The first pilot course on the network, a master's degree-level course in social work, began in January of 1993 from an originating classroom at Iowa Public Television.

An Investment That Will Return Savings and Benefits

The total cost for construction of the network is estimated to be $101.3 million (including what community colleges across the state will pay). This includes the associated electronics and codecs required to interconnect 124 two-way studio classrooms (for originating audio and video) to the fiber distribution system, at a cost of approximately $110,000 each. The studio classrooms will soon be equipped with three cameras, three monitors, and multiple speaker-phones for program origination in 54 high schools, 44 community colleges, 21 private colleges, three regent institutions, Iowa Public Television, and the Camp Dodge central control center. Each studio classroom is expected to cost from $28,000 to $32,000.

The ICN plan projects a capping of Iowa's governmental telephone costs, thus offering the potential for significant savings (projected to be about $9 million per year). The network's teleconferencing capability will reduce worker downtime, trim travel costs, and enhance productivity by involving government employees at all levels and at all locations. Government agencies will be able to harness ICN's video capabilities as a means of streamlining operations; improving productivity; reducing costs; and maintaining regular contact with offices, departments, and personnel from border to border. Once in place, ICN's fiber optic backbone will provide the platform for fast, accurate, and economical communications and services.

WOUB/WOUC-TV -- Ohio

Located in the Southeast region of Ohio, WOUB/WOUC-TV is positioned to provide new educational services to some of the most economically-disadvantaged schools in the state. When a new program was initiated by Governor George Voinovich in 1991, these public television stations were selected to implement the first pilot--using existing open broadcast technologies as a medium for providing live and interactive distance learning experiences to some of the state's most disadvantaged students.

Collaborating for Educational Equity

Collaboration on the use of technology to meet the educational needs of the citizens of Ohio is supported through both infrastructure and funding from the highest office in state government. In July of 1991, Governor Voinovich created the Ohio Education Technology Equity Commission, charged with examining the application of electronic technology to education, and planning for improvements in education via technology. Educational improvement through the use of technology is specifically targeted for those public schools that have the fewest resources -- Ohio's lowest wealth districts. The Commission designed a three-phase plan, known as Project Technology Equity, that addressed the present need to first understand what technology tools are currently available to educators and how teachers are using technology, and then to support the development of pilot projects in every region of the state to study how different types of electronic delivery systems can work to improve education for children.

The pilot is a project of WOUB/WOUC-TV and their affiliated instructional TV agency, Educational Technology Services of Ohio, Inc. (ETSEO), to use existing open broadcast technology to serve thirty of the state's lowest-wealth school districts that are located within the stations' broadcast service areas. WOUB/WOUC-TV were selected for the pilot because of their long-standing service to schools in the area, and because of the importance the stations place on partnerships with organizations on and off campus.

Collaboration with other departments at Ohio University is exemplified by the development of the audio program, *African American History, Retold*, with the Department of Lifelong Learning. Beyond the Athens campus, WOUB/WOUC-TV operates the Higher Education Microwave Services (HEMS) interactive microwave network to enable the sharing of instructional resources among all six of the university campuses spread across Southeast Ohio. Another example is its support of the Chillicothe Telephone Company in its plans to make available, at no cost, the use of advanced, broadband fiber optic telecommunications facilities to connect high schools for educational purposes in celebration of the company's 100th anniversary in 1995. With the interconnection of the HEMS network to the emerging fiber optic network, the university will have increased distribution capabilities for its programs and services.

Collaboration beyond Ohio is demonstrated with the stations' work with other universities on production projects, such as with the Rural Clearinghouse for Lifelong Education and Development at Kansas State University. Together, they produced a social science television course funded by the Annenberg/CPB Project, *Rural Communities, Legacy and Change,* for national distribution.

Traditional Technology/Non-traditional Programs

The Ohio University Telecommunications Center owns and operates two open-broadcast television stations (WOUB-TV and WOUC-TV), five radio stations (four FM and one AM), and one microwave network (The Higher Education Microwave Services/HEMS). It also programs one cable channel in Athens. WOUB/WOUC-TV uses existing open broadcast technologies common among public televion and radio to provide unique educational resources needed by its viewers, particularly in the school and in the home, in Southeast Ohio. Programs such as *Take Me To Your Leaders* for fourth grade students are broadcast live via over-the-air broadcasts, and supported by audio interactivity via telephone, regular mail service, and computer response via the ETSEO electronic bulletin board on the Ohio Educational Computer Network (OECN). State funding has supported installation of phone lines and provision of equipment to allow students to interact with the teacher, as well as with students in other schools.

In addition to open broadcast technologies, the Higher Education Microwave Services (HEMS) is licensed by the FCC in conjunction with WOUB/WOUC-TV as the first network in the State of Ohio to be operated by a university. HEMS is an interactive network providing television, telephone, and computer data services between the university's six campuses. The distribution of course offerings from the main campus at Athens to supplement the remote campus offerings is a significant contribution to the educational program of each community.

The HEMS studio classrooms form a network of interactive audio and video sites, offering simultaneous interaction by participants at two or more campuses. The instructor controls the operations at the host classroom from a podium equipped with a camera and monitor for displaying graphics, host site camera controls, and switches to display remote site video on the monitors. Each studio classroom contains three cameras, 12 ceiling microphones, videotape players, and three television monitors. Switching is controlled from the Radio-Television Communications Building on the Athens campus. Each campus is equipped with towers and microwave dishes. A trained student operator is assigned to each HEMS class to start up the system, monitor the audio and video signals, and assist the instructor when needed. HEMS studio-classrooms have been designed as enhanced classrooms, so that it is not necessary for instructors using the system to adapt their teaching styles to the sometimes artificial demands of a broadcast studio.

Programming for Southeast Ohio and Beyond

The WOUB/WOUC-TV open broadcast instructional schedule includes over 100 programs per week (including repeats), plus additional block feeds to schools to record for later use. Through participation in Project Technology Equity, the stations have been able to expand beyond traditional ITV offerings via open broadcast, to develop a model distance learning program.

During the initial phase in 1993, nine interactive broadcast video courses are being developed and targeted to low-wealth districts served by the Ohio public television stations, WOUB/WOUC-TV, and their affiliated instructional TV agency, ETSEO. These live, audio-interactive distance learning courses, available at both regional and state levels, are intended as "demonstration" pilot projects to serve those schools most in need, but are available to all schools across Ohio. *Take Me to Your Leaders* is the product of this pilot: a series of six live, interactive 20-minute video programs presenting government officials at the state, regional, and local levels, as a means to provide an in-depth look at the offices they hold. An estimated 25,000 fourth graders in low-wealth school districts in the WOUB/WOUC-TV coverage area in southeast Ohio will have access to the course when it is initially broadcast in the Spring of 1993. Thirty of the lowest wealth school districts in Ohio are located within the broadcast area of WOUB/WOUC-TV, and are served by in-school programming offered through ETSEO.

Through the development of such programs as the innovative *African American History, Retold* series of half-hour radio programs about the American past, WOUB/WOUC-TV has expanded the experience of the traditional telecourse. The series begins right after the Civil War, examining the meaning of freedom for African Americans. Each half-hour program is a self-contained story about a period of history or a great African American leader, and was developed and originally broadcast (even nationally on NPR) as a radio supplement to a credit-bearing telecourse. In addition, a live audioconference connecting participants with noted Ohio citizens and leaders also has been used to supplement the telecourse, even allowing call-in questions from across the country.

WOUB/WOUC-TV has also expanded the experience of the traditional correspondence course, producing four video series designed to supplement correspondence course offerings in Sign Language and Philosophy. Ohio University distributes these videotapes to registered students around the world to supplement their text materials.

The program objective of HEMS is to meet the educational needs of its campus communities in the form of subject matter experts for school instruction, professional continuing education and staff development, and increased access to information and instructional resources for business and community members. Over the 1991-1992 school year, 45 credit courses in such subjects as nursing, health, economics, finance, accounting, management, and communications were offered via HEMS to approximately 800 students. In addition, 48 ad hoc programs, including teleconferences, workshops, and meetings were offered to support such needs as continuing legal education, civil servant professional development, and inter-campus planning.

Cost Effective Alternatives for Change

The HEMS operating budget for the 1992-93 school year is $221,000, providing for three full-time staff members and several student workers. Faculty members who teach on the network are paid an $800 faculty development fee for each course. The capital cost of the Network over a ten year period has been approximately $4.5 million, with each studio classroom costing approximately $80,000 to $90,000 for equipment and associated room modifications.

Funding for the development and production of the *Take Me to Your Leaders* Project Technology Equity demonstration pilot is provided by the Ohio Education Technology Equity Commission. The WOUB/WOUC-TV operating budget for the project is $150,000. Of this, $50,000 is for an equipment survey; and $100,000 is for development of six, 20-minute television programs.

Video programs distributed to supplement correspondence courses (10 programs lasting 25 minutes each) are produced internally at the University Center for about $4,000 each. The cost would exceed $15,000 each if they were produced commercially.

Utah Education Network

Technology provides answers to real problems in Utah. Applications of technology in education are getting more than the traditional "quick look" in remote areas of Utah--residents are welcoming the opportunity to participate in educational experiences unavailable before now.

The Utah Education Network exists to provide a quality instructional and informational service by harnessing telecommunications technology in the service of education for the benefit of Utah learners. The Network does this by planning, constructing, maintaining, managing, and programming the state's non-broadcast education systems (EDNET, ITFS) and public broadcasting stations (KULC-TV Channel 9 and the daytime schedule on KUED-TV Channel 7), on behalf of Utah's systems of higher education, public education, and state government. Network staff also provide leadership, advice, and advocacy to educators and public officials in the field of telecommunications.

Creating Electronic Communities of Learners

The State Educational Telecommunications Operations Center (SETOC), which was established in 1982, was officially renamed the Utah Education Network in 1991. KUED, KULC, and EDNET are developing within the network to create electronic communities of teachers and learners in classrooms and libraries without walls. The result will be greater quality, access, and efficiency in education throughout Utah.

KUED-TV Channel 7 in Salt Lake City is licensed to the University of Utah, and is Utah's "flagship" public broadcasting station. KULC-TV Channel 9 in Salt Lake City is licensed to the state Board of Regents and dedicated to the distribution of instructional programming for students of all ages. EDNET, an abbreviation for Education Network, distributes public education (K-12) classes, vocational education, and continuing medical education throughout the state.

The Utah Education Network is governed by the Utah Education Network Consortium, an 18-member cooperative representing higher education, public education, government, and business. Membership in the consortium includes the nine colleges and universities, as well as the state Office of Education, the state Board of Regents, the state government generally, the Regional Service Centers (Public Education), the private pector, the chief rural and urban school superintendents, and the Applied Technology Centers.

The Utah Network for Instructional Television (UNIT) is a public education committee responsible for identifying, licensing, and coordinating the offering of instructional television programs on KUED-TV and KULC-TV. Upon selection of programming for each school year, UNIT's program recommendations are presented to the state's school superintendents for their consideration and final approval.

Distance learning and telecourse broadcast schedules for each school year are developed by regional consortia (such as northeastern Utah high schools under the umbrella organization of Northeastern Utah Educational Services). Committee and task force organizations designed to provide a more comprehensive and systematic use of emerging instructional technologies continue to form as the need for each is defined.

Utah Education Network: Multiple Technologies for Multiple Services

KUED-TV is a full power VHF broadcast television station licensed to the University of Utah. Its broadcast signal covers the largest geographical area of any public television station in the United States--including all of Utah, and parts of Arizona, Idaho, Nevada, and Wyoming.

KULC-TV's full power VHF broadcast television station is licensed to the Utah State Board of Regents and is operated by the University of Utah on behalf of the state's nine colleges and universities and the state system of public instruction. The station's primary broadcast signal is extended north and south throughout the central part of the state by an expanding translator system, and by agreements with affiliates of TeleCommunications, Inc. (TCI) cable.

EDNET is a closed-circuit, interactive (two-way audio and video) microwave television system that connects communities via specially-equipped studios and classrooms in cities and towns throughout Utah. "Last mile" connections to community sites are supplemented with transmission via low power television, Instructional Television Fixed Service (ITFS) microwave, fiber optics, cable, and early forms of compressed video on telephone lines (such as COMNET). In addition to the EDNET microwave network, the Utah Education Network also operates a single-channel ITFS network for medical programming.

The individual classrooms on EDNET are electronically connected so that participants in any of the site locations can see and hear participants at any of the other sites. In addition, origination can occur from any of the EDNET sites. The system also provides quality data channels for the exchange of computer information by libraries, data processing departments, and telecommunications agencies throughout Utah. A major expansion of EDNET is planned into 57 new sites using compressed video technology. This will make it possible for the video to travel over standard T1 (high speed telephone) lines leased from private phone companies. Recent legislation in Utah has also provided for research and experimentation into the incorporation of digital video technology into the network.

Programming for Instruction and Information

The network's program priorities are both instructional and informational, and are provided through the acquisition, creation, and distribution of telecourses, teleconferences, data transmission, in-service training, and instructional television programs.

Consistent with KUED's intent to be a vital community resource in the areas of public discourse, education, community service, and the arts, the state's primary Public Broadcasting Service station dedicates a significant portion of its resources to educational/instructional programming and related services. In addition to its award-winning prime time programs, KUED broadcasts six hours of instructional programs for public school (K-12) students each Monday through Friday from 9 a.m. to 3 p.m. during the school year. The station broadcasts more than 1,400 hours of instructional television during 1991-92, reaching an estimated 250,000 K-12 students, teachers, and administrators.

KULC-TV is dedicated to the distribution of instructional programming for students of all ages. Considered the state's "Learning Channel," KULC's programming comes primarily from Utah's institutions of higher education, national producers of instructional television programs, and PBS. In cooperation with the state Office of Education and the Utah Network for Instructional Television, KULC broadcasts more than 1,570 hours of "core curriculum" programs in arts, foreign language, health, language arts, mathematics, music, science, and social studies for Utah's K-12 school-age children during 1991-1992. The station broadcasts an additional 1,117 hours for university and college credit, and 1,192 hours of not-for-credit instruction. The college and university for-credit classes were offered in anthropology, art, health, history, government, literature, science, psychology, sociology, and mathematics. Over 4,000 students enrolled in KULC broadcast classes during 1991-1992. Other programs and services offered include general educational programs, adult education courses, GED high school courses, and general education required courses. KULC broadcast a total of more than 3,800 hours of instructional and information programs in 1991-1992.

Education Network's (EDNET's) primary purpose is to distribute public education (K-12) and post-secondary classes, vocational education programs, and continuing medical education programs to communities, faculties, and students, both rural and urban, who might not otherwise have access to these services and resources. During 1991-1992, EDNET delivered approximately 2,047 hours of instruction that led to either high school, college/university, or vocational credit; 267 hours of training and development for such agencies as the Division of Human Services and training and credit coursework for public educators; 253 hours of administrative meetings; and 178 hours of programming for miscellaneous projects. More than 1,860 students enrolled in credit classes offered via EDNET during 1991-1992. EDNET is increasingly being used to deliver specialized courses in K-12 to students who would otherwise not have the curriculum offerings available. Course offerings include foreign languages, mathematics, science, and technology; as well as advanced placement courses.

In addition to the vast amount of programming distributed within Utah by KUED, KULC, and EDNET, the Utah Education Network has become involved with several national partners (*e.g.*, South Carolina Educational Television and Nebraska Educational Television) in the distribution of satellite videoconferences nationwide.

Funding Upgrades and Expansion

In 1992, the Utah Education Network had an operating budget of $799,849. Operating funds for the Network are provided primarily by the state legislature. The Legislative Telecommunications Task Force has provided $2 million for the beginning of the T1, compressed video-based EDNET extension to additional high schools, applied technology centers, and school district offices.

The Utah Education Network Program Development Fund was established in 1991 to aid distance education "producing institutions" in planning and implementing for-credit instructional programs for distribution on EDNET, KULC-TV, or KUED-TV. A combination of federal and state money is used to upgrade and expand the broadcast station equipment and establish new electronic links. Funding for regional interconnections of communities has come from such sources as Title III and Distance Learning Grants, such foundations as the USWest Foundation; and various other federal and state grants.

South Carolina Educational Television

The South Carolina Educational Television network of today began with the vision, and developed under the leadership, of its twenty-eight-year president, Henry Cauthen. Cauthen says that in the early 1960s, a lot of states were building television stations, then asking themselves what they could do with them. South Carolina approached it differently by first asking, "What do we need in this state?'" and then deciding how to go about delivering it. A two-year television experiment at Dreher High School in Columbia led to the creation of the South Carolina Educational Television Commission, signed by then Governor Ernest Hollings in 1960.

To compete in the broadcast market in the future, Cauthen predicts public stations and state networks will have to become community-wide or state-wide service agencies that go far beyond just sending out a single broadcast signal. South Carolina ETV began implementing future technology more than 30 years ago; it is now positioned to be the first to implement 21st- century technology to serve today's educational needs across its home state, and beyond.

In the Business of Education

Since its beginning in Dreher High School more than 30 years ago, South Carolina ETV has become one of the top four producers in the nation for PBS, producing such well-known programs as *Great Performances, Firing Line,* and *American Playhouse*. ETV also produces a number of local programs for South Carolina audiences. The general public sees these and other *cultural* programs everyday through public television's over-the-air broadcast services. However, first and foremost, SC ETV always has been in the business of *education*. Distance learning began to take shape at the network in the early 1960s, when mathematics lessons were being transmitted live to classrooms across the state via the nation's first statewide cable network.

The extent of the current involvement of the network in the infrastructure of education is illustrated by a recommendation contained in a report on the Educational Excellence Team on Instructional Technology submitted by the state superintendent of education in July of 1991. The report provides a framework for seeking educational excellence and for restructuring schools through appropriate uses of instructional technologies. That report recommended that South Carolina ETV and other interactive telecommunications networks be completed and maintained as a primary vehicle for communication within the state Education Department, public schools, schools of teacher education, and the business community.

The priority for cooperative development also extends to the national level, with SC ETV assuming a leadership role in 1988 in the creation of the Satellite Educational Resources Consortium (SERC), now a 22-state consortium providing interactive satellite-based distance learning course work and programs to students and teachers in rural America. Since SERC's pilot semester in spring of 1989, SC ETV has been a contributing course producer for SERC, which is also headquartered in Columbia.

For over 30 years, education has been ETV's primary mission. South Carolina's high-quality instructional programming harnesses television's enormous power to inform, stimulate, and educate children and adults.

First at Many Technology Innovations

South Carolina ETV created the nation's first statewide cable network to link up schools and other sites in the 1960s. By 1963, SC ETV's closed-circuit network reached all South Carolina counties and included most state colleges and university extension centers, 10 hospitals, and the majority of public schools. In the late 1970s, SC ETV secured one of five satellite uplink/downlink facilities installed at the time by PBS in Columbia. In the 1980s SC ETV advanced its service to education by creating a four channel, closed-circuit network on Instructional Television Fixed Service (ITFS) microwave. For a number of years, SC ETV has offered distance learning and teleconferencing services over much of the state using a "backbone" four-channel Operational Fixed Service (OFS) microwave system, interconnected with its four-channel ITFS microwave system, as illustrated in **Figure 3**. Currently, about 95 percent of the state's population lives within five miles of an ETV site.

South Carolina ETV has been involved in distance learning at the college level through live, interactive instruction since the 1970s, when the University of South Carolina, via SC ETV, began broadcasting engineering and business courses statewide. Today, seven higher education sites originate courses and programs on the ETV network. An additional 29 higher education sites are planning to interconnect to the SC ETV Network over the next several years.

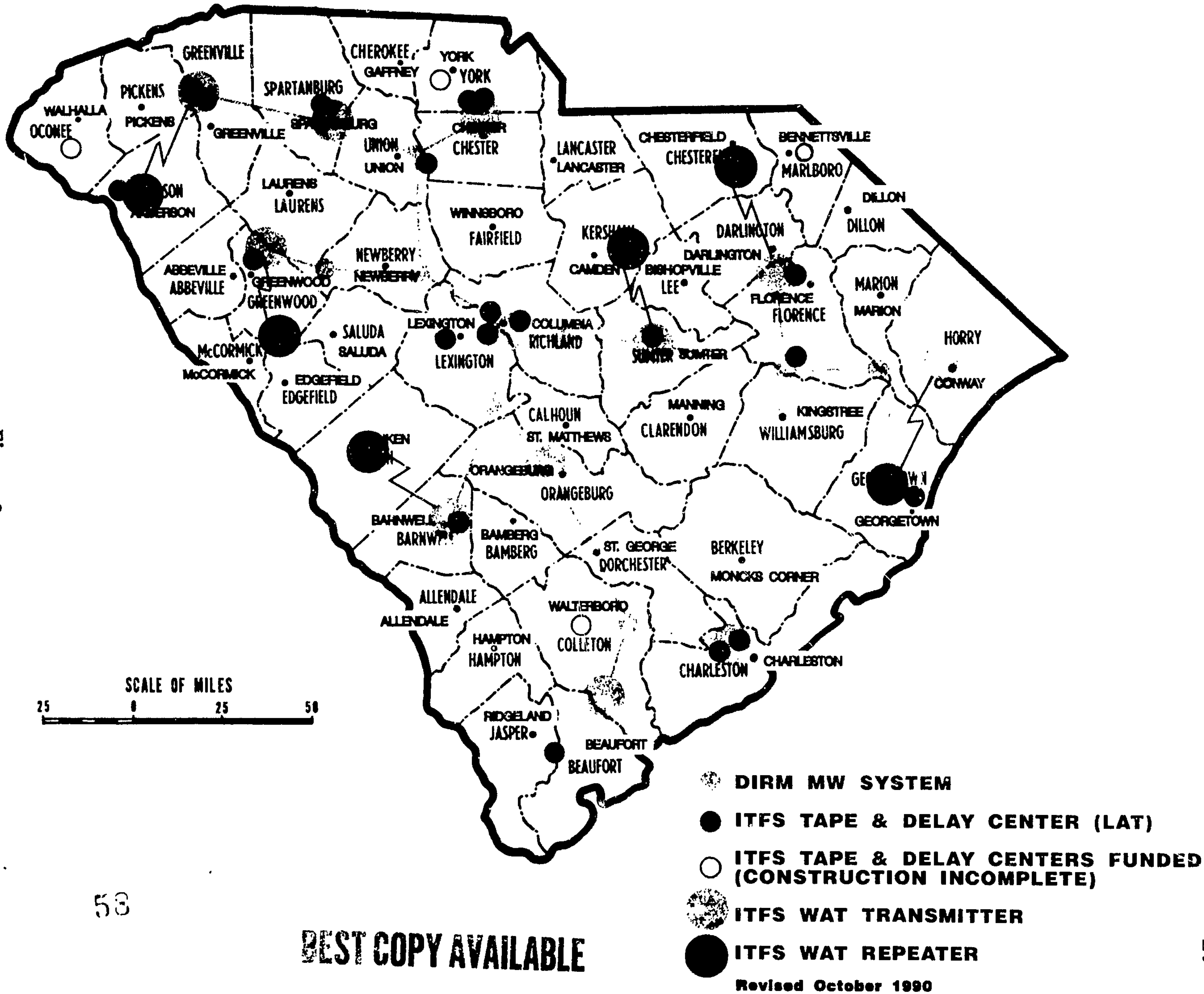


Figure 3.

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As the most significant driving force behind the formation of the Satellite Educational Resources Consortium (SERC), SC ETV has been involved with satellite-delivered distance learning on a national level for a number of years. SC ETV has recently undertaken two major initiatives which will effectively apply the SERC approach at the local level and at the statewide level. The first of these initiatives is the Short Distance Learning Project which was begun in 1992, and is being expanded throughout 1993. This project consists of outfitting the Tape and Delay Centers with low-cost (generally under $10,000) "mini-studios," to function as program origination or production sites. These centers are now producing and distributing their own live, interactive courses, and are transmitting them via ITFS to schools within their local districts. Of the 21 Tape and Delay Centers, 15 have already begun originating short distance learning classes for their local districts.

In the fall of 1993, South Carolina ETV will enter a new era when it launches what is by far the most innovative of its recent technology initiatives--the Multichannel Digital Satellite Network (MDSN). The 20 channel system will utilize the General Instrument/AT&T digital video compression system recently adopted as the standard to be used by PBS to provide its program distribution services on Telstar 401.

All 20 channels will be uplinked from the Columbia ETV Center. However, programming for distribution via the MDSN can originate not only at the SC ETV Center in Columbia, but also at the numerous local origination sites at colleges, universities, and agencies that are interconnected via the statewide microwave system. Local programming can also be contributed by communities across South Carolina through the new Short Distance Learning Project mini studios located at Tape and Delay Centers. The Multichannel Digital Satellite Network will be the first network to transmit so many CDV channels in one satellite transponder, and will be the first state network to be able to simultaneously rebroadcast via satellite a large number of remotely-originated programs.

The completed system will continue to use the existing ITFS systems and all of the existing microwave equipment. Since the ITFS channels will be fed via satellite, those channels will be available at any satellite receiving location, along with any of the other 20 channels. New receiving sites can then be economically added to the system without regard to their location (including anywhere in the 50 states). Existing ITFS receive sites can expand the number of channels available to them by the addition of satellite receive capability where needed.

Programming to Inform and Stimulate

The South Carolina Educational Television Network was founded to provide instructional programming to schools, and today feeds more than 100 hours each weekday from 8 a.m. until 4 p.m. to more than 83 percent of students in South

Carolina's public schools. Schools are currently served over SC ETV's network of 11 TV broadcast stations covering most of the state. These schools receive one or two channels of instructional programming by this method. Instructional programming also includes many specials for students, consistent with SC ETV's effort to inspire and motivate students.

While ETV's closed-circuit channels are used for providing instruction for middle schools and high schools during the day, the early morning and evening hours belong to college credit and adult education. The broadcast day begins at 5:45 a.m. with college credit courses and teacher training series. This year, more South Carolinians earn their masters degrees through SC ETV than through all of the state's college and universities combined. Four universities offer more than 160 subjects for college credit through telecourses. An additional ten college courses in subjects like elementary education, library science, and physics are broadcast direct into homes via ETV's open circuit channel. Adults with limited formal education are served with a GED series for adults, and a reading skills program for adults who read at less than the fifth grade level.

In service to other sectors of the state, ETV operates the busiest state teleconferencing center in the nation, handling 1,050 teleconferences for businesses and state government last year alone. SC ETV also operates the largest state medical network in America. Dating back to 1961, the network today delivers close to 1,040 hours of medical programming each year to 86 hospitals, mental health offices, and other sites.

To meet education needs not only within the state, but beyond, SC ETV is increasing its use of satellite-based distance learning. ETV remains a major producer of high school credit courses offered by SERC, contributing Russian I and II, and AP Economics to the math, science, and foreign language course offerings of the national consortium. Building on its experience in teaching foreign languages to high school student via SERC, SC ETV has launched *Speed Russian*, the first of many offerings design to meet needs of South Carolina and national business and industry. The course, to be launched in the Spring of 1993, is delivered via live, interactive satellite to course participants at their businesses. In addition to the live instruction offered via satellite, telephone tutoring via an audiobridge and special hot lines are available for after-hours student/teacher telephone tutoring.

Recently, SC ETV has added a new twist to distance learning in South Carolina, which it calls "short distance learning." Technology is adapted to accomplish on local and regional levels what the successful SERC program does nationally--which is ETV's way of empowering local communities to better meet the educational needs of their residents. Schools are equipped to create their own live, interactive classes, conferences, and personnel training sessions, and to transmit them to area schools district wide. From SC ETV's perspective, short-distance education creates a compelling learning environment, saves time and money, prevents duplication of services, and makes education more equitable.

Through South Carolina ETV's Short Distance Learning Project, 21 ITV Centers (traditional Tape and Delay Centers around the state) are now using their facilities and technologies to produce and transmit live, interactive classes, meetings, staff development presentations, and student projects district-wide to meet individual schools' needs. Essentially, the SERC concept is being used at the local level, with ITFS microwave, rather than satellite, serving as the distribution technology.

South Carolina ETV's Short Distance Learning Project requires an investment of less than $10,000 to convert a Tape and Delay Center into an instructional classroom or "mini studio." No additional transmission equipment is required since the Tape and Delay Centers are already connected to their local ITFS transmission facilities. The project is considered a tremendous cost saver for school districts because it allows a district to offer a wider curriculum to several of its schools while paying for only one teacher, thereby relieving the teacher shortage and saving taxpayer money

South Carolina ETV also has built a national reputation for quality early childhood instruction with its training videotapes for childcare staff and parents. Produced at the Children's Place, ETV's on-site child-care facility and learning center, the videos are recognized as critical training for under-served groups and are distributed nationally. SC ETV is taking the leadership in increasing access to educational resources for underserved populations through the Early Childhood Professional Development Network's Head Start demonstration grant, an innovative collaboration between public broadcasting and the early childhood professional community to provide live, interactive instruction via satellite to meet the critical need for effective, cost-efficient Head Start staff training nationwide.

The ECPDN program has been developed primarily for individuals who lack access to available and affordable early childhood training, and targets Head Start teachers working primarily with rural, migrant, Native American, Alaskan village, and other populations in rural and isolated areas of the United States. Over three years, ECPDN will make quality educational resources, training, and information available to over 1,050 Head Start teachers.

The ECPDN is funded by a three-year demonstration grant from the U.S. Department of Health and Human Services' Office of Human Development Services. The total budget for FY 1992 was $1.2 million; for FY 1993 is $3.2 million ; and for FY 1994 is yet to be determined. The federal share each year is 75 percent, and the non-federal share is 25 percent.

Leveraging Experience and Leadership

SC ETV has been able to secure grants and funding that allow South Carolina to be a technological leader in the country and the world. By moving ideas instead of people, SC ETV is able to not only save the state money, but also provide training to people who otherwise wouldn't get it at all, or would have to leave their communities to do so.

To implement its newest innovation, the Multichannel Digital Satellite Network (MDSN), South Carolina ETV has received funding from the state. The cost of the satellite uplink equipment and the digital encoding systems for the MDSN will be $3.9 million, which is being funded by "re-financing" an existing loan (for the original microwave/ITFS system) at a lower interest rate and extending the term. This arrangement will be used to fund the satellite "hub" uplink equipment located at the ETV Center in Columbia, as well as an associated upgrade to the microwave system. The cost of the satellite receiving systems located at user sites over the state will be borne by the users themselves. Every school in the state will be a potential receiving site, with no schools remaining out of reach of SC ETV programming. The network has applied to the Public Telecommunications Facilities Program of the National Telecommunications and Information Administration for a grant to connect the remaining secondary schools to the Digital Satellite System. Satellite receive systems will cost $3,500 for a single channel system, and $1,850 for each additional channel.

SC ETV plans to contract with AT&T for a full 54-MHz transponder on Telstar 401, at a cost of about $1.5 million for an annual lease (or $12 million for purchase for an expected 12 year life). Transponder funding will come from the state, or from a combination of the state and local users. The per-channel transponder cost will be much less than for any other satellite-delivered programming offered to date by any provider in the nation.

Satellite Educational Resources Consortium (SERC)

PBS has been using satellites to distribute programming since 1978. It has only been in the past five years, however, that local and state public television entities have begun to demonstrate the enormous potential of satellites to increase access to and use of their programs. This has been accomplished by public television not in isolation, but in collaboration with local, state, and university educators, with the support of state, federal, and private funds. Through such a collaboration called Satellite Educational Resources Consortium (SERC), the increased access to critically-needed educational resources is available for the first time among economically and geographically disadvantaged schools across the United States. SERC is a dramatic example of how public television can create partnerships to accomplish national priorities.

A Membership-Based Organization

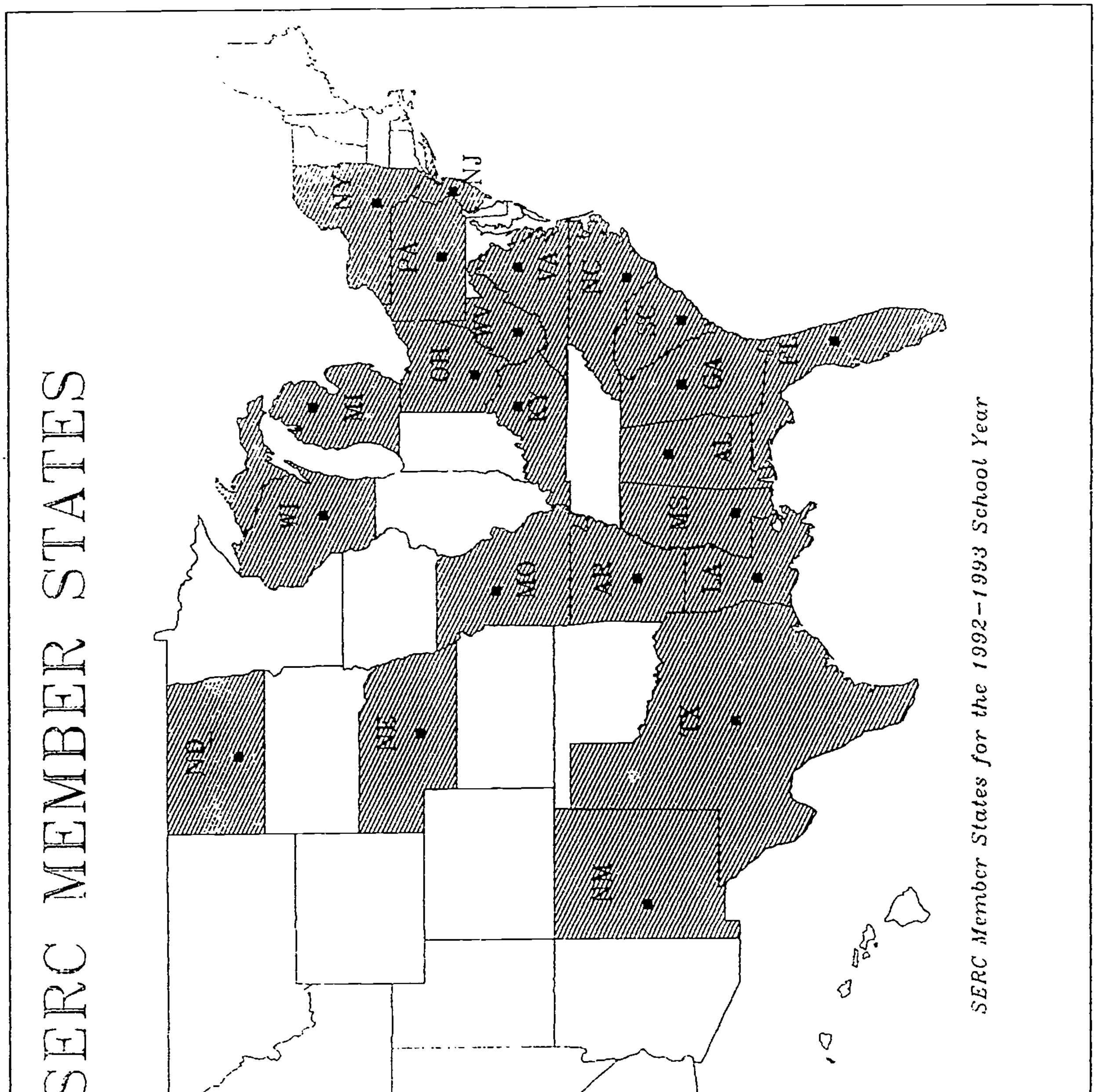
Satellite Educational Resources Consortium, Inc., was founded in 1988 to make quality education in math, science, foreign language, and social studies equally available to all students, regardless of geographic location or socioeconomic status. SERC is a nonprofit 22 state collaboration of state departments of education, local school districts, state and local educational television entities, instructional program producers, university educators, and private industry.

Through the SERC multi-state partnership, state and local public education agencies combine their curriculum expertise with the technical and production expertise of state and local public broadcasting agencies to deliver live, interactive courses via satellite. State and local educational agencies are SERC's links to schools, determining and designing courses, helping to pinpoint schools that can benefit the most from SERC course offerings, and providing communications links to schools in member states. Public television provides the technical, production, and distribution support to deliver courses direct to students in their local schools via satellite, ITFS, cable, fiber optics, and open broadcast technologies. The SERC partnership of education and public broadcasting is aided by private industry, universities, and state and federal government. The SERC Board of Directors is comprised of two representatives from each member state: one from the Department of Education, and one from Public Television.

SERC's primary focus is on serving economically and geographically disadvantaged schools by meeting the needs of students and teachers in critical subject areas. SERC currently offers 15 high school credit courses to more than 5,000 students in over 500 schools in 28 states (some student registrations are from nonmember states); one middle school course to 118 middle schools; and 126 hours of staff development to teachers and administrators in participating schools in each of the member states, and more. Approximately 71 percent of SERC schools are Chapter 1 eligible, 60 percent are rural, and 73 percent have fewer than 1,000 students. The map in **Figure 4** indicates the 22 states that are currently SERC members and associate members. The average SERC student is 16 years old, has a grade point average of 3.0 or better, and plans to enroll in college upon graduation from high school.

Leveraging Existing Facilities

The majority of SERC courses are produced each school day in public television studio facilities staffed with public television employees, and transmitted via public television-owned Ku-band satellite uplinks to GTE's Spacenet II geosynchronous satellite. The satellite signal is then broadcast back to satellite dishes located at participating schools; and/or at cable, ITFS, or open broadcast system headends for retransmission to local schools.


SERC MEMBER STATES
NY
NJ
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VA
NC
KY
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TX
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NE
NM
SERC Member States for the 1992–1993 School Year

Figure 4

All SERC classes require a color television, a programmable VHS videocassette recorder, a speakerphone with mute button, and a private phone line. Students in classrooms in as many as 28 states across the country watch the teacher on the television screen, and communicate directly with the teacher using the speakerphone, or an electronic keypad response system in the classroom. All students viewing the course hear the teacher, as well as any questions or comments asked by their fellow "satellite classmates" across the country. In addition to being used for audio interactivity during class time, the telephone is also used for tutoring sessions that are integral to the success of SERC's foreign language courses.

To support mathematics, physics, and Latin instruction, students are also able to communicate with the distant teacher through wireless keypads on their desks. Students key in responses to the teacher's questions, the responses are then transmitted from the keypad to a data collection unit interfaced with a computer in the classroom, and then transmitted via telephone line from each classroom computer to a master computer in the teacher's instructional studio. The cumulative responses are then tabulated and immediately displayed on a monitor in the instructional studio. Both the teacher and the distant learner can view the results on bar charts and other types of displays. The keypads are used in these classes for official testing, instructional pacing, opinion polling, and more. Most importantly, the keypad response system can be used by the teacher to track individual student's responses over the course of the school year to monitor and assess progress. Because the SERC keypad response system requires a computer in each classroom, some instructors also take advantage of the electronic-mail capability via Learning Link to further enhance interactivity.

SERC is planning to convert to the PBS-selected compression technology as it transitions its programming to the PBS Telstar 401 satellite in early 1994. The consortium is also examining how to expand its interactivity options, in recognition of the fact that it addresses on a continuing basis the key question of how to deal more effectively with interactivity. In this regard, SERC is considering supplementing credit courses with computer conferencing activities, and with an expanded use of electronic keypad technology.

Programming for Equity and Access

The SERC broadcast schedule for the current school year includes the following high school credit courses: *Japanese I and II* produced by the Nebraska Department of Education in cooperation with the Nebraska Educational Television Network; *Russian I and II* , and *AP Economics (Microeconomics and Macro-economics)* produced by South Carolina Educational Television in conjunction with the South Carolina State Department of Education; *Latin I and II, Probability and Statistics, Discrete Mathematics, Precalculus,* and *Physics,* produced by Kentucky Educational Television; and *World Geography - Honors,* produced by the University of Alabama Center for Communications and Educational Technology (CCET), in conjunction with Alabama Public Television and the Alabama Department of

Education. One science course is also currently offered by SERC for middle school students: *Integrated Science 7,* produced by the same triad of Alabama entities as *World Geography.* Unlike the high school credit courses offered by SERC, *Integrated Science 7* is offered as a teacher *resource* model, not as a complete credit course. Enrollment totals for the 1992-1993 school year are reflected in **Figure 5.**

SERC requires a classroom facilitator for each course in which a local school has students registered. The facilitator is critical to the success of the course, and must be someone who is excited about the subject matter, is willing to learn along with the students, and who will work to create the kind of classroom atmosphere in which students can learn.

The final component of SERC's program offerings is staff development. Through the 1992-1993 school year, 20 different events totaling 127 hours of programming are available to individual school sites in SERC member states through a comprehensive Staff Development Package. Graduate courses are also offered for teachers and administrators across the country, with subjects varying from Math Methodology, to Science Certification, to English as a Second Language.

Membership-, Tuition-, and Grant-Supported

The development, operation, and expansion of the SERC program has depended, over its brief five year history, on annual state membership fees and student course fees. The consortium has supplemented this income with state, federal, and private grant funding when attainable, but views these sources of funds as supplementary--using them primarily to fund evaluation, technical advancements, and downlink equipment. SERC received its first grant of $5.6 million from the Star Schools program of the U.S. Department of Education in 1988. That grant was followed by another in 1989 for $4.1 million. With changes in federal legislation, former Star Schools recipients once again became eligible for participation in the program this year, and SERC received its third grant award of $2.3 million. With these grant funds, SERC will provide more downlink, computer, and keypad equipment for schools in member states. It will also add two high school credit courses to its 1993-1994 broadcast schedule: *Calculus,* to be produced by Corinth High School and the Mississippi Authority for Educational Television, in cooperation with the Mississippi Department of Education; and *Spanish III,* to be produced by Prairie Public Television in North Dakota. *Integrated Science 8,* to be produced by the University of Alabama (Tuscaloosa) Center for Communication and Educational Technology, in conjunction with Alabama Public Television and the Alabama Department of Education, will be added for middle school students. Schools are also encouraged to use Eisenhower and Chapter II grant monies to assist with the cost of providing *Integrated Science 7* and *Integrated Science 8* for their students. Even though the development cost of these courses is covered under the Star Schools program funds, member schools continue to pay student tuition for the courses.

1992-93 Course Enrollment Totals

Course	Students	Schools	Enrollments
Japanese I			1,395
Section A	563	136	
Section B	552	98	
Section C	280	61	
Japanese II			553
Section A	288	87	
Section B	265	84	
Russian I			410
Section A	197	65	
Section B	113	36	
Section C	100	26	
Russian II			243
Section A	155	55	
Section B	88	43	
World Geography, Honors			274
Section A	214	39	
Section B	60	12	
AP Macroeconomics			169
Section A	116	35	
Section B	53	22	
AP Microeconomics			205
Section A	130	36	
Section B	75	31	
* Discrete Mathematics	322	57	322
* Latin I	537	54	537
* Latin II	116	19	116
* Probability & Statistics	348	62	348
* Physics	353	32	353
* Precalculus	88	11	88

Total Schools Participating:			549
Total Students Enrolled in High School Credit Courses:			5,013
Total FTEs (Full Time Equivalents):			4,491
Integrated Science 7		20	

*Total includes Kentucky students not registered through SERC.

Figure 5

In addition to the recent Star Schools grant award, SERC has also received a federal grant of $500,000 from the Public Telecommunications Facilities Program of the National Telecommunications and Information Administration for downlink equipment in schools which are presently unserved in 12 states. The steerable Ku-band and C-band capable downlinks will enable these schools to take full advantage of any satellite-delivered education and training programs. The average cost to equip each school is $5,900, which will allow approximately 85 sites to be equipped through this new funding source.

SERC also seeks and obtains underwriting from numerous sources to develop and offer specific programs. A current example is the *National Restructuring Forum*--a series of four live, interactive videoconferences and audioconferences, supplemented with computer networking. The programs are available to schools and public television stations in all states this spring through funding provided by CPB, which has also funded other projects for the consortium.

The current operating budget for SERC is $4.3 million, which is covered by membership fees and student registration fees. The organization pays producing stations a block grant of $65,000 for each course produced, plus a variable per pupil fee of $125 for non-language courses and $150 for language courses. In terms of cost effectiveness for participating schools, SERC states that for each instructional hour, the cost per student for its courses is comparable to the cost per student for courses taught in the traditional manner.

The Role of PBS

The Public Broadcasting Service has played an increasingly important role in providing instructional television and educational programming through its member stations. Until recently, PBS has not itself been a major player in the field of distance education (although its member stations, as discussed above, have played a pivotal role). That is expected to change dramatically in the coming year as the Telstar 401 satellite is launched and becomes operational.

Public broadcasting's contributions to educational television over the past 24 years are considerable:

• Public television's educational programming reaches more than 29 million students in 70,000 schools, making it the number-one provider of classroom programming.

• PBS's member stations have long broadcast a range of enrichment programs, documentaries, and courses to schools. Programs such as *Reading Rainbow* and *3-2-1 Contact* have become staples of the school curriculum. In addition, documentary programming, such as *Nova* and *National Geographic Specials*, are regularly incorporated into classroom instruction.

- PBS also offers print and other supplemental materials to accompany its educational programming. For example, secondary school science teachers have expanded the science curriculum by using *The Voyage of the Mimi* series and accompanying text and software.

- PBS also offers a wide range of college credit courses through its Adult Learning Service.

Looking to the Future

PBS plans to expand its distance learning and education services dramatically in the coming year when AT&T's Telstar 401 satellite is launched and becomes operational. Funding for seven transponders on Telstar 401 will enable PBS to create an expanded range of channels and services.

PBS has invited other complementary, but independent, distance education providers to join PBS on the satellite to make it as easy as possible for educators to access the services they need -- making it in effect a satellite "education neighborhood." The Satellite Educational Resources Consortium, the National Technological University, and SCOLA -- all three leaders and innovators in distance learning -- have already announced that they will join PBS as its first education "neighbors" on Telstar 401.

With the advent of digital compression technology, PBS envisions providing more than 40 channels on Telstar 401, with the majority of the channels devoted exclusively to instructional television or distance learning, and all capable of carrying two-way data communications. PBS is looking at the possibility of having entire channels devoted to one subject, such as math or history, with some of the programming being broadcast live or interactive. Other channels might be dedicated to PBS' own programming as well as to professional development programs for teachers and administrators.

PBS is also working to ensure that its member stations have the full benefit of the new distance learning technologies. In addition to providing a satellite dish at every member station, PBS is anticipating the creation of a two-way, interactive system through placement of very small aperture terminals (VSATs) at every PBS station. VSATs are satellite receive dishes which would enable the station to send and receive voice, data and limited video signals.

To support this planned expansion, PBS is conducting a research and demonstration project that connects a number of schools to their PBS station to ascertain the two-way distance learning capabilities of a VSAT system.

With these innovations, PBS is positioned to provide a significant lifeline to America's rural schools through the creation of innovative programming and the transmission of those programs via cutting-edge technologies.

Barriers to the Involvement of Public Broadcasting

The barriers to greater involvement of public broadcasting in distance learning fall into two broad categories: perceptual and technological.

1. Perceptual Barriers

The role of public broadcasting in distance education is not clearly understood by educators and administrators, particularly in states where educators themselves have established distance learning networks and services. Educators often perceive public broadcasters as dedicated primarily to cultural rather than educational programming. Accordingly, there is a mistrust on the part of many educators and administrators concerning public broadcasting's commitment to distance learning. This leads to mistrust over public broadcasting's motives and its ability to meet educational objectives. Instead of being viewed as an ally by the education establishment, public broadcasters are sometimes seen as lacking educational expertise and as unwelcome competitors for limited education funds.

Sometimes there is also a perception that because the primary focus of public broadcasting is the provision of national programming for general audiences, public broadcasting is unwilling to dedicate its most important distribution capacity to expanded daytime distance education programming, or to expand its service delivery to accommodate interactive technologies.

It must be stressed, however, that public broadcasting's editorial capabilities are the equal of its transmission capabilities -- a critical factor that frequently gets lost in the technological scramble. With its state-of-the-art production facilities, and extensive experience in the development of educational programming in longstanding partnership with schools and colleges, public television can provide excellence in program content as well as transmission of programs.

To the extent that public broadcasting is viewed solely or primarily as a content delivery system (and not as an accomplished and versatile content provider), a valuable educational resource will be left untapped. The people who will pay the price for that oversight will be the teachers and students in America's rural schools, who will find themselves unnecessarily shortchanged.

2. Technological Barriers

Although the aforementioned barriers are not to be minimized, it must be emphasized that if all of the perceptual barriers to greater involvement of public broadcasting in distance education were to disappear tomorrow, PBS and its member stations would still be confronted with the same barriers that confront every provider of distance education -- among them, lack of educational channels, lack of standardized equipment for interconnects, lack of distance learning equipment in the classrooms, lack of "last mile" technology to connect rural schoolrooms to the distance learning infrastructure, and a federal-state regulatory environment which is anything but user-friendly to distance education technologies.

Until these barriers to distance education are removed, public broadcasting stands in the shoes of every other programmer and provider of distance education in America, unable to bring the full benefits of educational excellence to geographically disdavantaged students.

Distance Education -- The Building Blocks

If distance learning networks are to overcome the barriers to increased use and effectiveness, and fulfill their instructional potential in schools across America, they must incorporate certain building blocks identified in the process of compiling this report. Namely, they must incorporate cutting-edge technologies that offer cost effectiveness, instructional effectiveness, and increased access and interoperability for distance learning into the 21st century.

Following is an overview of technologies that would serve as integral components of any proposed demonstration project, any new technological infrastructure, and any new program or service. Some of the technologies will be key to increasing the cost effectiveness of distance-delivered resources, others to increasing access to resources, and others to improving the instructional effectiveness of those resources. Because these technologies should not be viewed in isolation, but rather as building blocks to be integrated to support and supplement one another (as well as existing transmission and interactive technologies), the pieces can also form the foundation of an infrastructure for increased interoperability among networks and services. Increased access comes with making these technologies widely available through the demonstration models recommended in the following section.

Cost Effectiveness Through Technological Innovations

The technologies with the greatest potential to increase the cost effectiveness of distance learning soon are recent products that allow compressed digital video to be broadcast from one or more transmitting locations to a large number of receiving sites, where it is then converted to full-motion analog video for program viewing.

Compressed digital video has actually been in commercial use since the early 1980's, in the form of codecs (encoders/decoders) to provide point-to-point videoconferencing via telephone or computer circuits, as illustrated in examples to follow. The codecs were originally very expensive (about $250,000 each and required at each program origination and receive site), and the required telephone circuits were not available in many parts of the country. However, the costs of codecs have fallen dramatically over the past ten years (down to approximately $20,000 to $80,000 each), and, likewise, the telephone circuit capacity required has dropped while the quality of the video transmission has been maintained.

Examples of current uses of compression include:

• Videoconferencing technology via satellite, leased telephone circuits, and fiber are used across the country to provide local, regional and state video and data services. Nebraska Educational Television operates a 12 channel, two-way video service across the state via only half of a C-band satellite transponder. Fifteen sites across the state are equipped to share the available 12 channels for exchange of college credit courses and medical training. Nebraska ETV plans to expand its use of compression in the near future as PBS begins programming its new satellite services via Telstar 401.

• The Texas A&M University System, through the public television Educational Broadcast Services of KAMU-TV, operates one of the largest university-operated, two-way interactive digital video communications networks in the country. Twenty-two locations in fifteen cities across the state participate in meetings and classes via the Trans-Texas Videoconference Network (TTVN). Twenty-two academic courses were taught via TTVN during the Fall of 1992, bringing staff and students together face-to-face over long distances, and multiplying the number of students reached per faculty member among several campuses.

The greatest impact of compressed video is likely to be associated with satellite-based distance learning networks. The potential to transmit many programs per satellite transponder makes per-channel transmission costs much lower than for analog video now used by such satellite-based distance learning networks as SERC, and others providing similar programs and services. The cost of a Ku-band transponder for analog video (most commonly used by distance learning networks), which accommodates only one or two programs per hour, typically ranges from $400 to $800 per hour, or $100,000 to $190,000 per month. In contrast, the per-channel fractional transponder cost for a full-time compressed digital video transponder slot is estimated to be approximately $100 to $150 per hour, or between $20,000 and $40,000 per month.

These prices represent a major breakthrough for distance learning networks, especially for those offering a significant number of courses for students throughout the school day. Building a new network incorporating compressed digital video technology adds approximately $100,000 to $125,000 to the cost of the uplink for each channel. However, the cost of each receive site equipped to receive only compressed digital video programming is comparable to the cost of a traditional Ku-band analog system ($3,000 to $5,000, installed).

Converting an existing network from analog to digital requires retrofitting the satellite uplink (at a cost of approximately $100,000 to $125,000), as well as each school receive site (at a cost of $1,500 to $2,000 each). This retrofit becomes more and more cost effective as the ratio of the number of broadcast program hours to the number of receiving sites becomes larger and larger--that is, as transponder cost savings begin to offset increased equipment cost.

One example of a satellite network planning to convert from analog to digital is SERC, as profiled in the previous section. SERC plans to convert to compression as it transitions its programming to the PBS Telstar 401 satellite in early 1994. Through a special financing plan arranged by PBS, the conversion will be capitalized by AT&T, with SERC repaying the equipment cost out of future satellite time cost savings. After the payback, SERC's operating cost savings will be significant.

An example of a new network being planned as a compressed video, satellite-based service is the Multichannel Digital Satellite Network (MDSN) of South Carolina Educational Television (SC ETV, also profiled in the last chapter). MDSN will provide a 20-channel capacity, also using the digital video compression system recently adopted by PBS as the standard for its program distribution services on Telstar 401. The new network will enable colleges, universities and agencies throughout South Carolina to originate programming. With so much capacity, and the capability to reach all sites in the state via satellite, SC ETV will finally accomplish a long-standing goal of providing programs and services to the 102 secondary schools within the state which cannot currently be served by any existing microwave, ITFS or cable telecommunications link. Each new receive system will cost approximately $3,500 for a single channel, and $1,850 for each additional channel. The cost of the satellite uplink and the digital encoding equipment for the MDSN will be approximately $3.9 million for the multi-channel system.

Increased Access Through Conferencing Options

The advent of satellite delivery of instructional resources nationwide in the mid-eighties led to a dramatic increase not only in the availability of distance learning programs, but also in the attention given distance learning as an alternative for meeting the needs of schools. As a result, satellite-based distance learning programs have received the most attention, and have experienced the most significant growth. However, several alternative technologies for providing distance learning resources, to varying degrees, are instructionally effective, are cost effective, and can be easily integrated with other delivery systems to allow for greater interoperability of programs and services. These technologies are generally grouped under the broad category of teleconferencing--since each uses standard dial-up, analog telephone lines for transmission of program content. In addition to videoconferencing, the most common forms of teleconferencing used in distance learning applications include audioconferencing, audiographics conferencing, and computer conferencing. With the advent of the low-cost color videophone, it should also be considered a viable alternative for future distance learning applications.

Audioconferencing. Telephone audioconferencing between two or more parties is not only the most widely used form of technology-based interactivity, but also can be used, primarily in combination with other technologies, as the basis for delivery of programs and courses to distant learners. Audioconferencing can be synchronous, with parties communicating with each other in real time, or it can be asynchronous, with the communication time delayed. Synchronous, or real-time audioconferencing, requires use of a telephone or speakerphone, as well as an audio bridge. Audio bridges are available to accommodate varying numbers of simultaneous users. An eight-port bridge ranges in price from $15,000 to $20,000, and a 24-port bridge is available for $100,000 or more. (Additional ports for each system cost $1,000 to $2,000 each.)

Increasingly, voice mail, now the most common means of asynchronous audioconferencing, is used to exchange class information, student questions, language practice, tutoring, etc. in distance learning networks. Audioconferencing can be extremely useful to supplement other instructional/interactive techniques, but has its limitations in high-enrollment courses. Long distance line charges, combined with charges for an audio bridge, can become excessive for long-duration audioconferences among many participants, or for long periods of information exchange between individual students and their teachers or tutors.

Among the 50 states, Alaska has the most extensive experience with audioconferencing as a delivery technology for credit courses. With more than 250 audio sites across the state, the University of Alaska in Fairbanks offers as many as 80 credit courses each semester to remote learners. In some cases, instructors supplement the audio with text transmission and/or exchange via fax, print, or electronic mail.

Audiographic Conferencing. Audiographic conferencing combines telephone with some means of graphics exchange, such as electronic writing tablets (or electronic blackboards), still videos, or computer-generated visual materials. All participants can converse in conventional audioconferencing fashion, while looking at the same text or graphics on their computer screens. It is common for audiographic systems to require two telephone lines at each site--one for audio and one for data--although some systems now time-share single lines.

Typical hardware/software packages at the student site range in cost from $6,000 to $7,500, while the instructor's package generally costs $2,000 to $3,000 more. The equipment required typically consists of a personal computer with a modem, an electronic writing tablet, and a speakerphone. More sophisticated systems include a wireless pen or "mouse", one or more color monitors, a scanner, a printer, and a remote control to allow for teacher movement, and can cost $2,000 to $4,000 more.

Like audioconferencing, the cost of operating an audiographic conference increases as the number of participants increases, and can be particularly expensive if two telephone lines are required at each site. While audioconference systems seldom link more than eight or ten sites, more can be joined if an audio bridge is used.

Because audiographics has been shown to be an effective tool of distance learning, a wide range of projects in a number of states currently use the technology to provide courses to distant students. A collaborative project between the National Teaching and Development Center in Mansfield, Pennsylvania and schools in Utah has involved a six-year study of a calculus course taught by the same teacher using audiographics--with very positive outcomes. Another audiographics-based program conducted at Mansfield University was for the 25 tribally-controlled and Bureau of Indian Affairs colleges throughout the United States--the American Indian College Teleteaching Project. Tribal college faculty were able to teach from one reservation to another, and to use a telecommunications bridge to teach classes among 3 to 14 reservations simultaneously--also with impressive results in terms of student performance.

Computer Conferencing. Like audioconferencing, computer conferencing can also be real time, or non-real time. Real-time synchronous computer conferencing is commonly referred to as a "chat" mode, and provides each participant the opportunity to type messages that are transmitted out to all of the other participants (usually through a central host computer) for real-time display on their computer screens.

A more common mode of computer conferencing, much like asynchronous voice mail, is electronic mail, or "E-mail." Students and instructors can use their personal computers and modems to connect to a central host computer running the conferencing software program. Participants have 24-hour access to the host computer, and can dial in to retrieve messages, or leave messages for other participants. A student can communicate individually with another student or the instructor or tutor, or can participate in group projects with other distant students.

A computer with a modem, linked to a telephone line in the classroom, provides a relatively low-cost alternative for bringing telecommunications-based activities, and even credit courses, into the classroom to enhance learning experiences. Uses range from real-time conferencing, to E-mail exchange, electronic forum exchange, file transfer, database access, reference tool access, and gateway access for connecting to online systems.

While the list of state and national computer-based networks is too large to enumerate, three are worth noting as representative of the types of services currently available for schools properly equipped to participate--Learning Link, PBS Online, and the Big Sky Telegraph Network.

Learning Link is an interactive, computer-based communications and information system designed to support educational needs of K-12 students, teachers, administrators, parents, and more. It is a membership-based national consortium of public broadcasters and state departments of education. Learning Link features a variety of databases and information resources, message centers, and gateways to remote databases and bulletin boards. Its services are locally managed and operated by public broadcasting stations, educational agencies, or community organizations in 21 states. A national version of the system is available to any school that does not have access to a local system.

One of the newest services available to schools (currently on a pilot basis only) is PBS Online, which is working with 21 schools to create a composite national computer magazine using computer-based multimedia applications. Sixteen affiliate public television stations are working with the 21 pilot high schools. The premier issue of the *HiWavz* magazine is scheduled for release in the Spring. The composite news, feature stories, television and movie reviews, sports articles, columns, editorials, photos, artwork, and video segments will be reproduced on computer discs for viewing on a personal computer. The ultimate goal is for student work from across the country to be submitted via the PBS VSAT network (also currently being piloted), and the final product distributed via the new PBS satellite network scheduled to be operational in 1994.

The third example of a computer conferencing service is the Big Sky Telegraph Network based at Western Montana College. The Network offers not only supplemental computer conferencing experiences for the 116 one-room schools in rural Montana and neighboring states that participate in its services, but also computer-mediated credit courses. Big Sky Telegraph has offered a course on *Microcomputer Telecommunictions* for teachers, and at the high school level, MIT's Plasma Fusion Lab has delivered a course on *Chaos Theory* for gifted science students.

Videophone Conferencing. The video telephone, as an instrument for teleconferencing, offers renewed promise for distance learning applications in the nineties. Early versions of the videophone (commonly called video speaker phones) transmit only slow-scan, black-and-white "snapshots" via standard analog, dial-up telephone lines. The Hawaii Department of Education has used this inexpensive technology (ranging from $200 to $700 per instrument) for several years to connect students on its isolated islands with fellow students on other islands, as well as with people who impact their lives across America, such as their Congressmen.

Recently, the first commercially available videophone to operate over a standard dial-up, analog telephone line to transmit color, motion images was introduced at a price under $1,000. This color video imaging device has limited resolution, motion, and viewing area, but affords a new dimension to one-on-one videoconferencing. Video telephones are being joined by desktop video devices (most of which are PC-based), in a market place targeted to enable multi-party conferencing and "video mail" services. Such technologies will undoubtedly provide new alternatives for delivery and support of distance learning services in the near future.

Increased Learning Effectiveness Through Expanded Interactivity

Interactivity is considered one of the most crucial factors to the success and quality of distance learning programming. As distance learning experiences greater success and student enrollments in classes increase, the ability of the distant teacher to maintain contact with and monitor and assess the progress of each individual student becomes increasingly difficult. Program providers consider reaching a satisfactory level of interactivity one of the most significant challenges they face as they strive to improve the instructional effectiveness of distance learning courses. They also realize that interactive technologies can save on administrative costs by minimizing the transfer of paper between the instructor and each remote receive site.

The majority of "interactive" distance learning networks use audio talkback, or audioconferencing, as the only means of interaction between the teacher and distant students. A number of other interactive technologies exist and are available for use, but have not been widely adopted due, primarily, to lack of funding. In addition to audiographic, computer, and videophone conferencing, a number of interactive technologies exist for the interactive exchange of data and images, as summarized in the accompanying chart. Among them are electronic keypad response systems, electronic writing tablets, and hardcopy exchange (and/or broadcast) systems.

Talkback. Audio talkback is most often accomplished by means of dial-up telephone calls from receiving site classrooms back to the originating studio. The equipment at each receiving site includes, at a minimum, one wired or cordless telephone (standard or push-to-talk), a speaker phone, or a microphone. Each call to the instructor is mixed with the program audio at the originating studio and rebroadcast to be heard by all students. Some systems accommodate a small number of simultaneous calls using an audio bridge or similar device, so that students from different sites can converse with each other and with the teacher. This can be particularly useful in support of foreign language instruction.

Audio talkback is an essential component of most distance learning programs, but it does have its limitations. The main limitation is that only one student can talk at a time, both to the instructor during class and during tutoring "office hours." Although this is also true of instruction in the classroom with a teacher, students learning at a distance do not have the advantage of daily association and access to the teacher and are particularly limited when talkback, alone, is used for interactivity. Talkback is, therefore, most effective when used in conjunction with other forms of interactivity--particularly those that transfer data between teachers and students.

INTERACTIVITY OPTIONS FOR DISTANCE LEARNING

TECHNOLOGY	IMPLEMENTATION	ADVANTAGES	DISADVANTAGES	TRENDS
Audio Talkback	Cordless or hardwired telephones, speakerphones, or microphones used in conjunction with dial-up telephone circuits or other telecommunications paths such as microwave, VSAT, fiber, or cable. Some systems require an audio bridge.	Allows students to talk directly with the instructor and with each other. Makes the class more personal and increases the level of involvement of the individual students.	Even with multiple, bridged lines, only one student can talk at a time. For large classes, it may be weeks before any individual student can get a chance to converse with the instructor. Also, the talkback audio quality is sometimes poor.	More emphasis being given to audio quality and to providing audio tutoring outside class hours.
Electronic Keypad Response Systems	Individual student keypads, connected via hardwire, RF, or IR to classroom data collection devices. Data is then forwarded by dial-up or packet-switched telephone circuits (or other telecommunications paths such as microwave, VSAT, fiber, or cable) to instructor's computer for display and/or archiving.	Provides the instructor with feedback from the students, such that their progress and comprehension can be measured in a ongoing fashion and the instructional pace can be slowed down or speeded up as appropriate.	Responses are limited to a small character set on the keypad. Displays are small and text-based, rather than graphical. Phone line charges can be high, but can be kept to a reasonable level with care in system designed and use.	More use of *wireless* keypads anticipated. As the ability to monitor and assess the progress of individual students becomes a higher priority, use should increase.
Electronic Writing Tablets	One or more electronic writing tablets in a classroom, connected via hardwire, RF, or IR to classroom interface device. Data is then forwarded by dial-up or packet-switched telephone circuits (or other telecommunications paths such as microwave, VSAT, fiber, or cable) to instructor's computer for display and conversion to video to be broadcast back out for all class participants to see.	Provides feedback from students in written and graphical form. Very effective in math and science classes, languages, etc.	Only one student can respond at a time. Most systems require a computer in classroom to operate, making the cost to implement high for some networks.	Under-utilized to date, particularly for satellite-based networks. Increased interest in matching technology to individual learning styles and to curriculum should bring increased usage.
Broadcast Hardcopy Systems	Printer or facsimile files uplinked along with video via whatever data path is available (VBI, data subcarrier, aux data channel, or other), received, error-checked, stored at each receiving site, and provided to a computer for relay to a printer or fax machine. Another approach is to buffer the error-checked files in a standalone unit that provides a manually-initiated "print" capability to a printer or fax machine connected directly to it.	Allows class notes, assignments, and other materials to be sent simultaneously to all receiving sites, rather than via serial facsimile transmissions, or by mail or delivery services. This can result in cost savings and improved service.	Received files can be contaminated by errors and, therefore, require careful formatting, processing, and buffering. Without local control of the printing process, files can be lost due to paper, equipment, or operator problems.	More and more networks are gaining interest in broadcast printer and broadcast facsimile capabilities, and several are implementing one or both.
Computer Data Exchange	Files from the instructor's computer can be broadcast out to the receiving sites like broadcast hardcopy files. Files from the students' computers can be sent back to the instructor via dial-up or packet-switched telephone circuits (or other telecommunications paths such as microwave, VSAT, fiber, or cable) to a central computer. E-mail and electronic bulletin boards are commonly used for asynchronous computer data exchange.	Provides a two-way electronic interface between student and teacher. Efficient for making detailed assignments or for reporting back on their progress. Very useful when combined with other forms of interactivity.	Some systems are not "user-friendly," which tends to inhibit their use. Cost is also a factor for some networks.	Steadily rising in popularity as more and more students become proficient with and have access to PCs, and as more priority is given to monitoring and assessing student progress.

Databack. Several technologies allow for the transfer of data between distance learning teachers, and their students. Audiographics conferencing and computer conferencing, which were previously addressed, provide interactive capabilities that can greatly enhance distance learning programs. Used in combination with such transmission technologies as satellite, fiber, microwave, and cable, a broadcast data capability allows files from an instructor's computer to be sent out to computers at each of the receiving sites. With such a capability, the instructor can send out homework assignments, exercises, exams, and/or handouts to the entire class or to selected groups of students. Two-way computer data exchange can be accomplished via return paths on telephone circuits, or via such telephone bypass technologies as fiber, cable, microwave, or VSAT. Whatever approach is used, it is generally possible to use the databack transmission path selected for the transmission of talkback audio as well.

Another option for data distribution is broadcast hardcopy--enabling computer text files to be transmitted to a computer, or direct to a printer without requiring a computer. Use of broadcast facsimile capability allows the teacher to transmit handwritten notes, graphs, charts, etc. to students, and students to transmit responses back, as required. As with computer data exchange, hardcopy exchange can also be accomplished via return paths on telephone circuits, fiber, cable, microwave, or VSAT.

Another form of interactivity that allows graphic and handwritten responses (such as working a math problem on a blackboard in class) is the electronic writing tablet. Responses handwritten on a writing tablet can be sent back to the program origination location for viewing by the teacher, converted into video, and transmitted back out over the broadcast path for all program participants to view. As with all other databack technologies, the data exchange can be accomplished via any of the return paths possible for computer or facsimile data.

One data exchange technology that holds significant promise for distance learning teachers to assess and monitor student progress on a daily basis is the electronic keypad response system. More simple to operate than computer systems and less expensive to provide all students in a classroom, keypad response systems are being considered by more program providers than any other single databack technology. The Hawaii Interactive Television System (HITS), previously profiled, considers the electronic keypad to be "the most powerful teaching tool available"--even when used as a stand-alone technology in a local classroom.

An electronic keypad response system generally consists of a personal keypad unit for use by each student, a master unit of some sort at each receiving site (sometimes requiring a computer), and a central computer at the teacher's location that is linked to the remote master classroom units by a data return path via telephone, fiber, cable, microwave, or VSAT. Communications between the keypads and the master classroom unit at remote sites can be either one way or two way. One-way systems allow data entries from the student to be collected and forwarded to the instructor's computer for process and display. The response data from all of the keypads (as aggregated by each classroom master unit and transmitted back to the instructor's computer) can be displayed in real time in bar chart or other graphic form for immediate use and evaluation by the teacher. Two-way systems allow prompts, such as "good job," "try again," "right/wrong," etc. to be transmitted back from the teacher's computer to each student's keypad.

Since all response data received by the teacher's computer can be archived in any database format, keypad response systems can also allow linear tracking of the progress of each student over the course of a semester or a complete school year, through the use of unique student identification numbers. Assessment, evaluation, and reporting can thereby be automated for hundreds, and even thousands, of students--providing both accountability and cost savings. Although similar capabilities are possible with the use of computer testing, electronic keypad response systems with such features as changeable, course-specific templates and/or keypads tailored to individual network specifications, make the technology a particularly user-friendly and enjoyable option for students and teachers alike. And when a button marked "Help!" is readily available, the feedback received is more "telling" than even being able to look at a student's face.

Ideally, the technologies employed to allow for interactivity should be selected to address the individual learning styles of different students; however, reaching a level of interactivity in distance learning programs that enables the learning progress of each individual distant student to be assessed, monitored, evaluated, and reported will be a significant step toward increased effectiveness of instruction.

Models for Distance Learning In America's Rural Schools

Public broadcasting has a long record of service to schools and learners, and a strong tradition of promoting universal access to its services, particularly in rural areas.

It is the hope of the Corporation for Public Broadcasting that this report will open lines of communication, among public broadcasters, educators, state school officials, other providers of educational and communications services, and the Congress and Administration, to deliberate how best to foster the growth of distance learning in rural schools.

CPB proposes that Congress consider a wide variety of steps that can be taken to encourage distance learning services tailored to the needs of rural schools, and to foster greater use of public broadcasting facilities in the provision of those services.

Incentives

The Corporation proposes that Congress consider the following measures:

- Establish cooperative distance learning projects involving the use of public broadcasting facilities as a priority for funds allocated for non-broadcast educational projects by the Public Telecommunications Facilities Program in the Commerce Department;

- Continue and increase funding of the Star Schools program, which -- while not specifically targeted for rural schools -- has provided disproportionately great service to rural schools;

- Commission an interagency and intergovernmental task force to promote partnerships and coordination of policy among the many governmental authorities with jurisdiction over one aspect of distance learning or another, and particularly to focus on (1) encouraging interstate coordination of teacher certification and adoption or acceptance of courses and instructional materials, and (2) encouraging broad and affordable access to instructional software, programming, and other intellectual property.

• Fund a program of teacher pre-service education and in-service training to encourage acceptance and adoption of distance learning methods by classroom teachers.

Demonstration Program

The Corporation proposes that Congress consider authorizing a program of national demonstration projects to study new distance learning tools and to evaluate the most effective use of current distance learning applications in rural situations. It is CPB's judgment that continued experimentation and evaluation at a demonstration-project scale is the most appropriate strategy for the federal government to pursue, because the newness of most distance education services has left many questions unanswered.

To address the most important barriers to use of existing distance learning programs, the focus of each demonstration project should be at least one of the following three issues: increased cost effectiveness, increased instructional effectiveness, and increased access and interoperability.

An adequate program of demonstration sites could include four or five major "networks" or services, together with the schools and students using the networks' distance instruction, at a total cost of approximately $25 million per year. Selection of specific projects would be competitive. Congress might authorize such a program in the U.S. Department of Education, or might authorize CPB to administer a demonstration program, particularly so if Congress wishes to encourage distance education partnerships between public broadcasting entities and service providers or others outside public broadcasting.

Guidelines for the demonstration program should limit eligibility for funding to projects that showed fair promise to accomplish one of the following objectives:

• Enable current distance learning applications to incorporate multiple interactive technologies to support a variety of subjects delivered to schools, as well as to nontraditional learning environments.

• Encourage the partnering of existing broadcast facilities with existing teleconferencing service providers (such as computer conferencing and audiographics conferencing) to establish programs using teleconferencing technologies to support broadcast distance learning instruction.

• Develop, support, and measure the effectiveness of credit course offerings via varying teleconferencing technologies using multiple interactive modalities including a range of "databack" enhancements to audio talkback.

- Link advanced technology to advanced teaching strategies, inquiry-centered classrooms, and explorer teams--and measure effectiveness of doing so.

- Develop and support credit course offerings in subjects not traditionally taught and/or for age groups not traditionally reached (including the disabled and/or underachieving student) via current distance learning applications.

- Encourage the sharing of resources and teachers among schools in geographically isolated districts experiencing teacher shortages through short distance learning projects that incorporate multiple interactive modalities.

- Establish the technical capability for existing short distance learning projects to supplement their local offerings with distance learning resources distributed nationally by satellite and/or teleconferencing technologies.

- Establish demonstration schools which incorporate both short-distance and nationwide distance learning resources into their daily classes across the age groups and across the curriculum using multiple distribution technologies and multiple interactive modalities.

- Demonstrate distance education services with increasingly diverse student populations, including learning disabled students, younger students, students with less emotional maturity, students in lower grades, students with lower motivation, lower achievement, and less discipline. Measure technology's effectiveness in various applications across diverse age groups and academic subjects.

Evaluation: A practical plan should be required for investigation of the specific needs of rural schools which might be addressed by distance learning services, and for rigorous evaluation of the outcomes of the demonstration projects with respect to those needs. Each evaluation should measure the relative effectiveness of different communications modes, and the effects on individual learners of distance learning classrooms equipped in various ways. Academic measures of achievement should be used, as well as qualitative measures of learner and teacher satisfaction with the experience.

Local district involvement: Advance planning and coordination adequate to sustain comprehensive educational change should be required in order to assure at least some support for distance learning in the local district.

Conclusion

Public broadcasters are ready and willing to assist Congress in exploring the potential for the kinds of services and demonstration programs described in this report.

References

A computerized clearinghouse for children's television and radio. (October, 1992). *Kidsnet.*

Annenberg/CPB Project, and PBS Adult Learning Service (1992). *Going the distance. A handbook for developing distance degree programs.*

Barker, B. (April, 1991). K-12 distance education in the United States: Technology strengths, weaknesses, and issues. *Proceedings of the 1st Annual International Conference on Distance Learning.* Conducted at the meeting of the United States Distance Learning Association, Washington, DC.

Barker, B. O. (1991). K-12 distance education in the U.S.: Technology strengths, weaknesses, and issues. *Ed, The Official Publication of the USDLA,* 5(5), pp. 11-15.

Barker, B. O. (April, 1987). *The effects of learning by satellite on rural schools.,* Paper presented to the Learning by Satellite Conference, Tulsa, OK. (ERIC Document Reproduction Service No. ED 284 693).

Barker, B. O. (Fall, 1987). Interactive instructional television via satellite: A first year evaluation of the TI-IN Network. *Journal of Rural and Small Schools,* 2(1).

Barker, B. O., and Bannon, J. (1992). *The Hawaii Teleschool: An Evaluation of Distance Learning for Advanced Placement Calculus Instruction in "Paradise".* (ERIC Document Reproduction Service No. 344 729).

Barker, B. O.; and Goodwin, R. D. (April, 1992). Audiographics: Linking remote classrooms. *The Computing Teacher,* pp. 11 - 15.

Barnard, J. (1992). Video-based instruction: Issues of effectiveness, interaction, and learner control. *Journal of Educational Technology Systems,* 21 (2), pp. 45-49.

Batey, A., and Cowell, R. N. (1986). *Distance education: An overview.* Portland, OR: Northwest Regional Educational Laboratory. (ERIC Document Reproduction Service No. ED 278 519).

Batson, Dr. B. H.; and Tinsley, P. S. (1991). Distance learning: Integrated technology applications. *Proceedings of 1991 Global Satellite Communications Symposium,* Nanjing, China.

Beaudoin, M. F. (1991). Researching practice and practicing research: Critique of distance education research and writing. *Distance Education Symposium: Selected Papers Part 1* (pp. 1-8). Papers presented at The Second Annual American Symposium on Research in Distance Education, Pennsylvania State University.

Becker, H. J. (March, 1992). A model for improving the performance of integrated learning systems: Mixed individualized/group/whole class lessons. *Cooperative Learning, and Organizing Time for Teacher-led Remediation of Small Groups.* Center for Social Organization of

Schools, Johns Hopkins University, and Department of Education University of California. Irvine.

Bell, J. D. (1991). Distance learning: New technology and new potential. *State Legislative Report* 16, 6, pp. 1-6.

Benson, G. M., and Hirschen, W. (1987). Distance learning: New windows for education. *T.H.E. Journal*, pp. 63-67.

Benson, G. M. (April, 1988). *Technology enhanced distance education: The promise of new opportunities for lifelong learning*. Background paper for participants of conference on distance learning, Springfield, MA.

Blaschke, C. L. (Spring, 1992). Federal funding for FY92: Good prospects for technology. *Educational IRM Quarterly*, 1(3), pp. 13-16.

Bolt Beranek and Newman Inc. (August, 1992). *The Co-NECT School: A Winning Design for The New American School Development Corporation.*

Bolt Beranek and Newman Inc. (December, 1992). *The Copernicus Testbed: Phase 1 of a National School Network.*

Boyer, E. L. (1992). Shaping the future: A five-point plan for education reform. *Electronic Learning*, 12 (1), p. 66.

Bradshaw, D., and Brown, P. (1989). The promise of distance learning. *Policy Briefs*, Far West Laboratory, Number 8.

Branscum, D. (September, 1992). Educators need support to make computing meaningful. *MacWorld*, pp. 83-88.

Bruder, I. (November/December, 1991). Distance learning: Bridging gaps with technology. *Electronic Learning*, pp. 20-23, 26-28

Buckler, G. (September, 1991). Lack of CD-ROM standards among challenges Mac faces. *Computing Canada* (Supplement), p. 4.

Bunzel, M. J.; and Morris, S. K. (1992). *Multimedia applications development*. New York: McGraw-Hill, Inc.

California State University, California Technology Project (1990). *Distance learning for California schools: A resource guide on live interactive televised instruction.*.

Carl, Dr. D. L. (May, 1991). Electronic distance learning: Positives outweigh negatives. *T.H.E. Journal* pp. 67-70.

Carr, W. A.; and Reisman, S. (1991). Perspectives on multimedia systems in education. *IBM Systems Journal*, 30(3), pp. 28-29.

Celis, W. (December 16, 1992). PBS plans a magazine by students, on a disk. *Education*.

Chamber, L. (1988). *Delivery systems for distance education*. ERIC Digest. (ERIC Documentation Reproduction Services No. ED 304 11 1).

Chu, G. C., and Schramm, W. (1975). *Learning from television: What the research says.* (ERIC Document Reproduction Service Nc. 109 985).

Chute, A., Balthazar, L. B., and Poston, C. O. (1988). Learning from teletraining. *American Journal of Distance Education*, 2(3), pp. 55-63.

Cincinnati Bell Directory, Inc., Apple Computer, Inc., and Northern Kentucky University. (1992). *Northern Kentucky University Online Education.* (Downloaded from America Online).

Clark, C. (1989). Distance learning: A spectrum of opportunities. *Media and Methods*, 26(1), pp. 22, 24-27.

Columbia University, Media Studies Center (Fall 1991). Media at the millennium. *Freedom Forum.* 5(4).

Conroy, C. (September, 1991). Home is where the campus is. *CompuServe Magazine*, pp. 13-19.

Coombs, N. (1992). Teaching in the information age. *EDUCOM Review*, 20(2). The Copen Family Fund Project Report. (December 31, 1992).

Corporation for Public Broadcasting (1991). *Summary Report: Study of School Uses of Television and Video.*

Council of Chief State School Officers. (1991). *Improving student performance through learning technologies*: Policy statement of the Council of Chief State School Officers.

Dede, C. J. (May, 1992). The future of multimedia: Bridging to virtual worlds. *Educational Technology*, 32(5) pp. 54-60.

Dede, C. J. (December 2-3, 1991). *Potential uses of telecommunications to empower implementation of the NCTM mathematics standards. Forum report: Telecommunications as a tool for educational reform: Implementing the NCTM mathematics standards.* Report of a conference of the Aspen Institute's Communications and Society Program, pp. 61-83.

Dede, C. J. (December, 1991). *Potential uses of telecommunications to empower implementation of the NCTM mathematics standards - Appendix: The evolution of educational technology.* Paper presented to a Conference of The Aspen Institute's Communications and Society Program, Queenstown, MD.

Dede, C. J. (1992). Education in the twenty-first century. *Annals of the American Academy of Political and Social Science*, 522, pp. 104-115.

D'Ignazio, F. (March, 1991). DISKovery: The Starship Enterprise - new opportunities for learning in the 1990's. *Language Arts*, 68(3), pp. 248-252.

D'Ignazio, F., and Schultz, D. (1992). An inquiry-centered classroom of the future. In U.S. Congress: *Educational technology in the classroom.* Hearing before the Subcommittee on Technology and National Security of the Joint Economic Committee and Subcommittee on Education, Arts and Humanities of the Senate Committee on Labor and Human Resources. Washington, DC: U.S. Government Printing Office, pp. 229-234.

Dillon, C., and Blanchard, D. (1991, May). *Education for each: Learner driven distance education. Distance Education Symposium: Selected Papers Part 1.* Presented at The Second Annual American Symposium on Research in Distance Education, Pennsylvania State University, pp. 9-33.

Distance Education: Technology expands the classroom. (September/October, 1992). *Syllabus*, 24, pp. 2-5.

Distance learning's next wave is workgroups: *CLI EXEC*. (January, 1993). The Heller Report, pp. 4-5.

Distance learning profiles. (September/October, 1992). *Syllabus*, 24, pp. 7-10.

Distance learning strategies. (April 5,1992). No. 2.

Distance learning tops education, telecommunication agenda. (August 17, 1992). *Telephone Week*.

Douglas, S. G., and Bransford, L. A. (1991). *Advanced technologies: Innovations and applications for distance learning. Education policy and telecommunications technologies.* (Arthur D. Sheekey, ed.). Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

Doyle, P. & R. Hotakainen (1993). A Town Moves To Keep Its School, *Minneapolis Star Tribune*, January 12, 1993.

Ed, The Official Publication of USDLA. (1991 - 1992).

Vol. 5, No. 3, March,1991
Vol. 5, No. 4, April, 1991
Vol. 5, No. 5, May, 1991
Vol. 5, No. 6, June ,1991
Vol. 5, No. 7, July ,1991 (special edition)
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Vol. 6, No. 2, February,1992
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Vol. 6, No. 4, April,1992
Vol. 6, No. 9, September, 1992

Education Update.

Vol. 27, No. 5, May, 1992
Vol. 28, No. 1, September,1992

Educational telecommunications plans, policies, programs. (October, 1991). Western Cooperative for Educational Telecommunications.

Egan, M. W. (1986). *Two-way interactive television instruction: Comparative studies of instructional effectiveness in three rural/remote special education courses*. Paper presented at the Annual Convention of the Association for Educational Communications and Technology, Las Vegas, NV. (ERIC Document Reproduction Service No. ED 299 729).

Eiserman, W. D., and Williams, D. D. (1984). *Statewide evaluation report on productivity project studies related to improved use of technology to extend educational programs. Sub-report two: Distance education in elementary and secondary schools. A review of the literature.* Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA. (ERIC Document Reproduction Service No. ED 291 350).

Electronic media for the school market: Review, trends & forecast. (1992). SIMBA Information.

Ely, D. and Others. (1990). Determining trends and issues in educational technology through content analysis. *Proceedings of selected paper presentations at the Convention of the Association for Educational Communications and Technology.* (ERIC Document Reproduction Service No. ED 323 928).

Evaluation of the New York State/Moscow Schools Telecommunications Project. (February, 1992). Prepared for the New York State Education Department, Division of Elementary and Secondary Education, MAGI Educational Services, Inc.

Fabris, M. E. (1992). Using multimedia in the multicultural classroom. *Journal of Educational Technology Systems*, 21(2), pp. 163-171.

Fisher, A. (October, 1992). Crisis in education - Part 3. *Popular Science.*

Fitzgerald, M.l; and Wilder, C. (October 28,1991). IBM multimedia: An alluring vision. *Computerworld*, 5(43), pp. 37, 43.

Fowler, L. S. (1992). *Computer mediated communications in grades 3 through 12 education: Teacher reports of impact on social, cultural, and writing development.* From a dissertation submitted to the Division of Graduate Studies and Research of the University of Cincinnati.

Frankel, S. (Spring, 1992). New paths to learning. *Educational IRM Ouarterly*, 1 (3).

Gagne, R. M., Briggs, L. J., and Wager, W. W. (1992). *Principles of instructional design.* (4th ed.). Fort Worth, TX: Harcourt Brace Jovanovich.

Gerlovich, Dr. J. A. (February, 1992). *A national computer conferencing network for education: PSInet.*

Gibson, C. C. (1991, May). Changing perceptions of learners and learning at a distance. *Distance Education Symposium: Selected papers Part 1.* Paper presented at The Second Annual American Symposium on Research in Distance Education, Pennsylvania State University, pp. 34-42.

Gooler, D. (1992). Testimony in U.S. Congress.: *Educational technology in the classroom.* Hearing before the Subcommittee on Technology and National Security of the Joint Economic Committee and Subcommittee on Education, Arts and Humanities of the Senate Committee on Labor and Human Resources. Washington, DC: U.S. Government Printing Office, pp. 211-218.

Gore, A., Jr. (1992). The information infrastructure and technology act. *EDUCOM Review*, 27(5).

Green, C. (1992). Wider Course Selection, *Atlanta Constitution*, March 21, 1992.

Haffey, R. D. (Summer, 1992). The promise and practice of telecommunications. *Educational IRM Quarterly*, 1 (4).

Halstead, H. (1992). Designing facilities for a new generation of schools. *Educational Technology*, 32(10), pp. 46-48.

Hazlett, T. W. (Winter, 1990). Should telephone companies provide cable TV? *Regulation.*

Hefzallah, I. M. (1990). *The new learning and telecommunications technologies: Their potential applications in education*. Springfield, IL: Charles C. Thomas.

The Heller Report. (1991 -1992).

Vol. II, No. 4, January,1991
Vol. II, Nc. 12, September,1991
Vol. III, No. 1, October/November,1991
Vol. III, No. 2, December,1991
Vol. III, No. 3, January, 1992
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Vol. III, No. 9, July, 1992
Vol. III, No. 10, August,1992
Vol. III, No. 11, September. 1992
Vol. III, No. 12, October, 1992

Hezel, R. T. (1991). Statewide planning for telecommunications in education: Some trends and issues. *Tech Trends*, 36(5).

Hezel Associates (1992). *Planning for educational telecommunications: A state by state analysis.*

High cost of distance learning demands public funding. (August 24, 1992). *Telephone Week.*

Hixson, J., and Jones, B. F. (1991). Using technology to support professional development for teachers and administrators. *Education policy and telecommunications technologies*. (Arthur D. Sheekey, ed.). Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

Hollens, D.; and Rible, J. (July, 1991). Answers on the disc: General encyclopedias on CD-ROM. *CD-ROM Professional*, 4(4), pp. 54-61.

Holznagel, D. C. (1991). A depiction of distance education. *Education policy and telecommunications technologies*. (Arthur D. Sheekey, ed.). Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

Holznagel, D. C. (April 1,1992). *Distance Education Resource Directory for Northwest Schools.* Northwest Regional Educational Laboratory.

Hornbeck, D. W. (1991). Technology and students at risk of school failure. *Education policy and telecommunications technologies*. (Arthur D. Sheekey, ed.). Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

How to teach our kids. (Fall/Winter, 1991). *Newsweek.*

Innovations in distance learning. (1991). Papers from the Northeast Distance Learning Conferences, Springfield, Massachusetts. Northeast Distance Learning Planning Committee.

Integrated instructional systems report. (February, 1990). EPIE Institute, Water Mill, New York.

Integrated telephony unites the telephone with the desktop computer. (Fall, 1992). *Query, 7*, pp. 2-5

Integrated voice/video/data system puts Indiana Prairie Schools on leading edge. (August,1991). *T.H.E. Journal.*

Isaac, D. (March 6, 1989). Cards facilitate video storage on PC's. *PC Week*, 6(9).

Iuppa, N. (1988). *Advanced interactive video design: New technologies and applications.* New York: Knowledge Industry Publications.

Jill (1992). Tiny Schools Fight Merger Plans, *Billings* (Montana) *Gazette*, September 10, 1992.

Johnson, B. (October, 1991). What multimedia means to PC's. *Advertising Age*, 62(47), p. 16.

Johnstone, B. (December 19,1991). Compression technology: The Big squeeze. *Far Eastern Economic Review*, 154(51), pp. 49, 50.

Jordahl, G. (1989). Communications satellites: A rural response to the tyranny of distance. *Educational Technology*, 29(2).

Jordan, M. (1992). School 'Reform': Promise or Threat?, *Washington Post*, February 14, 1992.

Karpinski, R. (April, 1991). Video applications come into focus. *Telephony's Supercomm Wrap-up.*

Kaplan, R. (June,1992). Video on. *American Demographics.*

Kellner, M. A. (October, 1991). Multimedia's mounting momentum. *Infoworld*, 13(42), pp. 58-60.

Kernan, J. (Fall, 1992). Jostens learning: InterActive media delivers networked multimedia. *Educational IRM Quarterly*, 2(1).

Kirman, J. M., and Goldberg, J. (1980). *Distance education: One way television with simultaneous telephone group conferencing using satellite maps as a monitoring device. A report to the innovative projects fund.* Edmonton: Alberta Department of Advanced Education and Manpower. (ERIC Document Reproduction Service No. ED 224 460).

Kitchen, W. (1987). *Education and telecommunication: Partners in progress.* Testimony before U.S. Senate, Committee on Labor and Human Services. (ERIC Document Reproduction Service No. ED 282 551).

Knezek, D. (Summer, 1992). Courses by satellite. *Educational IRM Quarterly*, 1(4), pp. 34-37.

Krebs, A. (1991). Funding and policy initiatives in distance learning. *Ed, The Official Publication of the USDLA*, 5(3), pp. 9-14.

Kundu, M. R. (1992). The techniques of teletraining--new enhancements. *Journal of Educational Technology Systems*, 21(2), pp. 141-144.

Kyra Communications. (1990-1991). Compression facts: TOUGH but REAL. *Vizions*, 1 (1).

Lake, D. S. (1992). *TEAMS: Telecommunications Education for Advances in Mathematics and Science: Final report.* Los Angeles, CA: Los Angeles County Office of Education, Curriculum

Programs and Instructional Te.nnologies Division.

Langford, M. (1992) Senate Committee Adopts Constitutional Amendment on Funds 'Recapture', *United Press International*, BC cycle, Texas/Colorado, November 11, 1992.

Learning technologies and essentials for education change. (1991). Council of Chief State School Officers.

LeBaron, J. F. (Ed.). (1991). *Innovations in distance learning: Papers from the Northeast Distance Learning Conferences.* Springfield, Massachusetts, and New York. The Northeast Distance Learning Conference Committee and the Research Foundation of the State University of New York.

Ledwig, D. (1992). Testimony in U.S. Congress. *Educational technology in the classroom.* Hearing before the Subcommittee on Technology and National Security of the Joint Economic Committee and Subcommittee on Education, Arts and Humanities of the Senate Committee on Labor and Human Resources. Washington, DC: U.S. Government Printing Office, pp. 74-200.

Lee, R. (December, 1992). *Rural telecommunications*: The National Distance Learning Center. (Unpublished manuscript).

Lemke, C. (Summer, 1992). State educational technology initiatives. *Educational IRM Quarterly,* 1 (4).

Leonard, M. (December 13, 1990). Compression chip handles real-time video andaudio. *Electronic Design.*

Longworth, R.C. (1992). Young people leave rural America behind, *Houston Chronicle,* October 18, 1992.

Lowery, L. (1991). Distance learning across state lines: The transborder study. *Ed. The Official Publication of USDLA,* 5(7), pp. 3-12.

Lucas, Dr. J. (September, 1992). What business are the RBOCs in? *TeleStrategies.*

Mageau, T. (February,1991). Redefining the textbook. *Electronic Learning.*

Marcus, Dr. S. (September, 1992). *Interim report: California Technology Project/California Writing Project Alliance.*

Markwood, R. A. and Johnstone, S. M. (Editors). (1992). *New pathways to a degree project evaluations: First year report.* Western Cooperative for Educational Telecommunications.

Mathison, R. W. (May, 1991). Interactive multimedia and education: Specifications, standards, and applications. *College Microcomputer,* 9(2), pp. 93-102.

McCutcheon, J. W., and Swartz, J. (1987). Planning for cablecast telecourses. *T.H.E. Journal.*

McNichol, T. (September 18-20, 1992). Chris Whittle's BIG test. *Houston Post.*

Medlyn, D. A. and Kirk, K. L. (1987). *Com-Net: A successful alternative for credit programming.* Proceedings of the 6th Annual New Technologies and Higher Education Conference, p. 24.

Medlyn, D. A., and Hartman, L. M. (1991). *Maintaining academic integrity and quality of* *electronically delivered science courses*. Proceedings of the 13th Annual Conference in Quality and Off-Campus Programs, 35, pp. 169-176.

Meeting the education challenge. (1991). Computer Curriculum Corporation.

Midlands Consortium Star Schools Project. (1990). *The Midlands Consortium Star Schools Project (MCSSP): Final report.* (Grant No. R203A80036). Stillwater, OK.

Molnar, A. (Fall, 1991). National Science Foundation announces statewide science, mathematics, and technology projects for 1991. *Educational IRM Quarterly,* 1(1).

Moonen, J. (December, 1989). Involvement and information: Fifteen challenges for computers in education. *Educational Technology,* 29(12), pp. 7-11.

Moore, M. G. (1989). *Effects of distance learning: A summary of the literature.* Report prepared for the Office of Technology Assessment, Congress of the United States.

Morgan, D. J. (July 29, 1992). Testimony on behalf of the United States Telephone Association Before the Communications Subcommittee of the Committee on Commerce, Science, and Transportation, United States Senate.

The most complete guide ever to telecommunications. (March, 1992). *Electronic Learning.*

Multimedia: The Emerging giant--new tools for new times. (April-May,1992). National Technological University, Fort Collins, Colorado.

Murray, J. (Fall, 1992). Dreaming...of a truly global village... Internet. *Journal of the Oregon Educational Media Association.*

Murray, J. (1992). *Information technologies and the public schools: International telecommunications opportunities for K-12 schools.* Paper presented at the ASIS Fall Conference.

Murray, J. (August, 1993). *K- 12 educational applications in the global community: A survey.* Abstract of a paper to be presented at the INET '93 Conference.

National Demonstration Laboratory Library of Congress. (February 24,1992). *LC Information Bulletin,* pp. 73-76.

National Education Association, Special Committee on Telecommunications (July, 1992). *Educational Telecommunication: Report of the 1991-1992 NEA Special Committee on Telecommunications.* Presented to the 71st Representative Assembly of the National Education Association. (Downloaded from America Online).

National Teleteaching Research and Development Center. (January, 1992). *American Indian College Teleteaching Project: Final Report.*

Nee, E. (December,1991). Wireless is hot. *Upside.*

Needleman, R. (September,1991). Magic advances multimedia evolution. *Infoworld,* 13(36), p. 96.

Newman, D.; Bernstein, S.; and Reese, P. A. (April, 1992). *Local infrastructures for school networking: Current models and prospects.* BBN Systems and Technologies, BBN Report No. 7726.

Niemeyer, D.; and Black, B. A. (November/December, 1989). Deliver media service...not hardware. *Tech Trends*, 34(6), pp. 34-39.

1992 Legislature enacts significant funding, policy provisions for schools. (May,1992). *Education Update*, 27(5).

Northem Telecom Education Systems (February, 1991). *Distance learning using digital fiber optics..*

O'dasz, F. (June 17, 1992). Testimony for the Senate Commerce Subcommitte on Communications. Session on Telecommunications and Education, Chaired by Senator Inouye.

Ohler, J. (1991). Why distance education? *Annals of the American Academy of Political and Social Science*, 514, pp. 22-34.

On our doorstep--taking on society's challenges. (January,1991). *Leadership*, 20(4).

Pahwa, Dr. A. (February 6, 1992). *Muitimedia and CD-ROM*. University of Southem California Instructional Television Network.

Patten, L. G. (1990). *Technologies for learning at a distance: Looking to the future, changing educational relationships*. Washington, DC: Office of Technology Assessment.

Paulsen, M. F. (1992). *From bulletin boards to electronic universities: Distance education, computer-mediatedcommunication, andonline education*. The American Center for the Study of Distance Education, Pennsylvania State University, Research Monograph, No. 7.

Pea, R. D. (February 3, 1992). *Practices of distributed intelligence and designs for education.* (unpublished document).

Pea, R. D. and Gomez, L. M. (1992). Distributed multimedia learning environments (DMLE): Why and how? *Interactive Leaming Environments*, 2(2), pp. 73-109.

Pea, R. D. and Gomez, L. M. (1992). The collaborative visualization project: Share-technology learning environments for science learning. In *Proceedings of the SPIE '92* (International Society of Photo-Optical Instrumentation Engineers).

Pease, P. S., and Tinsley, P. S. *Reaching rural schools using an interactive satellite based educational network: Evaluating TI-IN Network's first year.* (unpublished paper).

Pease, P. S. (1991). *TI-IN United Star Network Final Project Report: Evaluation*. (Grant No. R203A80019). San Antonio. TX: TI-IN United Star Network.

Peterson, G. (1990). *Schools and national telecommunications policy*. Washington, DC: National Geographic Society. (ERIC Document Reproduction Service No. ED 328 224).

Phelps, M. (March, 1991). *Planning guidelines for the implementation of wide-area educational telecommunications systems*. Paper presented to the Learning by Satellite Conference, Dallas, Texas.

Portway, P. S.; and Lane, C., Ed.D. (1992). *Technical guide to teleconferencing and distance learning.*

Professional video from the inside out. (Fall,1990). *InView*.

Public Broadcasting Service (n.d.). *PBS On-line: A public television service created by and for teachers and students.*

Public Broadcasting Service, Elementary/Secondary Service (September,1989).*PBS School Satellite Survey.*

Public Broadcasting Service (1992). [Tinsley, P. S., Study of trends in funding and use of technology in schools for the Public Broadcasting Service] (unpublished, raw data).

Quinn, D. W., and Quinn, N. W. (August 6, 1992). *Buddy System Project Evaluation: 1991-1992 School Year Report.* Prepared for The Buddy System Project and the Indiana Department of Education.

Quinn, D. W., and Williams, D. D. (1987). *Statewide evaluation report on productivity project studies related to improved use of technology to extend educational programs. Sub-report three: Survey of technology projects throughout the United States.* Wasatch Institute for Research and Evaluation, Logan UT. (ERIC Document Reproduction Service No. ED 291 350).

Resta, P. (September 21, 1992). *National Museum of the American Indian: Off-site technology applications.* Planning document for the National Museum of the American Indian-Smithsonian Institution, Learning Technology Center, The University of Texas, Austin.

Riel, M. (December/January, 1991-1992). Approaching the study of network. *The Computing Teacher*, pp. 5-7, 52.

Riel, M. (December/January, 1992). Telecommunications: Avoiding the black hole. *The Computing Teacher*, pp. 16-17.

Roberts, N., Blakeslee, G., Brown, M., and Lenk, C. (1992). *Integrating telecommunications into education.* Englewood Cliffs, NJ: Prentice Hall.

Robinson, R. S., and West, P. C. (1986). *Interactive cable television: An evaluation study.* (ERIC Document Reproduction Service No. 267 789).

Rockman, S. (1991). Telecommunications and restructuring: Supporting change or creating it. *Education Policy and Telecommunications Technologies.* (Arthur D. Sheekey, Ed.). Washington, DC: U.S. Department of Education, Office of Educational Research and Improvement.

Romei, L. K. (October, 1991). Multimedia: Delivering added value today. *Modern Office Technology*, 36(10), pp. 43-46.

Rosenzweig, S. (August,1992). Everything old is new again. *PC World.*

Saving our schools. (Spring,1990). *Fortune* (special issue).

Salomon, K. (1992). New department of education and REA matching grant programs. *Ed, The Official Publication of the USDLA*, 6(7), pp. 22-23.

Schools urged to weigh value of computer networks. (April 4, 1990). *Education Week*, IX(28).

Schwartz, E. I. (November 1 1, 1991). Finally, an A+ for computers in class?. *Business Week*, pp. 158-159, 162.

Shapiro, E. (1990-1991). Multimedia: A festival of HYPE. *Vizions*, 1(1).

Simpson, H., Pugh, H. L., and Parchman, S. (1991). *Empirical comparison of altemative video teletraining technologies.* San Diego, CA: Navy Personnel Research and Development Center.

Sinker, H. (1992). End of An Era: State's Last One-Room Schoolhouse To Be Closed. *Minneapolis Star Tribune,* February 16, 1992.

Sivin-Kachala, J. P; and Bialo, E. R. (October, 1992). *Using computer-based, telecommunications sevices to serve educational purposes at home: Final report.*

Software trends and trendsetters--how they're shaping an industry. (January,1987). *Electronic Learning.*

Solomon, G. (March, 1989). A writing class taps into a world of knowledge. *Electronic Learning,* pp. 16-17.

Stanton, S. (1992). The big picture: Corporate and foundation sources of nationwide giving. *Technology and Leaming,* 12(4), pp. 38-47.

Steffey, R. J. (May, 1991). Compton's MultiMedia Encyclopedia: Bringing multimedia to the masses. *CD-ROM Professional,* 4(3), pp. 13-20.

Technology 8. *Learning.* (September, 1992). 13(1).

Technology in public schools. (1991-1992). QED Trend Series (extract).

T.H.E. Journal, Technical Horizons in Education.

Vol. 20, No. 2, September, 1992
Vol. 20, No. 3, October, 1992
Vol. 20, No. 7, February, 1993

Threlkeld, R. M. (1992). *Rural voices: Conversations about distance learning with four rural California schools.* (Unpublished manuscript). California Technology Project. California Polytechnic University, Pomona, CA.

Threlkeld, R. M.; Behm, R. J.; and Shiflett, M. (1992). *Live and interactive: Is it really important?* (Unpublished manuscript). California Polytechnic University, Pomona, CA.

Tinker, R. F., and Lenk, C. (1991). *The Star Schools Project: Final Report.* Cambridge, MA: Technical Education Research Centers, Inc.

Tinker, R. (January, 1993). *Educational networking: Images from the frontier.* (From an unfinished, unpublished paper).

Tinsley, P. S. (November, 1991). [PBS focus group study on multiple channel satellite services in math, science. reading, and the arts] (unpublished, raw data).

Tinsley, P. S. (September, 1992). *Creating multimedia experiences with applied interactive technology.* Paper presented at the Educational Technology and Telecommunications Market Conference, Alexandria, VA.

Toby Levine Communications, Inc. (1990). *SERC demonstration year: Fall 1989, evaluation studies.* Bethesda, MD.

Tueller, R. L. (1991). COM-NET, Utah State University's Electronic Distance Education System. *Ed, The Official Publication of USDLA*, 5(9), pp. 14-16.

United Press International (1992). Electronic Classes of the Future, BC cycle, Illinois/South Dakota, November 20, 1992.

United Press International (1992a). Education Board Unveils $3.5 Billion Budget, BC cycle, Illinois/South Dakota, December 17, 1992.

U.S. Congress, Office of Technology Assessment. (1989). *Linking for learning: A new course for education.* (OTA-SET-430). Washington, DC: U.S. Government Printing Office.

U.S. Congress, Office of Technology Assessment. (1988). *Power on! New tools for teaching and learning.*.Washington, DC: U.S. Government Printing Office.

U.S. Congress, Office of Technology Assessment. (1991). *Rural America at the crossroads: Networking for the future.* (OTA-TCT-471). Washington, DC: U.S. Government Printing Office.

Voice mail links parents. teachers. (July, 1992). *Communications News.*

Warr, M. (April, 1991). Technology and the media. *Telephony's Supercomm Wrap-up.*

Wagner, Dr. E. D. (January, 1993). *Evaluating distance learning projects: An approach for cross-project comparisons.* From a presentation at the Annual Meeting of the Association for Educational Communications and Technology.

Wagner, Dr. E. D. *Using evaluative data to promote quality and cost benefit for distance education: The New Pathways to a Degree Evaluation Protocols.*

Walsh, E. (February 21, 1993). Big-City Native Goes to Town Defining Beauty on Main Street, *Washington Post.* p. A3.

Weinstein, S. (1991). *Analysis of a proposal for an education satellite system.* EDSAT Institute.

Weinstein, S., and Foster, J.D. (1992). Testimony in U.S. Congress. *Educational technology in the classroom.* Hearing before the Subcommittee on Technology and National Security of the Joint Economic Committee and Subcommittee on Education, Arts and Humanities of the Senate Committee on Labor and Human Resources (pp. 3-60). Washington, DC: U.S. Government Printing Office.

Wells, R. (April 5, 1992). Distance learning on cable: The multimedia dimension. *Distance Learning Strategies,* The Lennox Group, Issue No. 2.

Wells, R. (July, 1992). Multimedia on cable: Computer firms need a carrier. Cable needs a program guide. Will consumers join the party? *CED.*

Wells, R. (1992). *Computer-mediated communication for distance education: An international review of design, teaching, and institutional issues.* American Center for the Study of Distance Education, College of Education, Pennsylvania State University.

Whittington, N. (1987). Is instructional television educationally effective? A research review. *American Journal of Distance Education,* 1(1), pp. 47-57.

Wilson, B. (1990, November). *Students' assessment of distance learning*. Paper presented at the Annual Meeting of the Mid-South Educational Research Association, New Orleans, LA. (ERIC Document Reproduction Service No. ED 326-558).

Wilson, C. (April, 1991). 'The doctor is on the phone' takes on a whole new meaning. *Telephony's Supercomm Wrap-up*.

Wilson, T. (1992). Where to find funding for your technology project. *Technology and Learning*, 12(4), pp.36-38.

Withrow, F. B. (Fall, 1992). Star schools: Defining the global classroom. *Educational IRM Quarterly*. 2(4). pp. 14-18.

Wohlert, H. S. (1991). German by satellite. *Annals of the American Academy of Political and Social Science*, 514, pp. 107-1 18.

Wright, L. J., and Meuter, R. F. (1992). *Instructional television for students: Historical development at California State University, Chico, 1975-1992.*

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Big Sky Telegraph
Central Education Telecommunications Consortium, Black College Satellite Network
GMI Engineering and Management Institute
Kansas Regents Educational Communications Center, Kansas State University
Kansas Regents TELENET System
Kentucky Educational Television Star Channels
Telelearning Project Outreach, Louisiana School for Mathematics, Science & the Arts
Educational Telecommunications Network, Los Angeles County Office of Education
Mass LearnPike, Massachusetts Corporation for Educational Telecommunications (MCET)
Mississippi State University, through National University Teleconference Network (NUTN)
Education Satellite Network, Missouri School Boards Association
North Carolina Learning by Satellite Network
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Audiology & Speech Sciences, Purdue University
Satellite Educational Resources Consortium (SERC)
Satellite Telecommunications Educational Programming (STEP)/ESD 101
Telecommunications Education for Advances in Mathematics and Science (TEAMS)
TI-IN Network, Inc.
TeleLearning Center, University of Texas at Austin
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