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ABSTRACT

This resource guide, prepared by the California Technology Project Distance Learning Task Force, is designed to introduce the K-12 educator to the rapidly growing field of distance education, i.e., using technology to link students to teachers. It is argued that this guide offers the state of California the chance to use its educational resources cost effectively to address problems of scale (not enough students at a location), and problems of scarcity (an instructional specialty not readily available). The first of four sections provides an introduction and background information on educational conditions in California. The second section, "Distance Learning Networks and Programs," offers a detailed look at what is happening in California and nationally in distance education, paying particular attention to educational television networks and communications satellites. The third section, "Distance Learning Technologies," describes available media options and offers practical advice on the purchase of electronic equipment and other telecommunications hardware. The last section, "Distance Learning Information," details interesting approaches in other states, enumerates some useful publications on distance education, lists the members of the California Technology Project Distance Learning Task Force, and concludes with a glossary of terms. (Contains 7 references) (DB)

Distance Learning for California Schools

A Resource Guide on Live Interactive Televised Instruction

California Technology Project Distance Learning Task Force

California Technology Project
OF THE CALIFORNIA STATE UNIVERSITY

Distance Learning for California Schools

A Resource Guide on
Live Interactive Televised Instruction

Distance Learning Task Force
1990

California Technology Project
OF THE CALIFORNIA STATE UNIVERSITY

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Forward

As part of its global effort to "bring the pieces together" in educational technology, the California Technology Project asked me to chair a task force to assist the State in making increased use of distance learning technology. This document and a companion which offers specific recommendations to California educational policy makers have been produced through the hard work and sage advice of the California Technology Project's Distance Learning Task Force, a list of whose members is attached. In particular, the work of Deputy Chairs Hall Davidson and Judy Lieb was particularly appreciated.

This document is designed to introduce the K-12 educator to the rapidly growing field of distance learning: using technology to link students to teachers. At a time of looming education crisis, this resource guide is particularly timely. It offers the State of California the chance to use its educational resources in a most cost effective fashion. In problems of scale (not enough students at a location) or scarcity (an instructional specialty not readily available) distance learning permits learning without travel.

The guide is divided into four main sections. The first, *Introduction and Background*, provides the reader with the rationale for this document and some educational conditions in our State. The second, *Distance Learning Networks and Programs*, offers a detailed look at what is happening in California and nationally in distance learning. It is most useful to educators exploring distance learning options for their local settings. A third section, *Distance Learning Technologies*, describes the various media options available and offers some practical advice on the purchase of hardware. The final section, *Distance Learning Information*, details interesting approaches in other states, enumerates some useful publications on distance learning, lists the Task Force members, and concludes with a glossary of terms.

I hope that this publication is useful, particularly to the public school educator. At a time of rapid change and development, information is the most potent force to guide progressive change in education.

Robert Threlkeld, Chair

Contents

Section I - Introduction And Background

Introduction

As part of the California Technology Project's effort to coordinate educational technology in the State, a Task Force for Distance Learning was established. A list of the Task Force members is attached to this report. The members represent a broad cross-section of California's educational system - local educators, higher education administrators, State Department of Education professionals, and others - all with interest in and knowledge of distance learning. Among other assignments, the Task Force was charged with the following:

> *Create a State-of-the-State Report on kindergarten through twelfth grade schools' Distance Learning in California, including network programming and locations.*

This report fulfills that purpose. After a brief introduction, the report describes current K-12 California distance learning networks. The report then details the national networks to which some California schools currently subscribe. A number of national organizations which provide single event satellite teleconferences are also listed. Finally, the report offers a variety of helpful sections, including a distance learning primer and glossary, as well as advice on selecting technology for distance learning at the local school site.

A companion document, "Distance Learning for California Schools: Recommendations for Educational Policy Makers," provides a series of recommendations from the Task Force. After reviewing the status of education in California and current distance learning activities, this document provides a series of recommended next steps in the development and use of distance learning to meet California's educational needs. These two documents will provide readers with a sense of the current status of live, interactive distance learning in the State.

The focus of the Task Force's efforts are on the K-12 school population, both students and teachers. Although there are substantial distance learning programs in both higher education and in adult continuing education, these groups are not addressed in the present report.

For the purposes of this report, distance learning is rather simply defined, using the definition offered in the Office of Technology Assistance' recent publication, Linking for Learning: "transmission of educational or instructional programming to geographically dispersed individuals and groups." Beyond that broad denotation, this report concentrates primarily on live, interactive televised instruction. This does not imply that other systems have more or less value; it simply means that live, interactive video is where the most explosive growth in technology and applications is occurring. The Task Force recognizes that there are many and varied technologies utilized effectively in distance learning, including live audio and audiographic conferencing, video tape and interactive computerized courses, and correspondence courses which use that oldest form of stored information: the book.

The wealth of information in this report should not obscure one key point. The application of distance learning for K-12 students and teachers is widespread and growing in the United States, but in this instance, California is lagging behind the rest of the nation. If the leaders in the State want to use these technologies to meet some of California's pressing educational needs, a single statewide plan needs to be developed, and funds need to be provided.

A Look at Schools in California - Present and Future

Beginning with the 1983 document, "A Nation at Risk," the American public has been taking a long hard look at its schools. The look is revealing a disturbing picture: we are failing our children. Test scores, in an undramatic and gentle decline, show that our children are learning less and leaving school earlier with each passing year. At a point when we need an ever more literate workforce, we are experiencing disappointing results from our K-12 education system.

President Reagan began his State of the Union Address in 1987 by stating "The quest for excellence into the 21st century begins in the schoolroom, but we must go next to the work place. We must enable our workers to adapt to the rapidly changing nature of the work place."

A declining birthrate is diminishing the number of new workers to fuel our economy. Between 1980 and 2000 the number of 18-24 year olds in the U.S. population will decline by 19 percent while overall population will increase by 18 percent. By 2010, one in every three 18 year olds will be Black or Hispanic, compared to one in five in 1985. These populations have low achievement rates and too often drop out of school. The declining young population and increasing elderly population means that by 2050 there will be approximately one worker for each social security beneficiary. Presently the ratio is about three to one. By the year 2000, the traditional bulk of our labor force, white males, will shrink to 15 percent of those entering the labor market.

In a recent study by the International Association for Evaluation of Educational Achievement, U.S. twelfth graders ranked last among twelve developed nations in calculus, and second to last in geometry and algebra. In the same study, U.S. students ranked similarly in biology, chemistry and physics. In addition to achievement, students appear to be losing interest in the key areas of science and engineering. The UCLA Higher Education Research Institute, which tracks student interest, has witnessed a steady decline of student interest in these two technical areas since 1983. These results are mirrored by the National Science Foundation's projections that from the pool of 4 million high school sophomores in 1977, only 9,700 will ultimately go on to a Ph.D. in science or engineering by 1992.

These statistics are outcomes of a number of problems in public education in California and the rest of the nation. Some of the more evident problems are:

Problem: ***There is an inadequate supply of new teachers.***

According to a 1987 Rand Corporation report, U.S. school districts will need to hire one million new teachers between now and 1995 to fill projected vacancies in the public school teaching ranks. The projected deficiencies in California alone, which graduates 10 percent of credentialed teachers in America every year, may be in excess of 100,000 by 1999. Because of the shortage of qualified instructors available to fill California's classrooms, many school districts have resorted to various forms of "emergency" credentialing in which prospective teachers with undergraduate degrees in liberal studies or subject areas such as mathematics or history, but without formal education course work, are employed contingent upon their completing such course work during the first few years of their career.

Problem: ***California educators are being assigned subjects they are unqualified to teach.***

There are too few qualified instructors in some subject areas such as foreign languages, mathematics and science. As noted previously, fewer and fewer students are majoring in these critical areas, and even fewer are electing to become teachers when they graduate from college. This has resulted in the assignment of unqualified instructors to teach these subjects. The California Commission on Teacher Credentialing estimates that as many as eight percent of certified teachers in California are teaching classes for which they are unqualified.

Problem: ***Although California's education and economic development are increasingly dependent on greater numbers of high school students who seek higher education, many students are ineligible for the CSU and USC Systems.***

More that one-half of California's high school graduates are ineligible to attend one of the State's two public university systems and an increasing proportion of students, particularly minority students, are unable to participate.

Problem: ***As part of the recent California educational reform movement, graduation requirements at the high school level have been modified to require a more rigorous curriculum. Some high schools are unable to provide the breadth and depth of course work now required.***

Toughening high school graduation requirements, coupled with stricter admission policies in the State's two university systems, has resulted in the reformation of the high school curriculum to include more course work in the sciences and mathematics, as well as other areas. Some California high schools, especially those in rural areas, are experiencing difficulty in offering the required courses because of a shortage of qualified instructors. Teachers who might qualify to teach the required classes if given appropriate in-service training live too far from the sources of such training to take advantage of it. High school counselors and advisors also need in-service training to fully understand the new regulations and their implications.

Problem: ***There is a lack of credentialed teachers in California to work with students who need bilingual instruction or who have special needs.***

California's public schools are experiencing an influx of students with special language needs. Instructors who have earned state credentials to teach bilingual students are in short supply. All California schools must offer instruction to children with special educational needs but some districts lack enough teachers with the proper training and credentials. Currently, California is producing approximately 12,000 bilingual teachers per year, but needs some 28,000 to adequately staff its schools. The State is now experiencing a shortfall of 16,000 bilingual teachers, and this number is growing.

Problem: ***California is a pluralistic, multicultural society, rich with the diversity of human experience; yet, many students have little or no opportunity to learn about the ethnic and cultural heritage of others.***

Students in California schools represent in their family histories a wide variety of cultures and ethnic backgrounds. Immediately adjacent to Mexico and facing the Pacific Basin region, California's heritage is a story of mingling cultural and ethnic experiences. However, geographic isolation causes much of this history to go unused, inaccessible within the confines of the classroom.

These are substantial education challenges for the next decade. While there is not single solution to any of them, the new communication technologies can assist in meeting one need which underlies them all - the need to bring educational resources to education consumers. As Dede (1989)[1] states:

> By creating connections between diverse groups of students, distance learning can aid in resolving America's emerging shift from assimilation to pluralism. Our nation is now more a "salad bowl" than a "melting pot," and this internal diversity could be a great competitive advantage in the global marketplace...The deliberate use of distance learning technologies to overcome students' segregation into homogeneous enclaves could help prepare the next generation of workers for the worldwide business environment they face.

Islands of Excellence: The State of Distance Learning for K-12 Schools in California

California has been very involved with technology to deliver instruction off-campus for several years. Although the body of this report describes these efforts in detail, some of the State's current noteworthy efforts are summarized here. If the reader is unfamiliar with some of the terms, he or she should read the report's Distance Learning Glossary and Technological Options for Distance Learning.

Distance Learning by Satellite and Broadcast Television

Satellite technology, which permits live programs to be sent throughout the State (and nation), is being used to an increasing degree by educational organizations in California. The Los Angeles County Office of Education has made a strong and visible commitment to satellite education in the past two years by creating ETN (the Educational Telecommunications Network). Originally designed to telecast live and interactive staff development in the 80 districts in Los Angeles County, ETN now provides programming through county offices to districts in 35 counties in California (see page 19, figure 3).

ETN utilizes a Ku-band uplink to provide teacher in-service in curriculum reform areas. The network is also used for administrative training and informational teleconferences. In addition to providing live, interactive education, the EMDC

[1] Dede, Christopher, "The Evolution of Distance Learning: Technologies Mediated Interactive Learning," University of Houston, Clear Lake TX, July, 1989.

(Educational Materials Development Center) provides extended staff development programs to membership counties.

For over a decade CSU Chico has been known nationally for its live, televised instruction by ITFS and satellite. The majority of its work involves either the provision of regular university courses to off-campus centers or a satellite-based master's degrees in computer science. However, CSU Chico delivers a significant amount of programming for K-12 students and teachers. The University is a partner in the TI-IN United Star Network, a Star Schools-funded national program. In this role Chico is providing a unique first-year teacher training program. To a lesser degree, other CSU campuses have been involved as well. Cal Poly Pomona has broadcast several university credit courses to advanced high school students. Cal State Sacramento offers regular grant-supported teleconferences in various disciplines.

The Los Angeles Unified School District operates its own broadcast television station, KLCS, which offers a wide variety of televised instruction. Of particular note is its "Homework Hotline" which allows students to receive on-air tutoring after school. In addition to watching a live television tutor, students can call in during the broadcast and receive individual guidance.

Distance Learning by ITFS

California has made extensive use of ITFS (Instruction Television Fixed Service) within regional areas of the State. ITFS is a microwave technology which permits the delivery of live televised instruction to sites within 30-50 miles of the transmitter. Ten of the California State University campuses utilize this technology to provide education to public school teachers and students. Four of these campuses provide university credit course instruction to advanced high school students. Under this program, all student fees are either waived or reduced. County Offices of Education also utilize ITFS technology. Major ITFS public school networks exist in Fresno, Kern, San Diego, Santa Clara, and Monterey counties. In addition, many of the California Community Colleges are in the planning stage for using ITFS to serve schools.

Distance Learning by Cable

California also has distance learning infrastructure which links schools together by either traditional coaxial cable or by fiber optics. Many cable companies in the State broadcast live educational programs to schools and homes. The Sacramento Educational Cable Consortium represents a model cooperative cable-based program within Sacramento County. The Consortium serves 300 schools within the county. Programming decisions are made by a board with representatives from all the public school districts, as well as persons from the California Community Colleges; California State University, Sacramento; the University of California, Davis; and the public libraries.

Cable television can also be used for two-way delivery of video and audio. The Irvine Unified School District has been using two-way cable for live instruction for more than a decade. The University of California, Irvine, is connected to this system, and provides regular instructional programs to students and teachers in the district. California State University, Bakersfield, uses high capacity telephone lines to transmit two-way video between the campus and Tehachapi High School. The Bakersfield application represents some of the most recent advancements in distance learning technology.

These examples demonstrate that distance learning is being employed in several locales within California. However, its use is not widespread, consistent, or coordinated. One of the most pressing needs in California is for the development of some form of statewide distance learning structure for K-12 schools.

Section II - Distance Learning Networks and Programs

California Regional Interactive Television Networks

Although California lacks a coordinated statewide interactive television system for K-12 schools, the State has a number of regional networks which provide live, interactive instruction to students and teachers. Because of the pervasiveness of ITFS within the CSU System, many of these programs are partnerships between individual Cal State campuses and local schools. These California networks are described briefly below. Maps showing the locations of various networks are included at the end of this section (see Figures 1 and 2 on pages 15 and 16).

University of California System Campuses

University of California, Irvine

Target audience:
    Irvine school teachers and students
Examples of types of courses:
    None currently
Technology:
    Two-way coaxial cable
Geographic coverage area:
    City of Irvine
Permanent receiving locations:
    All Irvine public schools
Number of students served annually:
    None currently
Cost to receiving school/student/teacher:
    None
Comments:
    The University of California, Irvine is linked to the Irvine cable television system, which provides two-way transmission of video between schools. The UC Irvine link is used occasionally for the delivery of teacher training in technology and for student enrichment.

California State University System Campuses

California State University, Bakersfield

Target audience:
    High school students, teachers, and aides
Examples of types of courses:
    University credit for high school students
    -- American History to 1865
    -- Technology and our Future (Philosophy)

Teacher education and in-service
-- Introduction to Education of Exceptional Children and Youth
Technology:
ITFS and compressed video over T-1 telephone lines
Geographic coverage area:
Within 50 miles of Bakersfield
Permanent receiving locations:
Fifteen high schools
Number of students served annually:
105 high school students, 120 teachers and aides
Cost to receiving school/student/teacher:
Schools purchase hardware, CSU Bakersfield installs at no charge, students pay $2 per course.
Comments:
CSU Bakersfield utilizes ITFS to provide university credit courses for advanced high school students. The University admits students through a fee waiver program, and students pay $2 per course. The program began in January, 1989, and taught 60 students during the Winter and Spring Quarters. Of particular note is a pilot program between CSU Bakersfield and Tehachapi High School. Instead of using ITFS to transmit programming, the University is using compressed video over T-1 (high capacity) telephone lines. The costly equipment and toll charges are being paid through a series of grants.
Contact:
Jaci Ward, ITV Coordinator
CSU Bakersfield
9001 Stockdale Highway
Bakersfield, CA 92211-1099
(805) 664-2448

California State University, Chico

Target audience:
Teachers
Examples of types of courses:
Educational Research
Mainstreaming
Resource Teaching
Occasional satellite teleconferences (exp. November, 1989 "Using Maps, Globes and Atlases in the Classroom.")
"Partners" - A Program for 1st Year Teachers
Technology:
ITFS, cable, and satellite
Geographic coverage:
Northeastern California (ITFS, cable, Central Valley Microwave), national (satellite)
Permanent receiving locations:
Seventeen in northern California plus all TI-IN sites
Number of students served annually:
Over 3,000 for special events
Cost to receiving school/student/teacher:
School pays for hardware and installation, plus per unit charge.

Comments:
For over a decade CSU Chico has been known nationally for its live, televised instruction by ITFS and satellite. The majority of its work involves either the provision of regular university courses to off-campus centers or a satellite-based master's degree in computer science. However, CSU Chico delivers a significant amount of programming for K-12 students and teachers. The University is a partner in the TI-IN United Star Network, and Star Schools-funded national program. In this role Chico is providing a unique first-year teacher training program called "Partners."

Contact:
Leslie Wright, Associate Dean
Center for Regional and Continuing Education
California State University, Chico
Chico, CA 95929-0250
(916) 895-6105

California State University, Fresno

Target audience:
High school students and teachers

Examples of types of courses:
University credit for high schools
-- French
-- German
-- Latin
-- Japanese
-- Russian
Teacher education and in-service
-- Early Childhood Education (3 units)
-- Economics (3 units)

Technology:
ITFS

Geographic coverage:
Four counties - Fresno, Kings, Madera, and Tulare

Permanent receiving locations:
Seven high schools

Number of students served annually:
First semester (1989), 26 students

Cost to receiving school/student/teacher:
Schools pay for hardware, CSU Fresno installs for free. High school students pay $6 per semester. Teachers pay $75/unit.

Comments:
In September, 1989, CSU Fresno began broadcasting live university courses to advanced high school students. Students are admitted through the CSU's fee waiver program and pay $6 per course.

Contact:
Dr. Patricia Hart
Program Development Specialist
Division of Extended Studies
California State University, Fresno
(209) 294-2524

California State University, Fullerton

Target audience:
  High school students and teachers
Examples of types of courses:
  University credit courses for high school students
  -- Art
  -- American History
  -- American Government
  -- Analytic Geometry
  -- Economics
  -- Introduction to Chicano Studies
  -- Political Science
  -- Psychology
  Teacher education and in-service
  -- Mainstreaming
Technology:
  ITFS and cable
Geographic coverage:
  Orange County
Permanent receiving locations:
  Eleven high schools
Number of students served annually:
  Fifty
Cost to receiving school/student/teacher:
  Hardware and installation provided free to schools, students pay $4 per course, teachers pay regular off-campus fees.
Comments:
  CSU Fullerton utilizes ITFS and cable television to provide university credit courses to advanced high school students in northern Orange County. Students are admitted through the CSU's fee waiver program.
Contact:
  Dr. Ernest Gourdine, Director
  TV and Media Services
  California State University, Fullerton
  Fullerton, CA 92634
  (714) 773-3484

California State University, Los Angeles

Target audience:
  Teachers
Examples of types of courses:
  Seminar in Career Education
  Computer Graphics for Instructional Pres.
  Foundations of Vocational Ed.
  Seminar in Vocational Education
  Curriculum Development in Adult and Vocational Ed.
  Health Studies on Alcohol Narcotics, Nutrition and Tobacco
  Methods of Teachuing Voc. Ed.
  Methods and Materials of Adult Learning
  Counseling in Adult and Occ. Ed.

Technology:
ITFS
Geographic coverage:
Los Angeles County
Permanent receiving locations:
Four schools
Number of students served annually:
(program begins 1990)
Cost to receiving school/student/teacher:
$54 per quarter unit
Comments:
Cal State Los Angeles will begin offering the Designated Subjects Credential in Vocational Education and Adult Education in 1990. The University already has an active ITFS program in Fire Science for firemen throughout the Los Angeles area.

California State University, Northridge

Target audience:
Teachers
Examples of types of courses:
Teaching the Bilingual/Bicultural Student: Mexican American
Health Aspects of Drug Abuse
Nutrition and Health
Technology:
ITFS
Geographic coverage:
Northern Los Angeles area
Permanent receiving locations:
Fourteen high schools in Los Angeles, Oxnard and Antelope Valley
Number of students served annually:
Not available
Cost to receiving school/student/teacher:
$100/unit
Comments:
CSU Northridge has a large and extensive ITFS network which is used primarily to broadcast graduate engineering courses to industry. However, during the Fall semester, 1989, the University is broadcasting a single course, "Teaching the Bilingual/Bicultural Student: Mexican American," to five school districts in the northern Los Angeles area. The cost of the three-unit course is $300. CSU Northridge does not currently offer programming for high school students.
Contact:
Dr. Elizabeth Perrin, Director
Instructional Television Network
CSU Northridge
Northridge, CA
(818) 885-2355

California State Polytechnic University, Pomona

Target audience:
High school students
Examples of types of courses:
General Education Courses
-- Family Relations
-- General Psychology
-- Introduction to Cultural Anthropology
-- Contemporary Aspects of Nutrition
-- Introduction to Ethnic Studies
-- The Visual Arts
Professional Readiness Series:
-- Business and its Environment
-- Introduction to Engineering
-- Science and Scientists
Technology:
ITFS and cable
Geographic coverage:
Los Angeles, Orange, and San Bernardino Counties
Permanent receiving locations:
Twenty-five high schools
Number of students served annually:
350 students
Cost to receiving school/student/teacher:
School purchases and installs hardware, and pays $1500 annual fee for courier and maintenance services. Students pay $4 per course.
Comments:
For the last four years, Cal Poly Pomona has been offering live televised university courses to high school students. The University calls its service "PolyNet." The network serves 24 schools in the Los Angeles area. Students are enrolled through a special fee waiver program which allows them to take courses for $4 per quarter.
Contact:
Dr. Robert Threlkeld
California State Polytechnic University, Pomona
3801 W. Temple Ave.
Pomona, CA 91768
(714) 869-2277

California State University, Sacramento

Target audience:
Teachers
Examples of types of courses:
Integrating the Language Arts - Issues and Answers
Strategies and Resources in Drug Education
Technology:
Cable and satellite
Geographic coverage:
300 high schools in the Sacramento area, national for satellite
Permanent receiving locations:
300 locations

Number of students served annually:
Not available
Cost to receiving school/student/teacher:
Free
Comments:
CSU Sacramento is a member of the Sacramento Educational Cable Consortium, and has access to more than 300 schools. In addition, because of close ties with the State Department of Education, they produce a large number of educational special events and teleconferences.
Contact:
Spencer A. Freund
California State University, Sacramento
University Media Services
6000 J Street
Sacramento, CA 95819
(916) 278-5764

San Diego State University

Target audience:
Teachers
Examples of types of courses:
Computer Literacy
Mainstreaming
Technology:
Cable
Geographic coverage:
San Diego City
Permanent receiving locations:
None
Number of students served annually:
Fifty-seven teachers
Cost to receiving school/student/teacher:
Not applicable
Comments:
San Diego State provides limited programming of live university classes to teachers. The University uses an ITFS link to the local cable television facilities, which in turn transmits the course to teachers in their homes. San Diego State does not currently provide university credit courses for high school students.
Contact:
Dr. Robert Behm
Associate Dean for Distance Education
College of Extended Studies
San Diego State University
(619) 594-4063

San Jose State University

Target audience:
Teachers
Examples of types of courses:
Counselor Education
Special Education
Bi-Lingual Special Education
Technology:
ITFS
Geographic coverage:
San Mateo, Santa Clara, San Benito and Monterey counties
Permanent receiving locations:
None
Number of students served annually:
300-400 teachers
Cost to receiving school/student/teacher:
Regular university fees
Comments:
Like San Diego State, San Jose State broadcasts directly into county public school ITFS systems. Both the Monterey and Santa Clara county ITFS networks receive San Jose States ITFS signal and rebroadcast it to interested schools. The network has been operational since 1985.
Contact:
Betty Bensen, Director
ITFS
San Jose State University
(408) 924-2635

Figure 1
Los Angeles Area ITFS Networks
California State University System

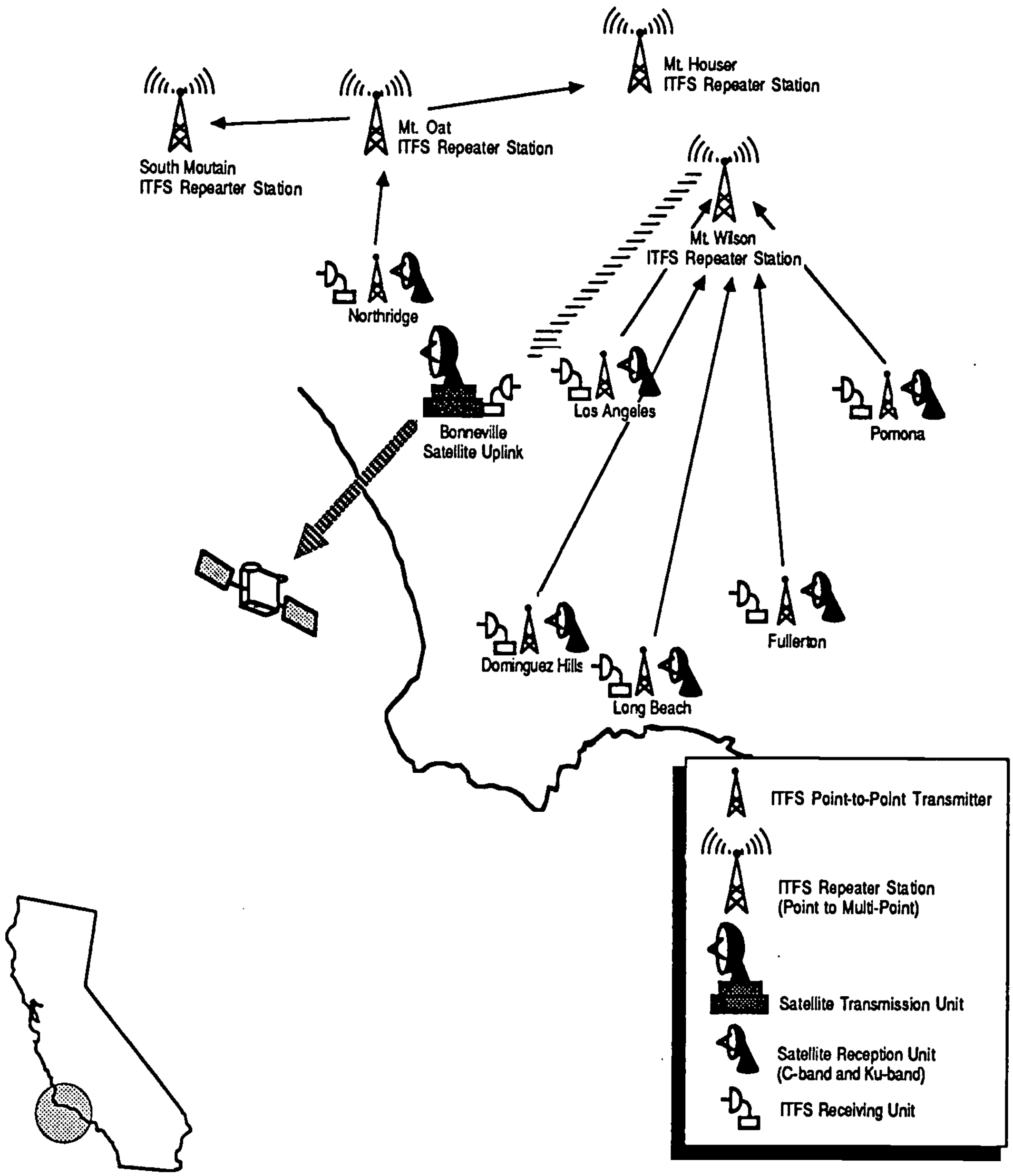
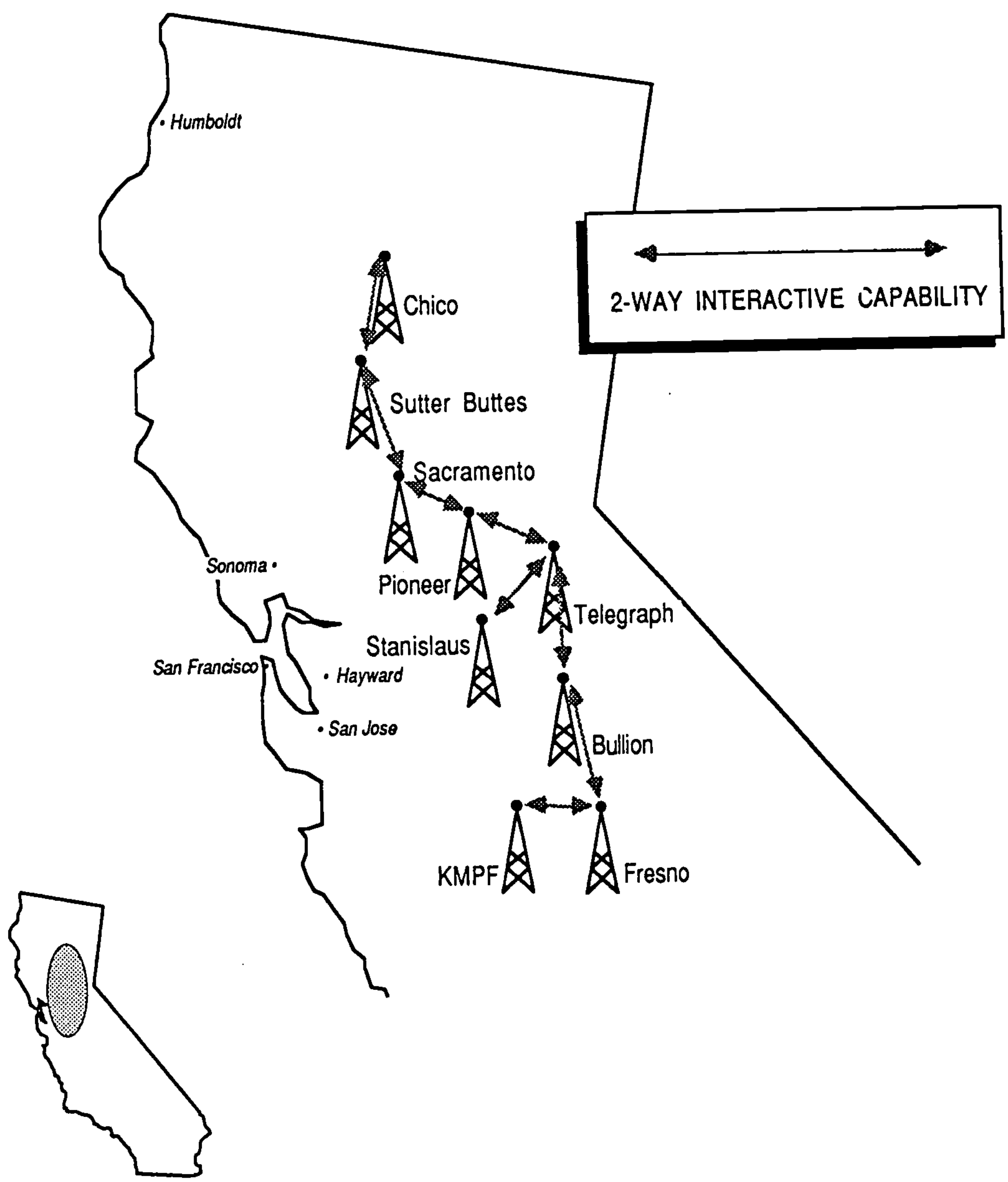


Figure 2
Central Valley 6GHz Microwave Network
California State University System



Community College Campuses

Peralta Community College

(Program is in the planning stage for a September, 1990 start)

Target audience:
  High school Students
Examples of types of courses:
  Not determined
Technology:
  ITFS and cable
Geographic coverage:
  Oakland and east bay area
Permanent receiving locations:
  None at this time
Number of students served annually:
  None at this time
Cost to receiving school/student/teacher:
  School will install hardware, no charge to students.
Comments:
  The Peralta Community College program is still in development, slated for broadcast in September, 1990.

County Offices of Education

Although a number of county offices have large and extensive ITFS and cable networks, they are not currently being used to originate live, interactive education for either students or teachers. Several (San Diego, Monterey, Santa Clara) do, however, retransmit broadcasts from other live programming sources.

Los Angeles County Office of Education

Target audience:
  Teachers and Administrators
Examples of types of courses:
  English Language Arts Series
  -- Collaborative Learning
  -- CAP: Assessing Authentic Achievement
  Leader's Edge (Administrative Series)
  -- Case Studies: Success in Secondary Math
  -- Case Studies: Success in Elementary Math
  History Social Science Series
  -- Focus on World History (grades 6,7,10)
Technology:
  Ku-band satellite
Geographic coverage:
  California
Permanent receiving locations:
  Sixty Los Angeles County districts, 33 California counties

Number of students served annually:
Not available

Cost to receiving school/student/teacher:
School must purchase install hardware. No instructional charges to Los Angeles County schools. Other participating counties pay an annual fee plus charges based on county-wide ADA.

Comments:
The Los Angeles County Office of Education has made a strong and visible commitment to satellite education in the past two years by creating ETN (the Educational Telecommunications Network). Originally designed to telecast live and interactive staff development in the 80 districts in Los Angeles County, ETN now provides programming through county offices to districts in 35 counties in California counties.

ETN utilizes a Ku-band uplink to provide teacher in-service in curriculum reform areas. The network is also used for administrative training and information teleconferences. In addition to providing live, interactive education, the EMDC (Educational Materials Development Center) provides extended staff development programs of the curriculum telecasts to membership counties.

Contacts:
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Downey, CA 90242
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Donald S. Lake, Consultant-in-Charge
Educational Materials Development Center
Los Angeles County Office of Education
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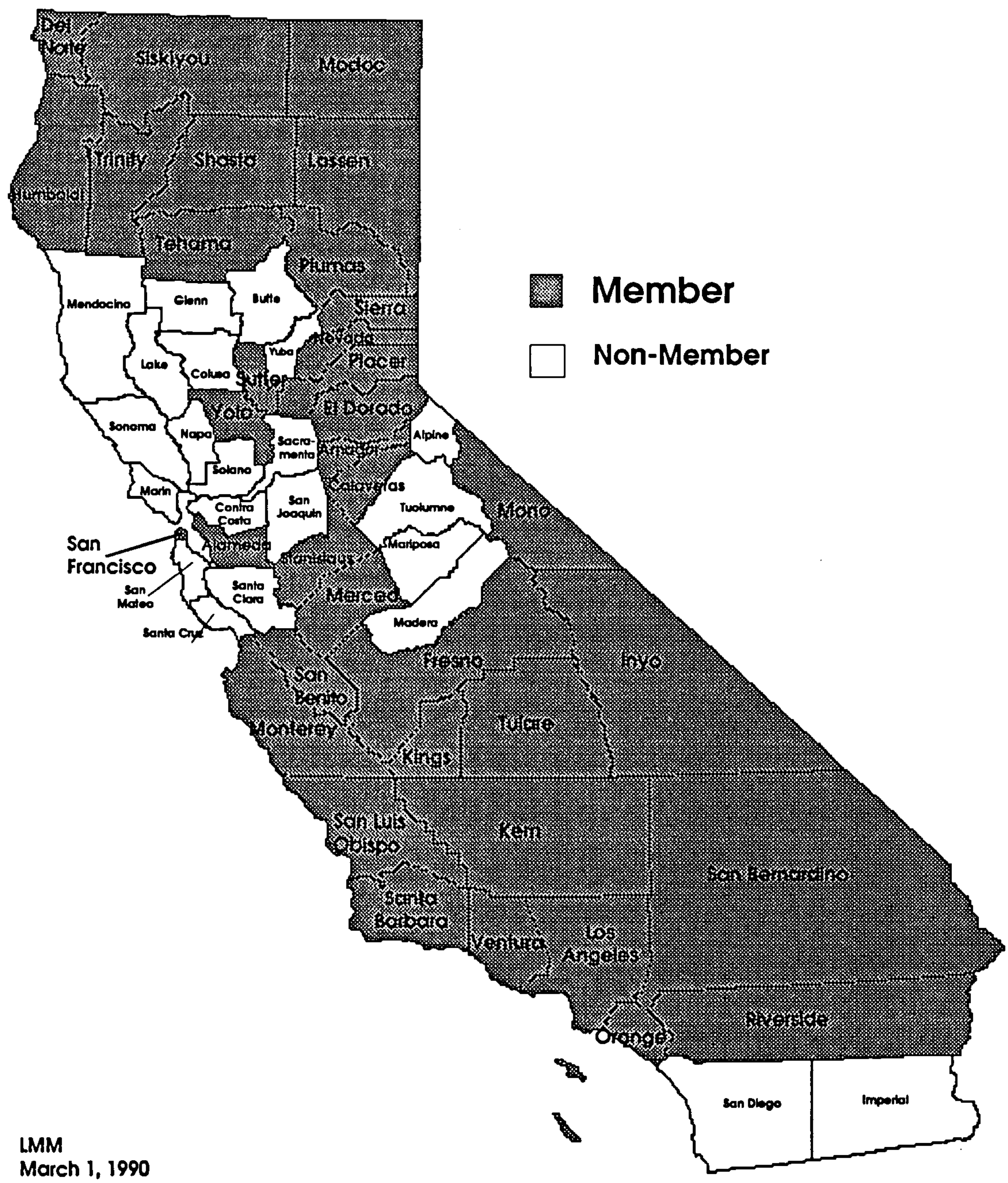
Figure 3
ETN Member Counties
Los Angeles County Office of Education



LMM
March 1, 1990

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National Satellite Educational Networks

The following is a listing and description of organizations which provide extensive, regular satellite programming for K-12 schools. All the organizations listed deliver live, interactive video programming and reach large numbers of locations in several states. Three of these networks are recipients of Star Schools funding, and the name of their Star Schools project is printed in italics. The courses and programs listed are for the 1989-90 school year.

Oklahoma State University Arts and Sciences Teleconferencing Service - ASTS (*Midlands Consortium*)

Target audience:

(K-12) students and teachers

Courses available (1989-90 school year):

High School Credit Courses (See Table 1, page 26)

Noncredit High School Courses

-- Genetics
-- Lab Science Programs in Biology
-- Lab Science Programs in Chemistry
-- Lab Science Programs in Earth/Space Science
-- Lab Science Programs in Physics/Physical Science

Elementary and Intermediate Credit Courses

-- Basic English and Reading (7-8)
-- Japanese I for Middle/Jr. High (Kansas University)

Credit Courses for Faculty and Administrators

-- Contemporary Issues for Teachers (OSU College of Education)

Noncredit Staff Development Programs

-- The Midlands Consortium is providing 29 different staff development activities during the 1989-90 school year. These events are charged on a pay-per-view basis.

Technology:

Missouri and OSU broadcast in C-band; Kansas State broadcasts in Ku-band. Receiving school provides their own television sets, VCRs, and telephone handsets. The signal is not encrypted, and can be received by general purpose downlinks.

Geographic coverage:

ASTS/Midlands Consortium currently has 375 sites in 28 states

Number of current California sites:

Four, plus demonstrations sites at six county offices of education.

Number of high school students being served in the U.S.:

4,100

Costs:

Schools provide their own receiving and classroom hardware. ASTS has no annual subscription fee. Charges differ between in and out of Oklahoma residence. Fees for out of state students, on a per course basis, are as follow:

	Full Year Course
1-3 students	$ 725/student
4-10 students	$ 2,900 total
Per student over 10	$ 100/student

For comparative costs with other networks see Table 2, page 27.

Local coordination responsibilities:

ASTS places heavy responsibilities on what they call the local "coordinator teaching partner." This person, who must be a credentialed teacher, is responsible for conducting a class on nonbroadcast days. In addition, the coordinator provides the final grade to students, using as input a grade provided by ASTS.

Comments:

Oklahoma State University's ASTS is an outgrowth of the University's effort to meet the needs of rural Oklahoma schools. The program began with the "German by Satellite" series, which now draws a total class size of more than 2,000 students. ASTS' live interactive programs are characterized by very high production values, and the classes approach the entertainment quality of network TV. Each course has its own development team, often heavily supported by State and Federal grants.

ASTS and Midlands Consortium courses are broadcast either 2 or 3 days per week. On non-broadcast days in-class activities such as review, discussion or reading are suggested. No credit is attached to these courses by the transmitting organizations. The local teacher is considered the teacher of record and credit is given by the receiving school.

ASTS worked collaboratively with several organizations to produce a winning Federal Star Schools grant project, now called the Midlands Consortium. From those funds are a number of new courses and staff development programs. Partnerships in the Midlands Consortium include:

-- Oklahoma State University
-- Kansas State University
-- University of Kansas
-- Missouri School Boards Association

Contacts for information about ASTS and the Midlands Consortium are the following:

Ms. Leigh Walters
ASTS
401 LSE
Oklahoma State University
Stillwater, OK 74078
(405) 744-7895

Dr. Malcolm Phelps
Midlands Consortium
401 LSE
Oklahoma State University
Stillwater, OK 74078
(405) 744-8131

In California:

Rick Nupoll
RETAC
L.A. County Office of Ed.
9300 E. Imperial H ighway
Downey, CA 90242-2890
(213) 922-6246

See Figure 4, page 28, for RETAC-sponsored ASTS demonstration sites.

Satellite Educational Resources Consortium (SERC)

Target audience:
Primarily secondary schools

Courses available (1989-90 school year):
High School Credit Courses (See Table 1, page 26)
Noncredit High School Courses
-- Science and Technology Seminars
Elementary and Intermediate Credit Courses (None)
Credit Courses for Faculty and Administrators
-- AP Calculus for Teachers
-- AP Economics for Teachers (1990/91)

Technology:
Ku-band satellite, cable and ITFS

Geographic coverage:
Last year SERC served 58 sites in a pilot semester (spring, 1989). This year, through the use of Star Schools funds, SERC is working with 19 states and four large cities.

Number of current California sites:
None

Number of high school students being served in the U.S.:
3,300

Costs:
Each State pays an annual membership fee ($25,000 in 1989-90, $35,000 in 1990-91). Students pay $300 per year-long course. For comparative costs with other networks see Table 2, page 27.

Local coordination responsibilities:
Each classroom has a facilitator, who serves as the in-class supervisor, but who is also encouraged to participate actively in the class. Each school has a coordinator, usually the principal, who oversees the project.

Comments:
Of all the national satellite programs, SERC is clearly the one which was most dependent on Star Schools funding. The network received $5.6 million from this source.

SERC developed as a partnership of states, all of which have the strong support of the Chief State School Officer as well as the public television agency. The SERC organization acts as a coordinating body for the participating states, and does not produce programming, per se. Major producers include Kentucky Educational Television (KET), South Carolina Educational Television, the Wisconsin Public Television Network, and Nebraska Educational Television. In all instances, these organizations worked collaboratively with the relevant educational agencies in their area. SERC is administered by SECA, the Southern Educational Communications Association. Each state has three representatives - one each on the technical, instructional, and evaluation councils, in addition to the board members.

California is not currently a member of SERC, and no agreement has been struck between the California Department of Education and one of the television agencies in the state. Because the state has not joined, schools in California are precluded from receiving programming from SERC.

Contact:
Lee Monk, Director of Communications
Satellite Educational Resources Consortium
P.O. Box 50,008
Columbia, South Carolina 29250
(803) 799-5517

Satellite Telecommunication Educational Program (STEP)

Target audience:
(K-12) students and teachers

Courses available (1989-90 school year):
High School Credit Courses (See Table 1, page 26)
Noncredit High School Courses
Forty hours of programming designed to supplement in-class instruction in grades 3-12.
Elementary and Intermediate Credit Courses (none)
Credit Courses for Faculty and Administrators
-- El/Se 571 "Elementary School Science" (3 units, from Washington State University)

Technology:
Ku-band satellite. STEP has a recommended equipment package which includes a satellite receiver and classroom equipment, or schools can provide their own.

Geographic coverage:
This year STEP is providing courses to 75 sites, including California.

Number of current california sites:
One

Number of high school students being served in U.S.:
1000

Costs:
With recommendations from STEP, schools purchase and install their own hardware. There is a one-time first-year membership of $6,000, and a recurring annual membership fee of $4,250. These figures are somewhat less if included in the purchase of staff development programs. There is an additional charge of $350 per enrichment program, or $1000 for all ten programs.

Student costs for high school credit courses are as follows:

1-3 students	$650/student
4-5 students	$2,450
6-12 students	$3,900
13-20 students	$4,850
over 20 students	$4,850 plus $220 each additional

For comparative costs with other networks see Table 2, page 27.

Local coordination responsibilities:
STEP expects the local coordinator to be responsible for operating equipment, monitoring tests, and the mailing of homework. If more than 10 students are enrolled in a school, STEP recommends that a credentialed person be present.

Comments:
STEP is the outgrowth of cooperative planning between rural schools in eastern Washington and the regional educational organization, Educational Service District 101. The programs all originate from Spokane, Washington. STEP grew from a small base of schools in the Northwest to its current size. It differs from TI-IN and ASTS is that it is a true cooperative, governed by its users, who set policy and fees. One interesting note: STEP is currently broadcasting calculus through the TI-IN network, which represents the first example of program sharing.

STEP contact in Washington:
STEP Network
Educational Service District 101
West 1025 Indiana Ave.
Spokane, WA 99205-4561
(509) 536-0141

TI-IN Network, Inc.
(TI-IN United Star Network)

Target audience:
(K-12) students and teachers

Courses available (1989-90 school year):
High School Credit Courses (See Table 1, page 26)
Noncredit High School Courses
-- Reading Improvement
-- Scholastic Aptitude Test Review
-- A variety of enrichment programs are provided for K-12 students as part of the subscription fee.
Elementary and Intermediate Credit Courses
-- Elementary/Intermediate Spanish
-- Elementary Fine Arts
Credit Courses for Faculty and Administrators
-- Junior High Science Teaching Institute (3 units)
This institute provides 34 hours of science training and demonstrations for grade 7-9 science teachers. (Mississippi State University)
-- Partners in Professional Growth (4-5 units)
Beginning teachers will be matched with experienced teachers who will be trained on the air in peer coaching techniques.
(California State University, Chico)
-- Mainstreaming (3 units) (California State University, Chico)
-- Introduction to Consultation for Special Educators (1unit)
Course presents a model for special educators who provide help and consultation to classroom teachers.
-- Foreign/Second Language Education (3 units)
(California State University, Chico)
Noncredit staff development programs
-- TI-IN offers a wide variety of staff development activities throughout the year. Programs of interest to parents and community members are also included. The fee for these programs is $1000

Technology:
Ku-band satellite. The Network requires the purchase or lease of a special antenna, AV cart, and cordless audio response system. TI-IN broadcasts on four channels. TI-IN encrypts its signal and is therefore not receivable by general purpose downlinks.

Geographic coverage:
TI-IN has over 900 sites in 32 states, including California.

Number of current California sites:
24

Number of high school students being served in U.S.:
6000

Costs:

Receiving school districts pay an average of $8,000 for an installed turnkey steerable satellite receiving unit. Recurring annual costs of $10,000 to $14,000, consists of an annual membership fee based on school ADA plus a per person student fee of $480-580 per year. The membership fees provide the school with a complete warranty of parts, including free equipment upgrades and free video tape back ups. It also provides over 100 hours of free enrichment broadcasts to students and teachers. For comparative costs with other networks see Table 2, page 27.

Local coordination responsibilities:

TI-IN requires an on-site coordinator to be in the viewing classroom with the students. This person need not be credentialed except in laboratory science courses.

Comments:

TI-IN is the largest and oldest network providing live interactive satellite instruction to students and teachers. The network is also the most technically advanced, having developed its own complete receiving and classroom instructional equipment. Interaction with the instructor is handled by students pressing a button which activates a preprogrammed 800 WATS line into the studio. Testing materials are electronically sent using satellite subcarrier frequencies to on-site secure printers. Courses are broadcast five days per week during the school year.

TI-IN is unique in that it is a private for-profit company which works closely with nonprofit educational organizations. Although initially created to meet the needs of rural Texas schools, the company has been successful in establishing itself as a nationwide supplier of critically needed education.

TI-IN received a major grant through the Federal Star Schools program, and many of the courses which they offer are funded through this source. Separately identified from TI-IN Network Inc., this project is called the TI-IN United Star Network. Partners in this project include:

TI-IN Network, Inc.
California State University, Chico
Illinois Board of Education
Mississippi State University, Starksville
North Carolina Department of Public Instruction
Texas Education Agency
University of Alabama, Tuscaloosa
Western Illinois University, Macomb

Both TI-IN Network, Inc. and the TI-IN United Star Network are marketed by:

Carolyn DeFreitas
Educational Consultant
26492 Valparaiso
Mission Viejo, CA 92691
(714) 586-8944

Rick Nupoll
RETAC
L.A. County Office of Education
9300 E. Imperial Highway
Downey, CA 90242-2890
(213) 922-6246

See Figure 5, page 29, for RETAC-sponsored TI-IN demonstration sites.

Table 1.
National Satellite Networks
High School Credit Courses Listing (1989-90)

Curriculum Matrix

Courses	ASTS	SERC	STEP	TI-IN
Foreign Languages				
French I				X
French II				X
French III				X
German I	X			X
German II	X			X
Japanese I		X	X	X
Japanese II			X	X
Latin I				X
Latin II				X
Russian I	X	X		X
Spanish I	X		X	X
Spanish II	X		X	X
Math and Science				
Calculus	X *		X	
Elementary Analysis				X
Discrete Mathematics		X		
Probability/Statistics		X		
Trigonometry				X
Analytic Geometry	X			
Anatomy/Physiology				X
Astronomy				X
Chemistry	X *			
Computer Science				X
Marine Science				X
Physics	X *		X	
Social Sciences/Humanities				
English and Reading	X			
English Literature				X *
Adv. Senior English			X *	
Amer. Government	X *			X *
Art History				X
Economics	X	X *		
Psychology				X
Sociology				X

* Advanced Placement

Table 2.
Hypothetical Cost Comparison for National Satellite Networks

Ten Students Enrolled in a Course by Satellite (1990-91)

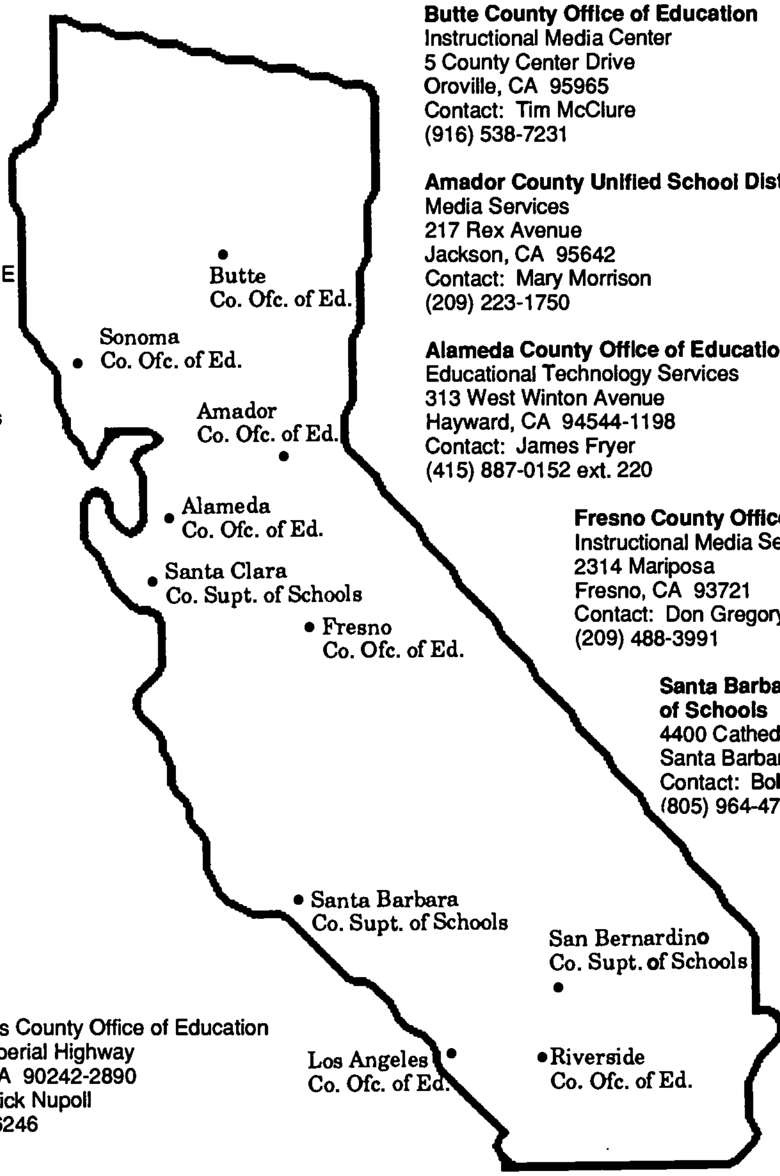
Because each of the previous satellite services uses slightly differing pricing structures, they are somewhat difficult to compare in the abstract. To attempt a more specific comparison, an example is presented. What would the costs be for a school to enroll ten students in a year-long non-laboratory course? The cost comparison assumes that a school does not have existing satellite receiving equipment, and that it was not provided through a Star Schools grant. While this comparison reflects the actual direct costs of each program, programs with membership fees provide substantial additional services. These are 1990-91 costs.

	ASTS	SERC	STEP	TI-IN
First Year Costs				
Equipment	$ 3,000	$ 3,000	$ 4,750	$7,950
Membership Fee	None	None	$ 6,000	$ 5,250 *
Student fees (10)	$ 2,400	$ 4,200	$ 3,900	$ 4,800
Total	**$ 5,400**	**$ 7,200**	**$14,650**	**$18,000**
Second Year Costs				
Membership Fee	None	None	$ 4,250	$ 5,250 *
Student fees (10)	$ 2,400	$ 4,200	$ 3,900	$ 4,800
Total	**$ 2,400**	**$ 4,200**	**$ 8,150**	**$10,050**

* TI-IN's annual membership fee provides a school with complete maintenance and warranty of the satellite receiving equipment, 100 hours of student enrichment, and a variety of other support services.

Figure 4
OSU/ASTS California Demonstration Sites
Regional Television Advisory Committee (RETAC)

RETAC has established Distance Learning demonstration sites for Oklahoma State University's Arts and Sciences Teleconferencing Service (ASTS). These sites are managed by county offices of education. They provide sample text materials, videos and the opportunity for viewing live distance learning classes. Inquires should be directed to RETAC or to the nearest county office demonstration site. Contracts for all OSU/ASTS services in California will be managed by RETAC Distance Learning Services*, 9300 East Imperial Highway, Downey, CA 90242-2890 (213/922-6246). Contact RETAC for specific information regarding local school sites participating in ASTS courses.



Sonoma County Office of Education
410 Fiscal Drive, Room 111-E
Santa Rosa, CA 95403
Contact: Judith Ehert
(707) 527-2925

Santa Clara County Superintendent of Schools
100 Skyport Drive
San Jose, CA 95115
Contact: Glenda Diggle
(408) 453-6640

RETAC*
Los Angeles County Office of Education
9300 E. Imperial Highway
Downey, CA 90242-2890
Contact: Rick Nupoll
(213) 922-6246

Butte County Office of Education
Instructional Media Center
5 County Center Drive
Oroville, CA 95965
Contact: Tim McClure
(916) 538-7231

Amador County Unified School District
Media Services
217 Rex Avenue
Jackson, CA 95642
Contact: Mary Morrison
(209) 223-1750

Alameda County Office of Education
Educational Technology Services
313 West Winton Avenue
Hayward, CA 94544-1198
Contact: James Fryer
(415) 887-0152 ext. 220

Fresno County Office of Education
Instructional Media Services
2314 Mariposa
Fresno, CA 93721
Contact: Don Gregory
(209) 488-3991

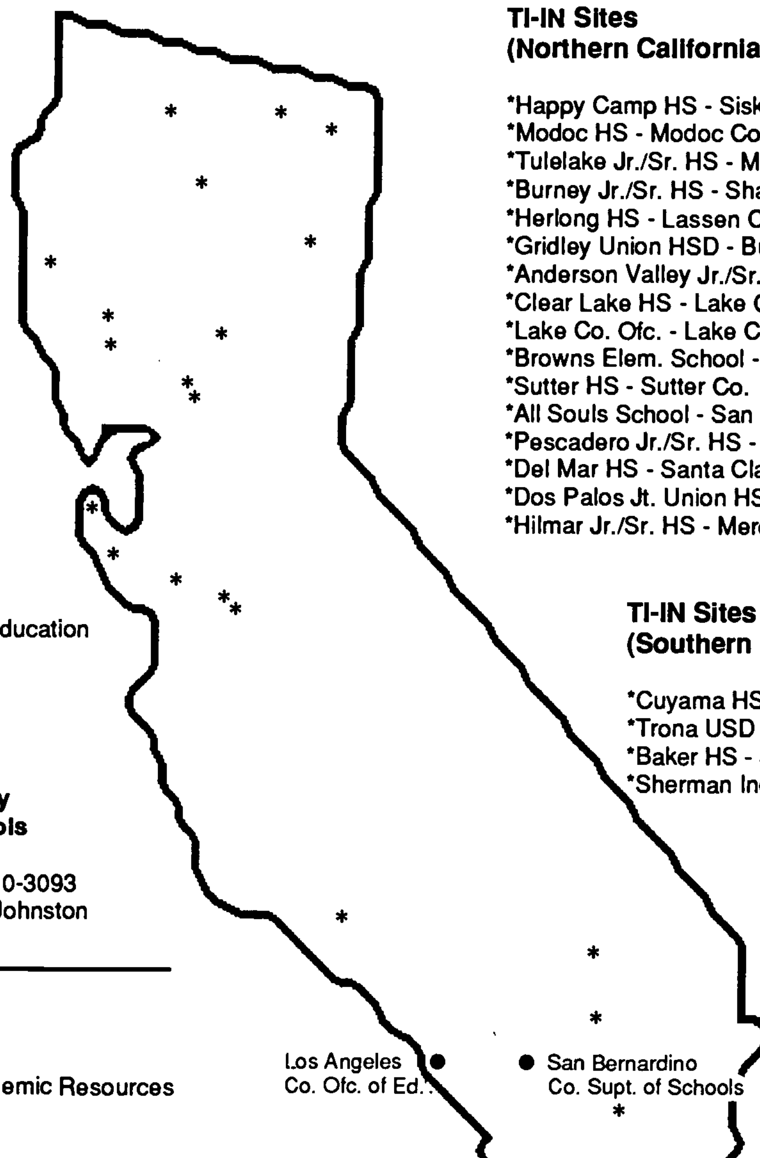
Santa Barbara County Superintendent of Schools
4400 Cathedral Oaks Road
Santa Barbara, CA 93105
Contact: Bob Krause
(805) 964-4711 ext. 244

San Bernardino County Superintendent of Schools
601 North E. Street
San Bernardino, CA 92410
Contact: Bob Bell
(714) 387-3156

Riverside County Office of Education
Instructional Technology
3939 Thirteenth Street
Riverside, CA 92502
Contact: Mary Liette
(714) 788-6684

Figure 5
TI-IN California Demonstration Sites
Regional Television Advisory Committee (RETAC)

TI-IN has established Distance Learning Demonstration Sites at the San Bernardino County Superintendent of Schools Offices and at RETAC's Distance Learning Demonstration Center in the Los Angeles County Office of Education. Also listed are schools currently participating in TI-IN courses. Contracts for all TI-IN services will be managed by RETAC Distance Learning Services, 9300 E. Imperial Highway, Downey, CA 90242-2890 (213/922-6246). For specific information regarding local school sites involved with TI-IN, contact their regional consultant.



TI-IN Sites
(Northern California)

*Happy Camp HS - Siskiyou Co.
*Modoc HS - Modoc Co.
*Tulelake Jr./Sr. HS - Modoc Co.
*Burney Jr./Sr. HS - Shasta Co.
*Herlong HS - Lassen Co.
*Gridley Union HSD - Butte Co.
*Anderson Valley Jr./Sr. HS - Mendocino Co.
*Clear Lake HS - Lake Co.
*Lake Co. Ofc. - Lake Co.
*Browns Elem. School - Sutter Co.
*Sutter HS - Sutter Co.
*All Souls School - San Francisco Co.
*Pescadero Jr./Sr. HS - San Mateo Co.
*Del Mar HS - Santa Clara Co.
*Dos Palos Jt. Union HS - Merced Co.
*Hilmar Jr./Sr. HS - Merced Co.

TI-IN Sites
(Southern California)

*Cuyama HS - Santa Barbara Co.
*Trona USD - San Bernardino Co.
*Baker HS - San Bernardino Co.
*Sherman Indian School - Riverside Co.

TI-IN Demonstration Sites:

• **RETAC**
Los Angeles Co. Ofc. of Education
9300 E. Imperial Highway
Downey, CA 90242-2890
Contact: Rick Nupoll
(213) 922-6246

• **San Bernardino County Superintendent of Schools**
601 North E Street
San Bernardino, CA 92410-3093
Contact: Bob Bell or Pat Johnston
(714) 387-3156

TI-IN Network*
Carolyn DeFreitas
Education Consultant
Satellite Transmitted Academic Resources
26492 Val Pariso
Mission Viejo, CA 92691
(714) 586-8944

Additional Satellite Teleconferencing Resources

The following additional organizations provide occasional satellite teleconferences for K-12 teachers and students. Programming information and schedules are available from the person given as the contact. Some of the citations in this section were provided with the permission of Virginia Ostendorf from her book *What Every Principal, Teacher and School Board Member Should Know about Distance Education.* The book is available for $30 from Virginia A. Ostendorf, Inc., P.O. Box 2896, Littleton, Colorado 80161.

Black College Satellite Network(BCSN)
500 N. Capitol St. NW, Suite 801
Washington, DC 20001

Contact: Dr. Walter Barwick
Telephone: 202-737-2405

Target audience: Classroom teachers and administrators
Satellite: Both C-band and Ku-band

Description: The Black College Satellite Network is a consortium of colleges with an interest in programming geared to black viewers. The network routinely includes programs of interest to public schools. Some programs at no cost.

California State Department of Education
Department of Educational Technology
721 Capitol Mall
P.O. Box 944272
Sacramento, CA 94244-2720

Contact: Frank Wallace
Telephone: 916-324-1859

Target audience: Administrators and classroom teachers
Satellite: Both C-band and Ku-band

Description: The California Department of Education delivers frequent teleconferences in specialized education topics (examples: special education, child development, bilingual education), as well as legal provisions, administrative procedures and educational accounting practices.

Eastman Kodak
343 State Street
Rochester, NY 14650

Contact: Ken Lassiter
Telephone: 1-800-445-6325

Target audience: Classroom teachers
Satellite: Both C-band and Ku-band

Description: Photography instruction, suitable for high school and adult. Free.

Elementary/Secondary Service
Public Broadcasting Service
1320 Braddock Place
Alexandria, VA 22314

Contact: Francis Thompson
Telephone: 707-739-5402

Target audience: Classroom teachers, administrators and high school students.
Delivery mode: C-band only

Description: Approximately fifteen programs averaging 2 hours in length are offered each year. Topics may cover school governance, school restructuring and curriculum issues.

Georgia Center for Continuing Education
University of Georgia
Athens, GA 30602

Contact: Dr. Robert Williams
Telephone: 404-542-3554

Target audience: Classroom teachers and administrators
Satellite: C-band

Description: A number of occasional programs targeted to school personnel are offered. Past topics include: Middle School Administration, Discipline in the Schools, Reinventing the School Board.

Kirkwood Community College
P.O. Box 2068
6301 Kirkwood Boulevard SW Room 206
Cedar Rapids, IA 52406

Contact: Gary L. Strand or John Weih
Telephone: 319-398-5447

Target audience: Classroom teachers and administrators
Satellite: Both C-band and Ku-band

Description: Kirkwood is installing an uplink and will be ready to broadcast programs during 1990. Plans include the delivery of occasional programs of interest to public schools.

Education Satellite Network
Missouri School Boards Association
2100 1-70 Drive SW
Columbia, MO 65203

Contact: Terri Baur
Telephone: 314-445-9920 or 1-800-221-MSBA

Target audience: Classroom teachers K-12
Satellite: Primarily C-band, but some Ku-band transmissions

Description: The Missouri ESN is a member of the Midlands Star Schools Project. In-service topics include Chapter I students at risk, disadvantaged students, handicapped students, special education, early childhood development and education; also programs for board members. Most programs are offered as a series of 3 or 4 programs, each 2 hours in length.

NASA Education Video Conference Series for Teachers
NASA Headquarters Mail Code XE
Washington, DC 74078-0422

Contact: Bill Nixing
Telephone: 202-453-8388

Target audience: Classroom teachers K-12; students with an interest in space exploration.
Satellite: C-band only; Westar 4

Description: NASA presents a series of four-90 minute programs for elementary and secondary teachers. Program titles include: planetary Exploration; Flight Testing; Space Science in the Classroom; Robotics in Space, followed by instruction for teachers from an aerospace specialist, who shows how to integrate this information into the classroom. All NASA programs are offered free to any interested school. Sites registered in advance are allowed to videotape the broadcasts for later use.

National University Teleconference Network
332 Student Union
Stillwater, OK 74078-0653

Contact: Pat Berberet
Telephone: 405-744-5191

Target audience: Classroom teachers and administrators
Satellite: Both C-band and Ku-band

Description: NUTN is a large consortium of university teleconference users. The network offers a wide variety of programs, most of which are produced by members. Nearly 20% of all annual programs are on education topics. Schools are encouraged to inquire about participation in NUTN events.

SCISTAR
Talcott Mountain Science Center
Montevideo Rd.
Avon, CT 06001

Contacts: Donald La Salle, President; Dan Barstow and Bill Dunkerly
Telephone: 203-827-8896

Target audience: All students, Grades 5-12, and their teachers
Satellite: C-band

Description: SCISTAR is an interactive satellite series about science technology. SCISTAR has ten one-hour broadcasts throughout the school year. Each broadcast is accompanied by a curriculum packet. Recent broadcasts have featured astronauts and noted scientists.

State of Virginia
Department of Telecommunications
Division of Continuing Education
P. O. Box 3697
Charlottesville, VA 22903

Contact: Eldred Hendricks
Telephone: 804-924-6911

Target audience: Classroom teachers and administrators
Satellite audience: Only C-band

Description: State has a satellite network linking 293 schools in Virginia. As of 1989, 800 students were being served. The network is governed by the State Board of Education. Each school site has a steerable downlink, a FAX machine, VCR, and telephone line.

Virginia Commonwealth University
Box 2041
Richmond, VA 23284

Contact: Richard A. Alekna
Telephone: 804-367-8460

Target audience: Health sciences, social services, nursing, engineering, statistics, and pharmacy
Satellite: Both C-band and Ku-band

Description: Has a variety of teleconferences which may be of interest to teachers and other school personnel. VCU is home of the Virginia Hospital Television Network, the Supported Employment Network, and the International Audio Network.

Virginia Tech
135 Smyth Hall
Blacksburg, VA 24061-0445

Contact: Stanley Huffman
Telephone: 703-231-6664

Target audience: Classroom teachers and high school students, colleges, general public
Satellite: C-band only

Description: Teleconferences on a variety of subjects which may interest any of the audiences listed above. Graduate credit in selected disciplines.

West Virginia Department of Education
1900 Washington Street East
Capitol Complex, Building 6, Room B-318
Charleston, WV 25305

Contact: Jeanne Moellendick
Telephone: 304-348-3788

Target audience: Students K-12, classroom teachers, administrators, all educational staff members
Satellite: C-band only

Description: A wide range of ad hoc events are offered to students and teachers in West Virginia. Sharing of this programming is desired and will be determined on a case-by-case basis on request.

Courses include a series of individual programs on West Virginia, its history, geography and cultural studies and teacher in-service. A number of programs are offered for curriculum enrichment and staff development.

The uplink is located in Institute, West Virginia and is operated by the West Virginia Educational Network under the Higher Education Central Office. Downlinks are located in 110 schools throughout the state.

Western Illinois University
Room 22, Horrabin Hall
College of Education
Macomb, IL 61455

Contact: Ron Davies, Utilization Specialist or Mike Dickson, Executive Director
Telephone: 309-298-1804
FAX: 309-298-2222

Target audience: Classroom teachers and administrators
Satellite: C-band only

Description: Western Illinois offers a variety of courses in student enrichment, staff development, and high school credit courses. At the present time, all courses are offered through the TI-IN United Star Network. A school needs to be a subscriber to obtain this programming.

Section III - Distance Learning Technologies

Technological Options for Distance Learning[2]

Although "distance learning" can be applied to a wide and diverse set of educational experiences, this report concentrates on those in which the instructor is both live, and in which the students have some method of interacting with the him or her. This excludes taped telecourses, or live one-way broadcast television.

The New Technologies

The development and refinement of communication technologies have created three distinct transmission configurations: two-way television, one-way television with audio return, and audiographics. These differ in the degree of live classroom simulation, in ease of operation, and in cost. All three differ from traditional educational television in that they don't require expensive formal program development, and they provide a way for students to communicate with the teacher.

Two-Way Television

This option, the costliest and most complex to operate and maintain, comes as close as possible to bringing students and teachers together in the same classroom. Each site in a two-way TV system resembles a little television studio with camera, microphones and monitors. Activities at each site are transmitted simultaneously so teachers and students across a wide area can both see and hear each other "live." Due to the high degree to which it simulates a normal classroom, two-way television is suitable for virtually all kinds of courses.

Its relatively high costs rise dramatically with increased distance between sites, which usually confines use of two-way television to a limited geographic area. If transmission is by microwave and the terrain is rough, costs rise further. The sophistication of the technology makes two-way television the most difficult of the three options to operate. It is also the most prone to technical problems; an engineer or well-trained technician should be on-call within easy travelling distance if not on-site. Some school districts enter maintenance partnerships with universities, cable, utility or local broadcast companies. To fully utilize the strengths of this system, teachers need to be trained in the range of possible teaching strategies, what works and what doesn't.

Application within California Very rare. The University of California, Irvine has links to the Irvine Unified School District's two-way cable system, and provides instruction to schools on an occasional basis. California State University, Bakersfield has recently inaugurated a compressed video link between the campus and Tehachapi High School, and in the near future California State University, Dominguez Hills will begin a similar pilot project with Dominguez High School in Compton.

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[2] Adapted from Bradshaw and Brown, "The Promise of Distance Learning," Far West Laboratory, 1989.

Two-way television is more common in Midwestern states, where consortia of small local schools create a microwave or fiber optic network to share educational resources.

One-Way Television with Audio Return

Less costly than two-way TV, this system resembles traditional educational television except that students can talk to the instructor or other distant students by telephone or radio. The students at remote sites can see the teacher on a television monitor, but the teacher cannot see them. However, students can speak to the teacher by phone or FM radio during the class to ask questions. Both the inquiry and the teacher's answers may be broadcast, although the large networks that distribute courses nationally use teaching assistants to help handle the large volume of student inquiries. The system can be enhanced by the addition of "faxing" capability, as well as computer conferencing. With its visual component, one-way TV can work for large-group instruction featuring teacher presentation and smaller group teaching.

Costs for setting up receiving sites are lower than in the previous example. All that is required are TV and telephones and a either a microwave or satellite receiver.

Application within California Very common. Using microwave, many of the California State University campuses have this technical configuration with K-12 schools. California State Polytechnic University, Pomona has the largest and oldest program serving public schools. Cal Poly's Young Scholar Program serves more than 350 students in 25 Los Angeles area high schools. ITFS is usually limited to a 50-mile radius around the transmitter.

One-way television with audio return is also possible by satellite, which permits statewide coverage. Los Angeles County's ETN is an example of such a satellite-based network. Both California State University, Chico and Sacramento, also regularly transmit programs to K-12 schools by satellite.

Audiographics

The least costly option and the simplest to operate, audiographics, is the combined use of voice transmission, computer networking, and "faxing" of documents. Teachers and students hear but do not see each other. In addition to speaking to the receiving classes, the instructor can use a digitized drawing pad and keyboard to "draw" on a computer monitor or television screen. The image appears in real time. Students, in turn, use their own drawing pad and keyboards, as well as the speaker phone, to interact with the teacher. Adding a facsimile machine provides rapid transmission of paper "hard copies" of tests, hand-outs and other materials.

Audiographics is typically the most economical of the three technological configurations, with costs tied to long-distance telephone rates and maintenance handled by the teacher with a few days of training. Audiographics works best with small groups at a limited number of sites. The technology has been particularly successful with language instruction, math and physics. The absence of two-way visual contacts puts a greater premium on attractive presentations by the teachers to maintain student attention, and therefore requires greater preparation by instructors.

Application in California None. Audiographics is used extensively in Utah, Pennsylvania and Colorado, but no known use of these technologies exists within California.

Selecting/Purchasing Your Satellite Equipment[3]

The following information, provided by Oklahoma State University, was contributed by Vicki Hobbs, a consultant who set up one of the first ASTS sites at New Franklin High School in Missouri; Wilbur Brakhage, a consultant at the Educational Television Services at Oklahoma State University; and Greg Heifner of Heifner Communications, Inc.

Selecting The "Instruction By Satellite" Classroom

-- Ideally, if room is available, it is advantageous to allow students at other free times of the day to have access to computers and to review taped lectures.

-- Where space does not allow for the dedication of a room, a computer lab, regular classroom or library/media center will suffice.

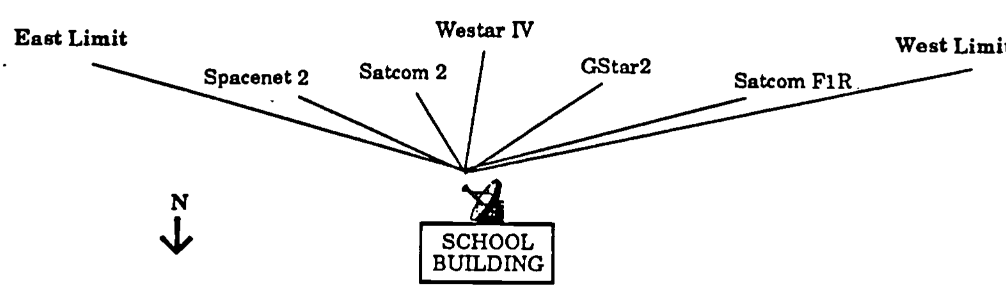
-- The amount of space required will be determined by how many students are enrolled, how many computers will be utilized, and how large a TV will be used.

-- A room with existing access to a phone line is preferable

-- Lab components for a course need not be located in the same room as the TV monitor. As existing science lab room may be preferable. Keep in mind, however, that students will need to have access to the TV on some lab days, as well as during live broadcasts.

Selecting A Receiving Site

-- Figure (6) may provide those unfamiliar with satellite systems the basic concept in choosing a receiving site.



-- Choose a preferred site location (reference to school building)

1. Antenna must have clear look angle to southeast, southwest direction.
2. Cannot point toward a building or trees.

-- Choose an alternate site location (reference to school building)

[3] Reprinted from *Setting Up ASTS Courses 1989-90* with permission from Oklahoma State University.

-- You may need a City permit to install your satellite antenna. Check with your City officials for answer. This is very important to know before ordering the system. If a permit is necessary, one should immediately start the process to avoid delaying the installation process when you receive the satellite antenna system.

-- Estimate the cable length from the antenna to building. Estimate the cable length inside the building. Cable length will have some effect on the quality of reception.

1. This should be approximately 150 feet total, max. 200 feet.
2. If more cable is required, additional costs will be required.

Location of Equipment

There are three major pieces of equipment involved in satellite instruction: the satellite dish (antenna), the receiver (about the size and shape of a VCR) which controls the satellite dish, and a TV which is connected to the receiver by coaxial cable.

Antenna

There are basically two options for locating the satellite dish: on the ground or on top of the school. Pros and cons exist for either type of mount.

	Pros	Cons
Ground Mounts	Cost of installation.	Needs to be secured from vandalism, e.g. chain link fence.
	Ease of access for repair.	Requires a concrete pad and piers to be poured.
Rooftop Mounts	Secure from vandals.	More costly.
	No need for security fence.	Will usually require a metal roof mount in order to avoid wind damage or leakage in room.
		Depending upon access to room, may be more difficult to install or repair.
		The building owner will need to require a structural evaluation of the roof, to be done prior to bid evaluation for installation

Side Mounts, e.g., dishes mounted on poles anchored to side of building and extending above roof line, are usually not recommended because of the likelihood of "play" in the antenna which will result in inferior reception, especially for Ku-band.

Receiver

The receiver, which acts as a tuner and power source for the antenna, also controls movement of the satellite dish.

1. It needs to be located indoors as close as is practical to the dish itself which is mounted outdoors.
2. It is physically connected to the dish by means of coaxial cable and control cable.
3. Entry through roof vents, windows, frames, or specially drilled holes in the wall should be taken into account when determining location of the receiver
4. Likewise, the receiver needs to be located in an area which is relatively secure from unauthorized access, e.g., principal's, counselor's, or librarian's office, unless a room can be dedicated to satellite instruction, in which case, it would make sense to have all interior equipment located in one place.

Need for remote control of satellite and channel selection: When it is necessary for the receiver to be located away from the viewing area or when multiple viewing areas will be needed within the school, the purchase of a receiver with remote control capabilities is desirable. This prevents the need for the operator to go physically to where the receiver is housed in order to turn it on, change satellites or change channels. With remote capabilities, a small remote sensor attached to the TV picks up infrared signals from a hand-held remote control device and performs all receiver functions from the viewing site.

How many receiving sites are necessary? If the satellite receiving system will only be used for ASTS/OSU or other advanced courseware, you may wish to have only one receiving site, e.g. only one room which is set up to receive the signal. If however, you wish to take full advantage of the instructional capabilities of a satellite system (e.g., PBS, The Learning Channel, etc.), you may want to include viewing sites in the high school and/or elementary library, the school multipurpose room, the computer lab, or perhaps in each classroom. Installation costs obviously vary according to the number of receiving sites and the number of feet of coaxial cable necessary to link each site with the receiver. There are limitations to the distances allowed without amplifying the signal, but because this will vary with your individual layout, this should be a question directed to your installer.

When multiple receiving sites are desired. Keep in mind that unless multiple receivers are installed, all sites must view the same channel on a selected satellite simultaneously. Multiple receiving sites can only simultaneously view channels on different different satellites if more than one dish (or dual feedhorns) and more than one receiver are installed.

Television Monitor

While the 36" big-screen TV is ideal for satellite instruction, almost any color set will do. If your building already has one or more televisions, you may decide there is no need to purchase another one.

1. Do keep in mind that the set will need to be dedicated at least three days per week during live broadcast time with additional time needed for students to review lectures or view missed lectures (which have been videotapes).
2. Where only one TV is available at the secondary level, significant restrictions may result in use of the television for other instructional purposes.

3. The TV will need to be located either in the same location as the receiver or in another location which has been wired for remote control.
4. Be sure to locate the TV away from windows in order to improve viewing.

Video Cassette Recorder

While not absolutely essential, it is certainly wise to purchase or use an existing VCR to record each downlinked session.

1. The VCR needs to be connected to the satellite receiver and TV used for satellite course viewing.

2. Keep in mind that unless a VCR can be dedicated to this purpose, use for other purposes, (e.g., taping cable instructional programming, viewing taped programming, taping or viewing school sporting events, etc.) will be very limited.

3. Videotapes of missed lectures may be purchased from OSU at $25 each. However, more expedient and less costly to arrange for local recording of tapes. It is also wise to develop a local or regional network for securing missed recordings due to equipment or other failure.

Insurance Considerations

Because the satellite antenna and receiving equipment are expensive pieces of equipment and potentially susceptible to lightning or other damage, do not overlook the need to have them included on your school's insurance policy. As they are installed, make note of their serial and model numbers. This will facilitate immediate coverage of the equipment.

Considerations in Purchasing Satellite Receiving Equipment

Because the area of satellite reception is so new, especially to the educational market, most people are not equipped with sufficient knowledge even to ask the right questions. This short course in terms and components will enable you to converse with satellite antenna dealers and to select a dealer and an antenna which will best suit your needs at the lowest costs.

<u>Commercial vs. High Grade Home Equipment</u> While commercial grade equipment, i.e., the same as used by cable television networks, may be desirable because of its likelihood of longer-term performance, high-grade home equipment will fit the needs of most single school districts very adequately.

<u>Select a reputable dealer who:</u>

1. carries a major brand of satellite receiving equipment
2. is knowledgeable about the equipment carried
3. is likely to continue in business for future service needs
4. has experience in school installations
5. will provide proof of equipment specifications
6. will make an on-site visit to the school to discuss installation and location of receiving site(s)

7. will install the equipment and provide staff training for equipment operation - handing you a manual to read is not sufficient!
8. will guarantee to service what the company sells
9. and most importantly, will not exceed a maximum of 48 hours (preferably 24 hours) response time should service be required.

Deciding Whether to Purchase a Dual C-Band/Ku-Band System With respect to satellite receiving equipment, one decision which will need to be made is whether you wish to purchase a system with dual capabilities at this time or whether you wish to modify or add additional equipment later in order to receive both bands. (See above section for a description of C-band and Ku-band broadcasting.)

In order to receive Ku-band signals in addition to C-band signals, three equipment specifications must be met: (1) the antenna must be capable of receiving both signals; (2) the receiver must be capable of tuning at both frequencies; and (3) there must be a prime focus feed with dual-band receiving capabilities. It is important to be able to converse somewhat knowledgeably with vendors on this issue. All C-band systems are not Ku-compatible nor are all Ku-compatible systems equally so. Require that vendors place in writing the add-on equipment and costs necessary to update the C-band equipment to dual C/Ku-band.

If the decision is reached to purchase a C-band receiving system only, please keep in mind that as air waves become more and more crowded, Ku-band transmissions will continue only to increase. At some point it may be necessary either to try to modify your current system or duplicate it with a Ku-band system.

The obvious other alternative is to purchase a system now which is capable of receiving both C-band and Ku-band signals.

Basic Technology

In order to be knowledgeable enough to converse when selecting a dealer and a brand or model of equipment, it is also important to keep the following in mind:

Earth Station. A so-called "Earth Station" consists of two basic components: the antenna (often called satellite dish or downlink), which is located outside the school, and the receiver/electronics, which is located inside the building. In order to receive satellite signals, these two pieces of equipment plus their sub-components are needed.

Antenna. There are several options with respect to size and type of antenna. Generally speaking, the larger the dish the better reception one can expect. The Midwest has the advantage of receiving stronger satellite signals than do either the East or West coasts and therefore does not require very large antennas.

Satellites. There are approximately two dozen communications satellites that carry domestic television programs. These satellites are strung along an arc above the Equator (the so-called Clarke Belt), high enough so that their orbital speed matches the rotational speed of the earth. Because of this "Geosynchronous" orbit, they appear to remain stationary in the sky and thus we can always receive their signals at the same location relative to earth.

Uplink/Downlink. Each C-band satellite has up to 24 transponders (or channels) that receive signals from an "uplink" on Earth (e.g., in our case, Oklahoma State University) and transmit them back again to an earth-based "downlink" (e.g., your school). Each satellite can therefore accommodate as many as 24 different transmissions or TV programs at the same time.

Satellite signals are in the microwave portion of the radio band, where the waves are "short" enough to be beamed at the satellite's antenna. Most video travels in what is known as "C-band," a portion of the microwave spectrum corresponding to 3700 to 4200 megahertz. This band was assigned to the cable-TV industry years ago.

Ku-band. The future of satellite broadcasting, however is said to be in "Ku-band," a band which is assigned for commercial satellite use at 12,000 to 18,000 megahertz. Ku-band signals can be made much stronger than C-band signals, so they can be picked up with a smaller size dish. A few Ku-band satellites are in orbit and several providers, such as Oklahoma State University, and other potential providers of educational programming are considering going to Ku-band transmission in the future. Therefore another consideration in selecting an antenna is the ability to receive Ku-band signals, in addition to C-band satellite signals. You may choose to purchase equipment which is currently capable of receiving both bands, or you may wish to purchase C-band equipment which can be adapted to include Ku-band reception at a later date.

Satellite Names. Each satellite has a name such as Westar 4 or Galaxy and a two-character designation like W4 or G3 (which is used to select a satellite for viewing).

Programming. Monthly program guides are available which list all the scheduled satellite broadcasts. The opportunity to receive other educational programming such as Discovery Channel, C-Span, or PBS' new Elementary/Secondary Services, in addition to receiving courseware from Oklahoma State University, should not be overlooked. Originators are increasingly "scrambling" their signal, however, thus requiring subscription to their service in order to allow viewing. For those interested specifically in educational programming, the Discovery Channel, PBS, etc, are currently accessible to anyone with C-band satellite signal receiving capabilities.

Satellite dishes not only have to be large enough to collect the weak satellite signal, but they also need a clear view of the satellite belt in the southern sky, unobstructed by buildings, trees, fences, or foliage.

Potential interference, especially from telephone company or other microwave transmitters, may cause a problem with reception. This is generally more of a problem in urban than in rural areas. You will want, however, to check with your local dealers concerning any known interference problems in the area. If you wish to be absolutely sure, a site survey can be conducted in which transportable antenna and electronics can be set up at the site to look at actual performance across several satellites. Interference will be evidenced by an inability to receive some channels, by interior picture quality, or by intermittent reception of some channels. Should interference be present, it can most often be minimized by attaching filters to the receivers or by taking advantage of natural shielding by buildings or local terrain. Note: Ku-band reception is not plagued by terrestrial microwave interference as are C-band frequencies.

Sidelobe performance. A recent ruling from the Federal Communications Commission also affects antenna selection. A program to reduce spacing between satellites in orbit from the present 4 degrees to 2 degrees will take place over the next few years. This means that earth station antennas must become more directional to prevent the reception of signals from two adjacent satellites simultaneously. Antennas which do not meet this requirement can receive unacceptable interference when adjacent satellites are actually moved closer together in space. Sidelobe performance of equipment purchased should allow for 2 degree satellite spacing.

Downconverter. A system using a "Low Noise Block Downconverter," sometimes referred to as an LNB, is preferred over a system using the older low-noise amplifier (LNA). While both components amplify the signal, the block downcoverter also converts the high microwave frequencies down to the "L" Band range - typically 950-1450 megahertz for transmission to the Satellite Receivers. Unlike a simple downcoverter, the LNB sends all 24 transponder signals at once, allowing viewing of more than one satellite channel at a time, for instance, by a second Receiver and TV. Additional advantages of a block downconverter include cost savings by allowing a less expensive interconnection cable to the receiver and the capability of using longer cable runs, e.g., extending the distance from the receiver to the TV.

Motorized Mount. While manual adjustment of the satellite dish is possible, it is highly desirable to have a motorized mount, allowing for movement of the dish from the receiver or remote control.

Section IV - Distance Learning Information

Examples of State-Supported Distance Learning Networks

One of the most pressing needs in California is for the development of some form of statewide distance learning structure for K-12 schools. Two states, Maine and Oregon, provide examples of how the various factions and constituencies can come together and produce a shared telecommunications network which benefits a variety of groups. Although both states are more similar to each other than to California, the example suggest ways in which mutual interests can be served by cooperative planning.

Oregon's Ed-Net

In 1986, a voluntary committee of education and industrial officials funded a study of the value of a statewide telecommunications network in Oregon. The results proved so positive that the Oregon Department of Education performed a more detailed study, leading to the creation of Ed-Net, a multi-media network designed to provide the citizens of Oregon with access to education.

Oregon appropriated $8 million of lottery funds to establish the network, which is a hybrid of satellite, ITFS, compressed video, cable, and telephone lines. Ed-Net will have a single uplink located in Portland. Programming will be available from 30 sites, which will send signals to the uplink via land lines. The network will include the installation of 800 downlinks throughout the state.

The network is governed by a nine-member board, made up of officials from the various educational organizations, Oregon Public Broadcasting, and interested citizens. Ed-Net has a small administrative staff and depends on the Oregon Public Broadcasting organization for technical and administrative support.

The network will be used by K-12 schools from 8 a.m. to 1 p.m. five days per week. High demand courses will be broadcast live to any school which requires them. After 1 p.m. the network will be used to provide adult and graduate education courses from higher educational facilities.

Ed-Net is designed to be self-supporting after four years. Funds will come from annual subscription fees, plus charges to organizations which originate programming. The network is aware that video transmission is expensive, and will therefore subsidize courses.

The Community College of Maine

Like Oregon, Maine is a large state with a small and dispersed population. The state in general, and K-12 education in particular suffers of lack of access to educational resources. In November, 1985, after two years of planning, the University of Maine Trustees approved the plan for the establishment of a Community College of Maine/Telecommunications System.

The Community College of Maine is designed as a vehicle to provide citizens with education delivered using telecommunications technology. Although the state looked briefly at satellite technology, it ultimately selected a combination of fiber optics and ITFS, linking all the University of Maine campuses, the vocational colleges, and ultimately every high school in the state. The program is funded through the Maine legislature, and the lead campus is the University of Maine at Augusta. All technology is handled by the Maine Public Broadcasting Network.

As of September, 1989, 23 high schools were on-line with the network. Forty courses are being offered. Many are high school credit courses sponsored and developed by the Maine Department of Education and Cultural Services. High school students also have access to university credit courses at regular tuition rates. After school hours, credit university courses are broadcast to teachers. In addition to the school programming, the higher educational institutions share programming among the campuses.

Schools which participate in the program are supplied with necessary receiving hardware and pay nothing for the televised service. Maine plans to ultimately have each high school in the state equipped with two viewing areas.

Contact is:

Office of Distance Education
University of Maine, Augusta
University Heights
Augusta, Maine 04330
(207) 622-7131

Useful Publication on Distance Learning

Bradshaw, D. and Brown, P. "The Promise of Distance Learning," Policy Briefs, Far West Laboratory, San Francisco, 1989. No Charge.

Gilcher, Kay and Johnstone, S. "A Critical Review of the Use of Audiographic Conferencing Systems by Selected Educational Institutions," Office of Instructional Telecommunications, University of Maryland, College Park, 1989. No Charge.

HSP Humanite' Services Planning, LTD., *Distance Education: A Program and Facility Study*, Distance Learning in Small Schools Project, Alberta Education, Alberta, Canada, 1988. No charge.

Kitchen, Will and Karen, *Two-Way Interactive Television for Distance Learning,* Technology Leadership Network Special Report, National School Boards Association, Washington, D.C., May, 1988.

LaValle, K., *Distance Learning: The Sky's the Limit*, New York Legislative Commission on Science and Technology, Albany, 1988. No Charge

Ostendorf, Virginia A., *What Every Principal, Teacher and School Board Member Should Know about Distance Education*, Virginia A. Ostendorf, Inc., Littleton, CO.,1989. Price: $30.

Roberts, Linda, *Linking for Learning: A New Course for Education*, Office of Technology Assessment, Washington, D.C., 1989. Price $9.

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Glossary of Distance Learning Terms[4]

The following glossary contains a listing of terms which relate to the broad field of distance learning. Many of these terms relate to non-video technologies, and are therefore not used in this report. However, the definitions will be of value to anyone who is interested in the full spectrum of technologies used in distance education.

ACTS Advanced Communications Technology Satellite. A National Aeronautics and Space Administration Ka-band satellite that is scheduled for deployment in the early 1990s.

addressable converter A device connected to a television set that allows cable television operators to turn on or block individual subscriber access to pay-per-view service.

amplifiers Electronic devices, spaced at intervals (cascaded) throughout a cable television system, used to boost the strength of the cable signal as it passes from the headend to the subscriber. In coaxial cable systems, amplifiers are needed approximately every 1,500 feet.

analog communication A communication format in which information is transmitted by modulating a continuous signal, such as a radio wave. See also digital communication.

asynchronous communication Two-way communication in which there is a time delay between when a message is sent and when it is received. Examples include electronic mail and voice mail systems.

audio bridges Electronic devices that connect and control multiple telephone lines for audio and data applications, allowing many callers to be connected as a group simultaneously. Used for audio conferencing.

audio conferencing An electronic meeting in which participants in different locations use telephones to communicate simultaneously with each other.

audiographics An advanced computer application in which computer interaction is augmented by two-way, real-time audio communication. Audio, data, and graphics are shared over regular telephone lines, allowing users in different locations to work on the same application simultaneously.

bandwidth The width of frequencies required to transmit a communications signal without undue distortion. The more information a signal contains, the more bandwidth it will need to be transmitted. Television signals, for example, require a bandwidth of 3 million hertz (cycles per second), while telephone conversation needs only 3,000 hertz.

bit Binary digit. The smallest unit of information a computer can use. A bit is represented as a "O" or a "1" (also "on" or off"). A group of bits is called a byte. Bits are often used to measure the speed of digital transmission systems.

Bell Operating Companies (BOCs) As a result of the divestiture of AT&T in 1984, the original Bell telephone system was divided into 22 local Bell Operating Companies that now provide local telephone service across most of the country. These companies are controlled by the seven "Baby Bells," the Regional Bell Operating Companies (RBOCs).

[4] Abstracted with permission from *Linking for Learning: A New Course for Education*, Office of Technology Assessment, Washington D.C., 1989.

Bulletin Board Service (BBS) A computer service that allows remote users to access a central "host" computer to read and post electronic messages. Communication is usually asynchronous.

C-band The designation for satellite communications operating at 6 GHz (billion cycles per second) uplink and 4 GHz downlink. These frequencies are also used for terrestrial microwave transmission.

coaxial cable Shielded wire cable that connects communications components together. It is commonly used in cable television systems because of its ability to carry multiple video (or other broadband) signals.

codecs The abbreviated form of "coder-decoder." Electronic devices that convert and compress analog video signals into digital form for transmission, and convert them back again on reaching their destination.

compact disc-read only memory (CD-ROM) An optical storage system for computers that only allows data to be read off the disc. New data cannot be stored and the disc cannot be erased for reuse.

compressed video A video signal requiring less information to transmit than broadcast quality of full- motion video. Digital technology is used to encode and compress the signal. Picture quality is generally not as good as full-motion; quick movements often appear blurred. Compressed video requires transmission speeds between 56 kbps and 2.0 Mbps.

computer conferencing Allows individuals at different locations to communicate directly with each other through computers. Communication may be in real-time or delayed.

digital communications A communications format used with both electronic and light-based systems that transmits audio, video, and data as bits ("1s" and "Os") of information (See Bit). Codecs are used to convert traditional analog signals to digital format and back again. Digital technology also allows communications signals to be compressed for more efficient transmission.

digital video interactive (DV-I) A system that combines audio, data, and limited-motion video on an optical disc. DV-I will run on a personal computer, allowing the user to control interactive program.

directed broadcast satellite (DBS) Satellites that operate in the 12.2 to 12.7 GHz frequency band. These satellites are designed to broadcast programming directly to small (1 meter) home receiving dishes. No such services are currently operating in the United States.

downlink An antenna shaped like a dish that receives signals from satellite. Often referred to as a dish, terminal, Earth station, TVRO (television receive only).

downstream The direction a signal travels as it moves from the transmitting (origination) site to the receiving sites.

electronic blackboard A computer application that allows graphics to be shared among many computers simultaneously. Each user can see and annotate the graphics as needed. The results will be visible to all users.

facsimile machine (FAX)	A telecopying device that electronically transmits written or graphic material over telephone lines to produce a "hard copy" at a remote location.
FCC	Federal Communications Commission.
fiber optics	Hair thin, flexible glass rods that use light signals to transmit audio, video, and data signals. Signals can be sent in either analog or digital format. Fiber optic cable has much higher capacity than traditional copper or coaxial cable, and is not as subject to interference and noise.
footprint	The area on the Earth's surface to which a satellite can transmit. Different satellites cover different areas and have different footprints. Satellite footprints generally cover all the continental United States (full conus) or only half of it (half conus coverage).
freeze frame	One method of transmitting still images over standard telephone lines. A single image is transmitted every 8 to 30 seconds. Also referred to as slow scan.
frequency	The number of times per second an electromagnetic wave completes a complete cycle. A single hertz (Hz) is equivalent to one cycle per second.
full-motion video	A standard video signal that can be transmitted by a variety of means including television broadcast, microwave, fiber optics, and satellite. Full-motion video traditionally requires 6 MHz in analog format and 45 Mbps when encoded digitally.
Gbps	Giga (billion) bits per second. See bit.
GHz	One billion hertz (cycles per second). See frequency.
graphics tablet	A computer device resembling a normal pad of paper that users draw or write on. The graphics tablet converts hand-drawn images into digital information that can be used and displayed by a computer.
headend	In a cable television system, the headend is the central transmission office from which programming is distributed to subscribers.
high definition television (HDTV)	An advanced television system that produces video images as clear as high-quality photography. HDTV is still experimental in the United States.
Instructional Television Fixed Service (ITFS)	A band of microwave frequencies set aside by FCC exclusively for the transmission of educational programming. Allows broadcast of audio, video, and data to receive sites located within 20 miles. Receive sites require a converter that changes signals to those used by a standard television set.
Integrated Services Digital Network (ISDN)	An end-to-end digital network that will allow users to send voice, data, and video signals over the same line simultaneously. Narrowband services now in operation give users up to 24 channels to send voice and data information, with a combined capacity of up to 1.544 Mbps. In the future, broadband services available over a public ISDN are expected to offer full-motion video services as well.
Ka-band	Satellite communications frequencies operating at 30 GHz uplink and 20 GHz downlink.
Kbps	Kilo (thousand) bits per second. See bit.

KHz	Kilohertz; thousand cycles per second. See frequency.
Ku-band	Satellite communications frequencies operating at 14 GHz uplink and 12 GHz downlink.
light emitting diodes (LEDs)	Used as transmitters in some fiber optic systems. They transmit digital bits as pulses of light along a fiber optic strand.
Mbps	Mega (million) bits per second. See bit.
MHz	Megahertz; million cycles per second. See frequency.
microwave	High-frequency radio waves used for point-to-point and omnidirectional communication of audio, data, and video signals. Microwave frequencies require direct line-of-sight to operate; obstruction such as trees or buildings distort the signal.
modem (modulator/ demodulator)	A device that converts digital computer signals into analog format for transmission.
Modification of Final Judgement (MFJ)	The 1984 agreement that brought about the divestiture of AT&T, and limited the Bell Operating Companies' involvement in manufacturing and designing equipment, as well as their ability to provide long distance and information services.
modulation	The process of encoding audio or video signals onto a radio wave (carrier frequency) for transmission.
multiplexer	A device that combines multiple signals for simultaneous transmission over a single channel.
multipoint distribution services (MDS)	Also MMDS; Multichannel Multipoint Distribution Service. Also known as "wireless"cable. A telecommunications service that uses microwave signals to transmit video entertainment and data.
Public Switched Telephone Network (PSTN)	The public telephone network.
real-time communication	Two-way simultaneous communication, as opposed to asynchronous.
repeater	A device used to extend the range of a communication signal.
reverse flow amplifier	In two-way cable television systems, these devices move video and audio signals from the receive sites back to the cable headend.
Signaling System 7 (SS7)	A recent development in control systems for the public telephone company computers to communicate with each other, making telephone call processing faster and more efficient and enabling more services to be made available to consumers.
slow scan	See freeze frame.

steerable dish A satellite receive dish that uses motors to rotate the dish to receive signals from many satellites. "Fixed" dishes are stationary, always pointed at the same satellite, unless reaimed by hand.

switched network A type of system where each user has a unique address (such as a phone number), which allows the network to connect any two points directly.

T-1 rate A digital transmission speed of 1.544 Mbps.

teleconferencing A general term for any conferencing system using telecommunications links to connect remote sites. There are many types of teleconferencing including: video conferencing, computer conferencing, and audio conferencing.

television receive only (TVRO) Satellite dishes only capable of reception.

touch screen A computer screen that allows data to be entered by using a specialized pen to write on the screen, or by making direct physical contact with the computer screen.

transponder The electronic equipment on a satellite that receives signals from an uplink, converts the signals to a new frequency, amplifies the signal, and sends it back to Earth. Satellites are usually equipped with 12 to 24 transponders.

uplink A satellite dish that transmits signals up to a satellite.

upstream The direction a signal travels as it moves from a receive site back to the site of original transmission. Used especially in two-way cable television systems.

vertical blanking interval (VBI) The unused lines in a standard television signal. The VBI appears as a black band at the top or bottom of a television picture. Often used for closed captioning.

very small aperture terminals (VSATs) Satellite receive dishes, approximately 1.8 to 2.4 meters in diameter, that are capable of sending and receiving voice, data, and/or video signals.

videophone A telephone combined with a video screen, allowing callers to see each other as they speak.