The value of the computer as an individual learning tool has long been recognized. Its value as a classroom presentation medium is just now **beginning** to be recognized. There are **fundamental** changes occurring today in the communications industry that are nothing short of revolutionary in how they will affect the value of the computer as a distance learning tool and as a general channel of educational and other services. One fundamental change is the transition to **digital** communications media, the reasons for which are varied and and are beyond the scope of this paper.

This fundamental revolution is going on, virtually unnoticed by the educational community and the public in general. **One of the primary needs addressed by this project is to perform an actual demonstration showing some of the educational capabilities of a digital medium** so that **the educational community can become aware of the vast potential that a digital broadcast medium has to offer.**

Much of the technology that is available in the classroom today is simply not used due to lack of teacher training or lack of relevant software and courseware. **Classroom computers should have some modes of operation that are at least as easy to use as a television set or a VCR!**

How the Needs were Identified

As early as the spring of 1987, discussions were undertaken with a number of national educational organizations interested in improving access to educational resources, the central objective of this project. Reports such as The Governors' 1991 Report on Education, A Time for Results - Task Force on Technology, and the National School Boards' Association, A National Imperative: Education for the 21st Century, make clear the concerns of many educators regarding the need to introduce new methodologies and technologies into education. Conversations with numerous state and federal officials reiterated support of technological applications in the classroom to broaden access to educational resources. Yet, nearly everyone also repeatedly stressed the **high costs associated with the conventional hardware** and available programs, and the **absence of a centralized, unifying network** to schedule programming and coordinate user interests.

Explicitly evident from all of the discussions, correspondence, and "brainstorming" sessions was the consensus that technology as a tool can and should be used to transform the classroom environment and the learning experience in revolutionary ways **if the costs can be reduced**. The realization of this widely-held consensus and the challenges posed by the apparent universal desire to create a user network led directly to the conceptual formulation of the described project.

There is great interest in satellite distance learning for students in remote locations and for teacher training in large metropolitan areas (e.g., Los Angeles County). However, satellite

transponder time is expensive. Where teachers with special backgrounds are simply non-existent, many underdeveloped countries are using expensive Government-supplied satellite equipment for educational training. Numerous attempts have been made to use expensive video compression equipment for distance learning over wire-line circuits as well as satellites. However, bandwidth and/or signal power usually requires such a low bit rate (high compression ratio) that the video quality is unacceptable for this purpose.

How the Need is to be Met

Improving access of the target rural schools to enriched educational resources can be accomplished by a new comprehensive, national network of users linked via satellites. However, this is not currently possible through conventional satellite systems. The high costs of the necessary hardware and software is beyond the reach of most school districts. By applying today's Digital DBS technology, all rural schools and especially financially disadvantaged schools could tap resources currently unavailable. Three elements are required to make the network possible:

(1) An efficient, cost-effective **technology** for disseminating the instructional and informational materials;
(2) An **organization** to manage the exchange of ideas and resources;
(3) The **financial capacity** to enable many users to participate relatively quickly after formation of the network.

The basic technology is now available as a result of development of digital-based satellite communications. This versatile technology is capable of disseminating a full range of instructional and informational programming at significantly reduced costs. Eventually, all schools would find access to the system to be easily within financial reach. This is especially true in light of the commitment of ACC to contribute DBS transponders (channels) to the Foundation for Educational Advancement Today (FEAT) which will also place receiving equipment in every school.

Once such a system is created and implemented through a network of users, there would be no reason for any school to be deprived of access to an extraordinary inventory of educational programming far in excess of that now available only to the wealthier urban districts. This great advance in educational access would be possible not only by introducing new hardware, but also through the pooling of resources in a user network.

Public Benefit from Meeting the Need

The public benefits to be derived from meeting the need for improved access to instructional and informational materials are legion. One might draw comparison between today's limitations in

access to educational resources and that potentially afforded by an effectively administered digital-based satellite communications network with the increased access to information created by the Gutenburg press revolution of the fifteenth century. With Gutenburg's movable type, printing costs fell and the dissemination of ideas exploded. Learning was available to a vastly expanded audience. Similarly today, although technology cannot replace the human resource of the teacher in the classroom, it can greatly extend and expand the teacher's inventory of educational materials and effectiveness with students. Demonstrating the feasibility of digital-based computer communications for education augmentation and the lower costs associated with such a system will be the most persuasive argument for implementing the described system.

Project Plan

In order to implement the described system, a plan is proposed by ACE which will allow:

- Simultaneous demonstration of a Computer Course and a TV Course (the latter using presently available, but expensive, codecs) through an existing satellite at the end of 12 months;
- Demonstration of the new TV Course system at 18 Months;
- Limited production of Computer Course receivers, with trial service at 24 months;
- Start of TV Course receiver production at 24 months.

The project is structured so that the initial twelve months' effort will result in classroom demonstrations of operational equipment for Computer Courses. Specifications for TV Course production receivers will also be a produced. The relatively short schedule is possible because of previous experience, already completed design work , and the deliberately robust system design, which allows many program elements to proceed in parallel before final integration.

The top level schedule for the project is shown in Figure 2.2 and the corresponding task time-line chart is shown in Figure 2.3. Each box shows the earliest start date and the calendar days duration of the task. Five subprojects are defined, indicated by the closed-corner boxes. The subprojects are summarized here:

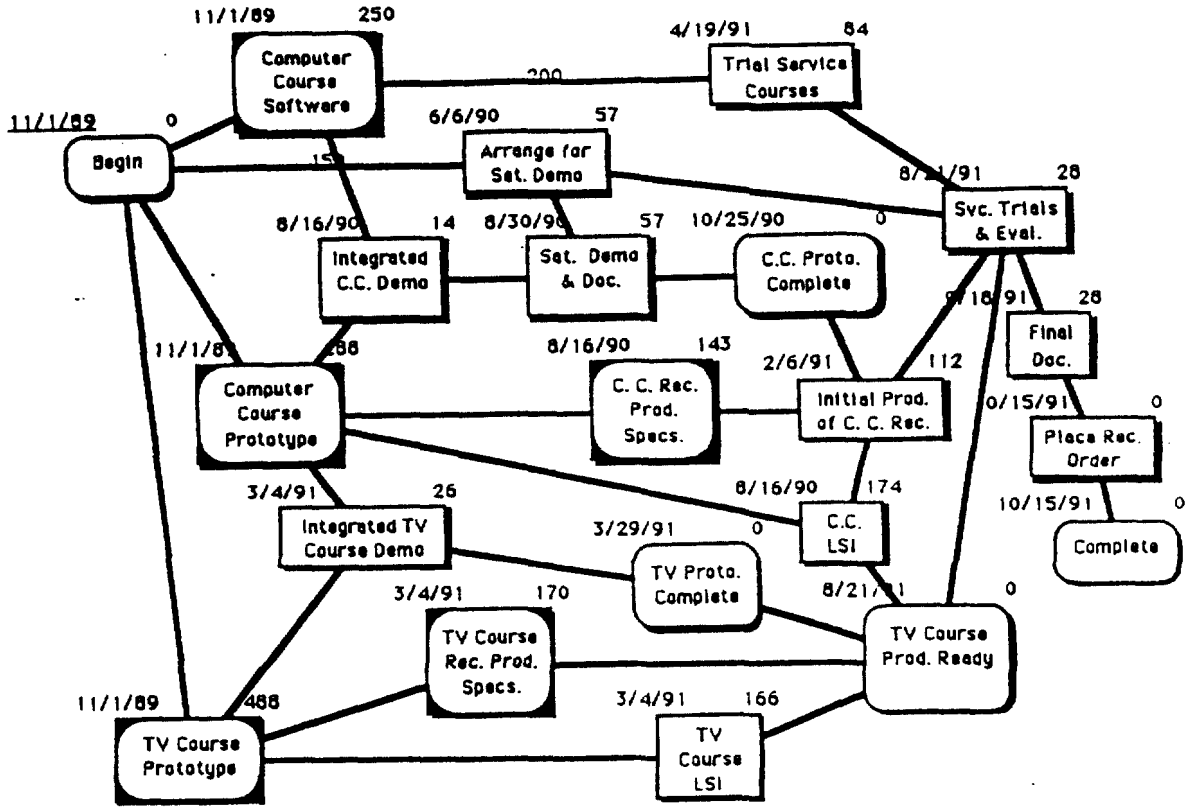

Figure 2.2 Top Level Project Function Chart

The Computer Courses

The Computer Course Prototype subproject will provide transmission and reception to be used in the Computer Course demonstration. This subproject includes the demodulator, decoder, service selection, and basic timing modules that are also necessary for the TV Course Prototype. Simulation verification of the demodulator algorithm and generation of a demodulator LSI (Large Scale Integrated) circuit specification, which will be sent to manufacturers for chip quotations, are also included. Production design and final specifications will be done in an additional subproject

The Computer Course Software subproject consists mainly of generating the necessary control software to allow commercially available software to operate in a sequential or selective manner under the control of the Computer Course instructor. It also provides for the proper timing and sequencing of file transfers from the source computer to the destination computer and management and disposal of files in the destination computer. It is, in effect, the computer transmission operating system. The software subproject is completed by a computer-to-computer demonstration which uses the computer serial ports for direct communication and allows evaluation of the Computer Course concept.

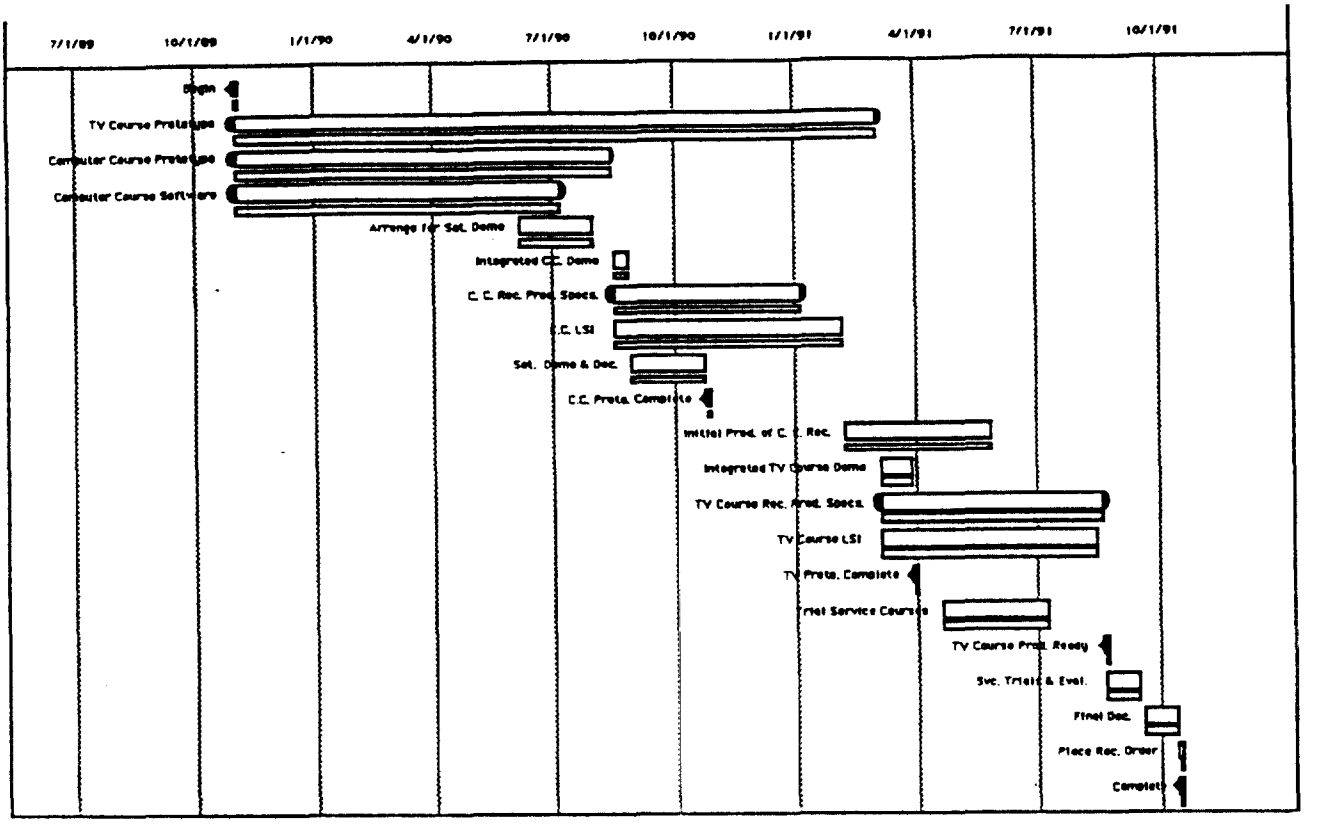

Figure 2.3 Top Level Time-Line Chart

The TV Courses

After integration of hardware and software, a demonstration through an actual satellite link is planned. Both the University of Hawaii and GE Americom have volunteered to provide satellite time for system tests and for the demonstration. An additional subtask is provided for generating final production specifications and LSI implementation. Schedule time is allocated for a limited production run of Computer Course receivers.

The TV Course Prototype subproject will provide transmission and reception for demonstration of a TV Course. Specifications will also be generated for a set of chips to be used in production of TV Course receivers to derive mass production cost estimates. An additional subproject will generate final specifications for receiver production. Production of quantities of TV Course receivers is scheduled to begin near the end of the proposed program.

Program Priorities

The major goal is to demonstrate an application of communications technology which can dramatically reduce costs and make available educational resources to rural students. The hardware

is very flexible. It can be used with existing microcomputer hardware likely to be found in schools along with the broad range of existing software packages available in the marketplace.

The described project offers a major new opportunity to develop a network of users who will enjoy expanded access to instruction and materials in all subjects, but especially in **mathematics and science** as a result of introducing advanced digital satellite technology to schools on a national basis. This type of technological application, involving computers and television, is readily adaptable to the programming appropriate to instruction.

Although the project's immediate purpose will demonstrate distance-learning in selected rural schools, the described system is applicable to **all educational users.** Beginning with public and private primary and secondary schools, applications exist today in educational agencies, industry, government, teacher training institutes, life-long education programs, libraries, conference and learning centers, vocational-technical schools, hospitals, and institutions of higher education. Even individuals and families will ultimately participate through learning libraries and the direct reception of educational courses and materials.

The major element of the user population who will benefit most from implementation of this project are **those traditionally excluded from careers in science and mathematics** because of inaccessibility of resources and disadvantaged backgrounds. Educational resources made available for the training of these groups will be expanded through a reduction in costs afforded by new technology and the eventual creation of a user network which will enrich programming, coordinate scheduling, and attract additional financial resources for growth.

Conclusion

"...and the last shall be first"[1]

New technologies and unique ideas - no matter how innovative and efficient they may prove to be, need demonstration and take time to be accepted. If educational resources are to be available with the greatest benefits to rural America, we must accelerate introduction and application of today's technology, starting now.

Digital-based communications can and will deliver educational programming to the rural areas more efficiently than current known alternatives. New communications hardware using this technology will transmit many times the programming now available through analog delivery equipment. So great is the level of advance that only two Digital DBS television channels could carry the rural educational broadcast burden for a national system. One channel today, using hardware currently in place, would carry only one television programs or courses - far fewer than the tremendous array which would be potentially available on only one channel using digital transmission and computer technology.

An actual implementation program, such as that proposed here, is crucial for the evaluation and promotion of innovative uses of Digital DBS transmission technology in the rural classroom. The proposed program could prove to be one of the best investments ever made in the future of education in rural America.

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1 Book of Matthew, Chapter 19, Verse 30.

Appendix A Technical Aspects of the Project

The immense versatility of ACC's Digital DBS transmission format almost guarantees that any current definition of the YES Networks' services will continue to change in the future as new and innovative applications are found for this incredible medium. Three main categories of services are presently envisaged as illustrated in Figure A1.

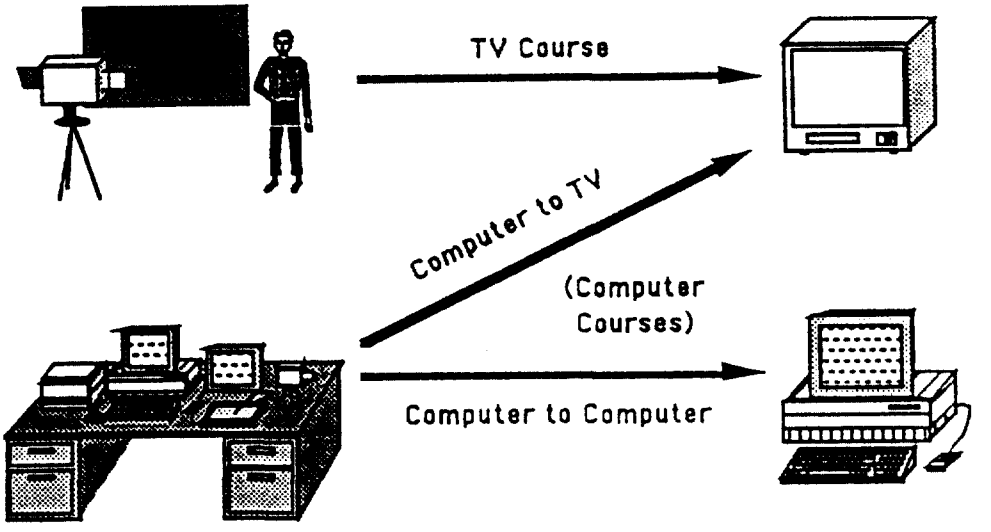


Figure A1 Service Categories

The first category is operationally the most conventional and consists mainly of televised lectures that would be used in the same manner as that commonly used in televised distance learning today. The only difference is that compressed digital transmission would result in substantial transmission efficiencies and lower cost. Reception would be by means of the same receivers used for ACC's standard (digital) entertainment television.

The second and third categories are new concepts in broadcasting which use personal computers to generate and/or coordinate the presented lecture materials. In the second category, video data compression is performed on the computer images in a manner similar to that used for the television lectures of the first category. This combination results in more cost-effective transmission yet allows the same television receiver to be used.

The third category is even more transmission-cost-effective and uses a personal computer for reception. In this case, data files and instructions are transmitted to the receiving computer which then **locally** generates the lecture images (still or animated) in the proper sequence and under control of the transmitting computer. This type of receiver would also have the capability of receiving the

images of the less efficient second category, if desired. This category has the additional advantage of providing a multitude of other unique and innovative educational services.

A.1 TV Course

The first category of services uses digitally-compressed television transmission. The signal source is from standard television cameras located in a classroom or studio or from pre-recorded video.

All television broadcasting systems today (including satellites) use analog transmission. In the western world the predominant system is known as NTSC[1], a standard that was established about 45 years ago. The analog system has served us well for all types of programming from stationary test patterns (for adjusting the analog television sets) to the violently-changing images of a special-effects ladened movie. It has long been recognized that, for business conferences and classroom lectures, changes in the picture (e.g., motion, scene changes) are far less frequent and less comprehensive than for entertainment television. Analog television is extremely inefficient in transmitting these types of images.

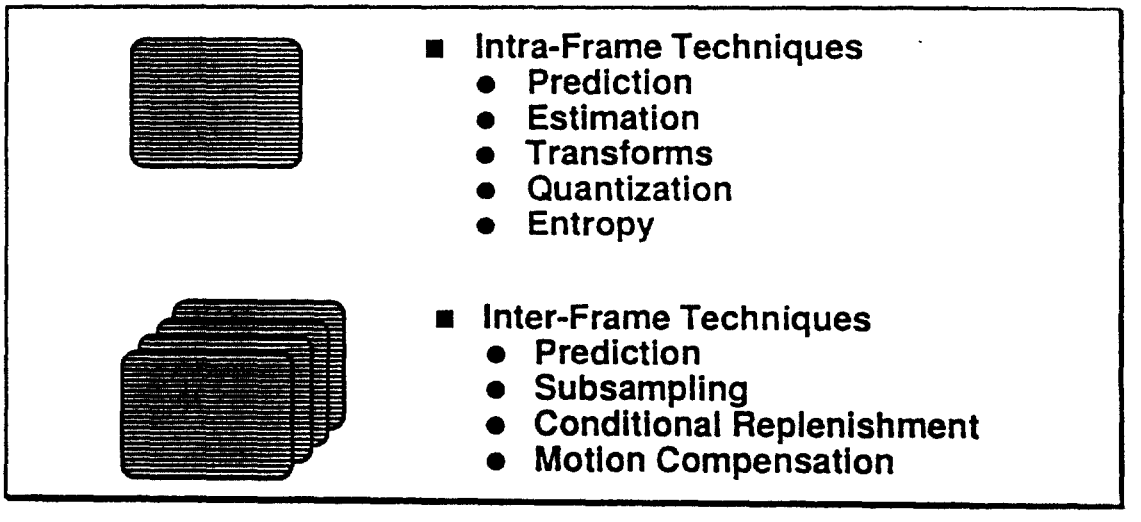


Figure A2 Image Compression Techniques

Much work has been done by many people over the last 20 years toward improving moving-image transmission efficiency to reduce costs and improve distribution. Some general categories of video data-compression techniques are illustrated in Figure A2. Intra-Frame techniques process localized data within the same frame and do not require large amounts of storage. Inter-Frame

[1] National Television Standards Committee

techniques are more efficient but require storage of at least one complete image, an expensive proposition in past years, but today only requiring one or two integrated-circuit memory chips.

From the beginning of video data-compression research, digital processing technology has been the prime choice due to its superior storage and processing qualities. Commercial systems have been available for over 10 years for high quality transmission of video conferences at bit rates of 1.5 to 3 Mb/s (mostly transmitted over expensive, leased telephone digital carrier lines). In more recent years, systems have been developed that operate at rates as low as 56 kb/s, although their video quality leaves much to be desired and their cost is prohibitive for school and home use.

Video quality adequate for conferencing and classroom lectures can be attained today at a bit rate of 384 kb/s or less. However, the required equipment is still expensive. The YES Networks TV Course system takes a conservative approach and allocates an average bit rate of approximately 1 Mb/s. Actually, this will be as good or better than a 3 Mb/s system because the YES Networks' dynamic multiplexing system assigns additional capacity (from a reserve "pool") when needed.

Although the details of the ACC television receiver decoder are proprietary, a generic top-level block diagram for TV Course service is shown in Figure A3. The ACC digital DBS broadcasting system will provide a usable rate of approximately 26 Mb/s in each transponder. Therefore, allowing for the reserve pool, about 20 TV Course channels can be simultaneously accommodated.

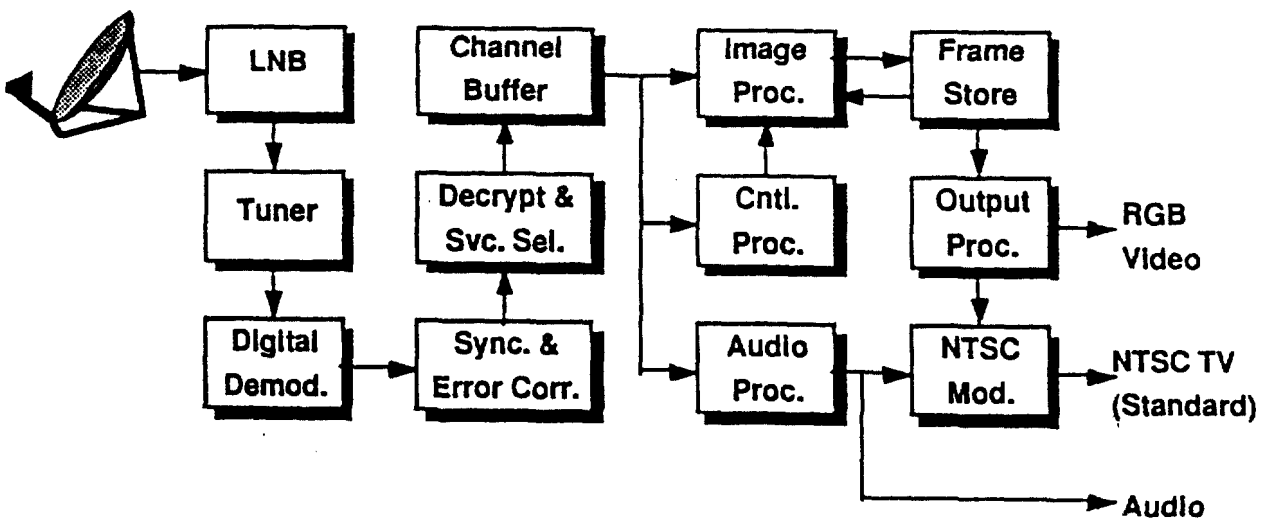


Figure A3 Diagram of Television Decoder

The system is even more flexible. The proprietary multiplexing technique allows a continuous spectrum of bit rates to be accommodated. Depending somewhat on the type of programming, the service originator can simply lease the bit rate that suits his needs and budget. All required operating parameters for this choice are automatically down-loaded through the satellite to the user receivers.

The compression-decompression algorithms are designed to automatically and efficiently handle a wide range of data rates and signal types from simple still-frames to full-motion television, and extension to compatible High Definition Television (HDTV).

Because this is a broadcast system (i.e., one source, many destinations), the television compression system is optimized to provide most of the necessary complexity and expense in the few encoders (source) and minimize complexity and cost of the many decoders (service recipients). One decoder is needed for each received course. However, the reconstructed standard NTSC television signal can be distributed to any number of television monitors within a school.

A.2 Computer Courses

The second and third categories functionally are very similar when used for class lectures. However, they are technically very different and each has its own strong advantages. The second category signal is receivable by the same (digital) television receiver as the first category. The third category can use the same receiver but adds the capability of a personal computer. The latter is much more transmission cost effective and allows inclusion of a vast number of additional services which cannot be provided otherwise. Some of these additional services may be necessary for some types of courses to be feasible for distance learning.

The means of presenting visual materials in classrooms and business is rapidly undergoing a revolution of its own. It began with developing vu-graphs for overhead projectors by drawing and typing them on a personal computer. Then they are printed on paper for transfer to acetate, or in some cases, printed directly to a transparency.

Only recently has it been realized that the "printed medium" stage is not necessary. Images can be output directly from the personal computer to a television monitor for small groups, or to a television projector for larger audiences. The latest trend is to use a liquid crystal plate placed directly on an overhead projector. This results in a crisp, bright image with similar quality to that of a printed transparency and can easily be viewed from anywhere in a lecture hall. Numerous software packages now are readily available (e.g., Microsoft "PowerPoint", Cricket "Presents") for generating vu-graph (or slide) images and then automatically sequencing them on the computer screen for the actual presentation.

Sophisticated animation programs (e.g., MacroMind's "Director," Apple's "Hypercard", Silicon Beach's "Supercard", Telerobotic's "Course Builder") also are available, are easy to use, and are relatively inexpensive. They include a multitude of special effects which keep the presentation visually stimulating and highly effective.

Another recent trend is the use of personal computers for the capture, storage and manipulation of a vast amount of external imagery. This has been made possible by the increasing availability of inexpensive RAM memory chips, large capacity permanent and removable discs, graphics processor chips, image scanners, laser video disks, television frame grabbers, various types of computer plug-in video boards, and generally more powerful personal computers.

Recordable CDs (Compact Discs) and DAT (Digital Audio Tape) are now available for personal computers, providing a quantum leap in available personal computer storage capacity. Being a brand new technology, the computer drives are still a few thousand dollars each but are expected to drop to the few hundred dollar range within a year or two. The actual recording media (CD or DAT) are inherently inexpensive.

Sketch pads are also being used by instructors as an electronic blackboard and for pointing to or annotating items on the screen showing vu-graphs. It should be noted that, in a broadcast system, most of the mentioned items are only necessary at the program source. The service recipient requires only a relatively inexpensive personal computer, some of which are now in the $500-$1000 range with prices continually declining.

High-quality voice transmission can be provided by using 64 kb/s digital encoding, the same bit rate used for the past 30 years by telephone digital carrier systems. However, the audio quality of the course system will be vastly superior to a telephone channel and will sound completely natural due to using ADPCM encoding which allows about twice the frequency range.

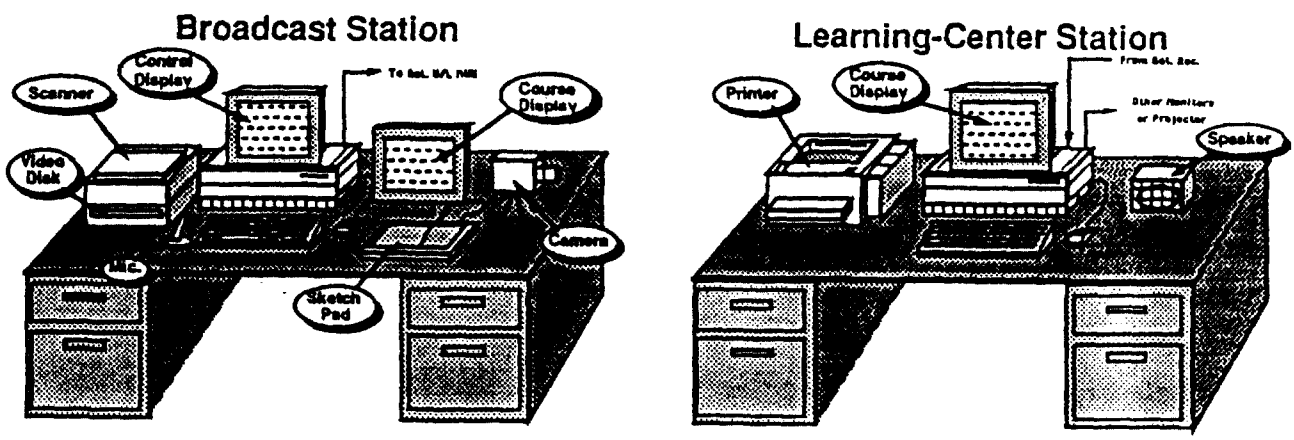


Figure A4 Computer Course System

Illustrations of a Category 2 or 3 transmitter and a Category 3 receiver are shown in Figure A4. Once prepared on the computer, the course could be presented entirely in real-time or by playback of a recording on CD, DAT, or F1-format VCR tape.

The simple addition of an inexpensive printer (possibly already available in the school) at the receiver will allow simultaneous transmission of printed materials for use by the class or the classroom teacher or assistant. Only a single personal computer is necessary. The video output signal can be distributed throughout the classroom or school to television monitors or use other display methods described previously.

Because the Category 3 receiving terminal inherently uses a personal computer, it is easy to see that a vast number of additional teacher and learning aids can also be transmitted. For example, examinations can be downloaded to the computer and still allow the local teacher to select questions or customize the exam. Grading can also be highly automated and impartial. Programmed learning can be provided for off-line remedial or advanced study. By using the new universal 3.5 in. floppy disk drives, the receiving computer could be a Macintosh (one of the Mac II series) and information could still be downloaded for use with the ubiquitous Apple II or IBM-type computers.

If the nominal basic bit rate for the computer course service is assigned to be 128 kb/s, with the capability of additional dynamically-assigned burst transmission when needed, as many as 200 computer courses could be simultaneously transmitted in one satellite channel if no other (e.g., television) services are transmitted. However, the most likely scenario is a mix of various services, some requiring less transmission capacity, some requiring considerably more.

There is a great need for digital transmission capability, even in mainly analog systems. For example, the Los Angeles County school system has initiated satellite services for teacher training within the LA system. Officials there have indicated that they have considered using a B-MAC analog encoding system simply because of the inclusion of a relatively low-rate data capability.

The MAC (Multiplexed Analog Component) transmission systems (e.g., C-MAC, B-MAC, D2-MAC, not to be confused with the Macintosh computer) were originally developed in England for commercial DBS transmission. They all use analog time-compressed component-video transmission which results in slightly improved video quality but increases the transmission bandwidth. Therefore, they still require an entire satellite transponder (channel) for each televised course. The only advantage of the MAC systems (over today's NTSC) in this application is the possibility of including some digital transmission capability which can transmit printed information.

A.3 Training and Installation

When new technology is introduced into a non-technical environment, the questions of training and ease-of-use must be addressed. If a tool is not easy to use and provides only marginal benefit, it will simply be discarded and ignored. In the earlier decades of computer technology, a vast amount

of training was necessary because humans had to change their mode of operation to conform to the rigidities of the computer. In the last few years that has radically changed. The introduction of personal computers into the mass non-technical market required that the human interface be given higher priority. Indeed, today's market will rapidly reject any software or system which is not sufficiently "user-friendly."

The TV Courses will not require any special training of either the course originator or the classroom users because it operates in the same manner as any other television system. However, the originating instructor should be aware that movies and visual scenes containing extended periods of rapid image changes may require prior arrangement with the YES Networks in order to insure high image quality for such transmissions. (This is a course lecture system. It does not supplant PBS.)

For basic computer courses reception, the user will not require any special training. Computer literacy is not required. Many of the supplementary services will also require no special training because the computer will prompt the user to perform certain actions such as inserting or removing a floppy disc or making sure that the printer is turned on and has paper.

Some of the more advanced features (e.g., customizing downloaded exams) will require more interaction between the local teacher (or assistant) and the computer. However, the user-friendly graphics interface of today's Macintosh and Amiga computers (and later, IBM with Microsoft's OS-2 Presentation Manager) allows people with no previous computer experience to accomplish what is needed with little or no special training.

The remaining training consideration is that of the computer course originating instructor. Part of the proposed software task is to generate a user-friendly interface for the originating instructor. Once the instructor has generated (or scanned) a set of presentation charts, the presentation will be no more complicated than using an overhead projector and a blackboard in a classroom. Impromptu changes or additions (e.g., response to called-in questions) can be accommodated by real-time use of the scanner, sketch pad, and/or TV frame grabber (a device which freezes a television image by digitizing it and storing it in computer memory). Training time for using this system is expected to be about one hour and requires no prior computer experience.

Most presentation materials are expected to be generated directly on the computer rather than being "scanned" from paper input. (The latter would still be used for pictures or previously generated materials.) In this case, familiarity with some of the available software packages is desirable. This can be done off-line and most of it can be done by teaching assistants, if available.

Use of more sophisticated presentation software, e.g., animation, is at the discretion of the instructor and can be done by a trained assistant.

The Computer Course control software will likely be "Hypercard" based. It will consist mainly of generating the necessary control software to allow commercially available software to operate in a sequential or selective manner under the control of the Computer Course instructor. It also provides for the proper timing and sequencing of file transfers from the source computer to the destination computer, and management and disposal of files in the destination computer. It is, in effect, the computer transmission operating system.

No installation crew or training program is necessary at the school site, although it is anticipated that introductory seminars might be offered on a school district basis. Therefore, the only limitation on the rate of system installations is the rate of manufacturing. Installing the antenna is much easier than installing a conventional television antenna because it does not have to be on the building roof. In fact, the two-foot diameter antenna can be located indoors (for security reasons) and simply pointed through a window or a skylight.

Appendix B Key Personnel

Advanced Communications Engineering, Inc. (ACE)

Officers and Directors:

Mr. James M. Beggs - Chairman, Advanced Communications Engineering, Inc. Mr. Beggs was nominated and confirmed as the sixth NASA Administrator in June, 1981, shortly after the first flight of the Space Shuttle Columbia.

AS NASA Administrator from 1981 through 1985 he was responsible for all aspects of the American Space and Aeronautics Program. During his tenure he directed the Space Shuttle program through the experimental flights into operational use of the shuttle for commercial launches, spacelab flights, scientific activities, and retrieval and repair operations.

During his administration the space science program was expanded and several new starts were initiated including a Venus mapper and a Mars Polar Observer. The science budget was increases to over 20% of the NASA budget. The Hubble space telescope, the Galileo Jupiter orbiter and probe, and several explorer spacecraft were completed, and are presently awaiting launch.

In 1984, he was credited with convincing the Reagan Administration to initiate and fund the next logical step in space exploration with the design and development of of a space station. He then embarked on a world wide space station effort which resulted in the European space community, Japan, and Canada joining in the program. Additionally, he initiated the NASA program for Quality and Productivity, which seeks to stimulate a drive for excellence within NASA and its contractor family.

Prior to service with NASA, Mr. Beggs was, from 1974 to 1981, Executive Vice President and a Director of General Dynamics in St. Louis, Missouri.

Mr. Beggs first government post was that of Associate Administrator, Advanced Research and Technology, NASA to which he was appointed by President Johnson in 1968. In 1969 he was nominated by President Nixon and confirmed as Undersecretary, Department of Transportation. In that position he was involved in restructuring the department during a very active period of new legislation initiatives in Airports and Airways, Urban Mass Transit, Railroads (including Amtrac founding and the initial resolution of the Penn-Central bankruptcy). and the initiation of the deregulation legislation for the transportation system.

From 1955 to 1968, he was employed in various marketing and engineering positions with the Westinghouse Electric Corporation. His last assignment was that of Vice President of the Westinghouse Defense and Space Center and the General Manager Electronics Division.

He is a 1947 graduate of the U.S. Naval Academy and in 1955 received an MBA from the Harvard Graduate School of Business Administration. He has also been awarded six honorary doctorates.

Dr. G. Gordon Apple - President, Advanced Communications Engineering, Inc. Dr. Apple received his BSEE degree from the University of Arkansas in 1966 and an MSEE and PhD from Purdue University in 1967 and 1970 respectively. He has over 20 years experience in digital communications beginning with a NASA research contract for implementation of a transform coding digital filter. He then worked at Bell Telephone Laboratories on digital interframe coding techniques for PicturePhone® transmission. At North Electric he headed up a group which developed transmission and synchronization systems for a new digital telephone switching system. He then was Director of Engineering for Automation Products Company. At TRW, Dr. Apple was involved in many digital communication system projects including satellites, modems, and data compression systems. He served as system engineer on the Space Shuttle's primary communications system.

Dr. Apple was principal investigator and project manager for a contract with CBS Television for data compression for High Definition Television (HDTV) transmission via Direct Broadcast Satellites. He also served as assistant Program Manager for VHSIC-implementation of ground terminals for the MILSTAR satellite system, a pioneering program which was the first to use the most advanced digital-signal-processing integrated-circuits ever designed.

In recent years Dr. Apple has devoted his efforts toward concept development, system design, and promotion of digital transmission for DBS broadcasting of television, HDTV, educational services (e.g., the YES Networks), and other services. In particular, he pioneered the concept of using personal computers to (digitally) broadcast services directly to televisions and other personal computers. He has also been actively engaged in extending the concept of "object-oriented computer programming" across boundaries between multiple diverse processors and dedicated hardware, particularly between personal computers and embedded signal processors.

Dr. Apple has several patents in the fields of error correction coding, digital transmission, synchronization, and video data compression. He also has various publications and has made many presentations (including internationally) on these subjects. Dr. Apple is a Senior Member of IEEE, a member of Sigma Xi (research society), Eta Kappa Nu, Tau Beta Pi, Pi Mu Epsilon, and the Society of Motion Picture and Television Engineers.

Mr. Donald K. Dement - Vice-Chairman, Advanced Communications Engineering, Inc. Mr. Dement is founder and president of Novacom, Inc., a consulting company which provides specialized planning, marketing, and design studies in direct broadcast satellite systems, technology, and applications; and a director of ACC. He has over 30 years of practical experience in planning and management of engineering development in communications systems and technology. He recently directed a project team designing and developing an aeronautical communications satellite system. Mr. Dement has a long work history in the public sector, and many years of project management and contract administration.

As NASA Headquarters' Director of Communications Programs, Mr. Dement planned the nation's new research and development efforts in satellite communications,. As Headquarters' Manager, Advanced Communications Research, he led NASA's advanced communications research program for five years in work including digital television transmission and satellite broadcast technologies. Additional work experience includes successfully managing a 600-person team in a Defense Department development of a major information processing system. He is a member of many professional associations, a Senior Member of IEEE, and an Associate Fellow of AIAA. Among other awards and honors, he is a recipient of the Air Force Meritorious Civilian Service Medal.

Mr. Daniel H. Garner - Secretary, Advanced Communications Engineering, Inc.

Foundation for Educational Advancement Today (FEAT)

Trustees:

The Honorable Wilbur D. Mills - Chairman, Foundation for Educational Advancement Today. The representative from Arkansas' 2nd congressional district in the 76th-94th Congresses, the Honorable Mr. Mills provided extraordinary service to the nation as Chairman of the United States House of Representatives Committee on Ways and Means. Currently, he is associated with the Washington, D.C. office of the prominent New York legal firm of Shea and Gould serving in the capacity of special tax counsel.

Mr. Wayne Wells - Vice-Chairman, Foundation for Educational Advancement Today. Mr. Wells was for many years a major asset to the General Dynamics Corporation as Treasurer and Director of the Company. He is now retired from General Dynamics, but remains active in investments and civic affairs.

Mr. Gary S. (Toby) Coe - Secretary/Treasurer, Foundation for Educational Advancement Today. Mr. Coe has over twenty years experience in ownership and management of broadcasting properties. Retiring in 1981 from an active role in the industry, he nonetheless maintains continuing communications interest, and was until recently a partner in a successful investment banking firm.

Your Educational Services Networks, Inc. (YES Networks)

Officers and Directors:

Mr. Jackson T. Stephens, Jr. - Founding President and Board Member. Mr. Stephens was Senior Vice President of the prominent investment banking firm, Stephens Inc., until 1983. Since then he has been President of J.T. Stephens Enterprises, Inc., Little Rock, Arkansas and Chairman, Scientech MarketSource, San Antonio, Texas. He is a graduate of Hendrix College with a B.S. Degree in Business Economics. He is active in many civic and community charitable organizations.

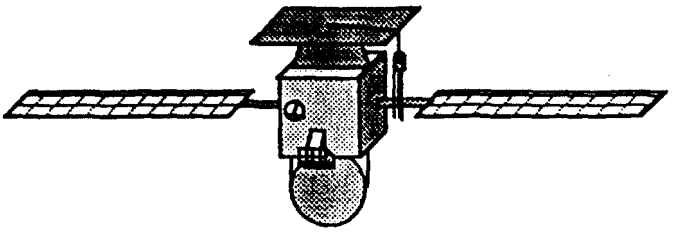
Mr. Jerome Simonoff - Mr. Simonoff holds a B.E.E. from City College of New York (1959), and an M.S. (1963) and M.B.A. (1967) from George Washington University along with considerable additional graduate course work at the New York University Graduate School. He has been with Citicorp since 1967, and is Vice President with various responsibilities including corporate finance of telecommunications and space-related projects. He also was financial advisor for the British DBS system. Prior to his association with Citicorp, he was with the Applied Physics Laboratory of Johns Hopkins University, Baltimore, Maryland.

Mr. Frank Weaver - Mr. Weaver is currently General Sales Manager, Atlas Centaur Launch Vehicles, General Dynamics Co. Previously, he was an executive with G.E. Astro Space Division for eleven years. Since 1981 he has been responsible for G.E./RCA's pre-eminent position on earth in direct broadcast satellite (DBS) development. Prior to joining G.E., he was employed at Mellon Bank, Pittsburg, Pennsylvania in corporate lending activities. Mr. Weaver received a B.S.E.E. from Howard University, Washington, D.C., and his M.B.A. from the University of North Carolina, Chapel Hill.

Ms. Kay Goss - Ms. Goss received her B.A. and M.A. in Political Science from the University of Arkansas, Fayetteville. She received her secondary teaching certificate in Social Science from Northwest Missouri State University in 1964, and completed course work toward a Ph.D. at West Virginia University, 1968-1969. She is an Adjunct Professor of Political Science, University of Arkansas at Little Rock. In Addition to various positions with the Arkansas Constitutional Convention, State Auditor's Office, and Constitutional Study Commission, Ms. Goss was Legislative Assistant to Congressman Ray Thornton and Administrative Assistant to Congresswoman Patricia Schroeder. She is Special Assistant for Intergovernmental Affairs, Arkansas Governor's Office.

Mr. Doug Jackson - Mr. Jackson received a B.A. in Television and Film from the University of Iowa, and was an officer in the United States Air Force from 1969-1973. From 1973 until 1978 he gained extensive experience in theatrical film production. In 1978 he became executive assistant to Senator David Pryor. From 1983 to the present he has been the producer of the successful CBS prime-time television comedy series, "Designing Women."

Rough Draft



July 14, 1989

Digital Broadcasting in Education

(A demonstration project proposal)

Submitted to:

The United States Department of Education

Washington, D.C.

By: The Foundation for Educational Advancement Today*

(* FEAT)

The Partners:

The Wilbur D. Mills Education Service Cooperative
Advanced Communications Engineering, Inc.
The University of Arkansas at Little Rock
Causal Systems Inc.

Rough Draft

TABLE OF CONTENTS

1. Abstract 1
2. Project Description 1
   (1) How the Project Meets the Purpose of the Statute 2
      i. Objectives 2
      ii. Objectives and the Statute Purpose 3
   (2) Meeting the Needs Recognized in the Statute 3
      i. The Needs Addressed by the Project 3
      ii. How the Needs were Identified 4
      iii. How the Need is to be Met 4
      iv. Public Benefit from Meeting the Need 5
   (3) Plan of Operation 5
      i. Proposed Project Design 5
      ii. Management and Administration 7
      iii. The Project Objectives Related to the Program Purposes 8
      iv. Resources, Personnel, and Planning 8
      v. Selection Plan 9
   (4) Quality of Key Personnel 9
         (A) Key Personnel 9
         (B) Allocation of Personnel Resources 11
         (D) Non-Discrimination 12
   (5) Budget and Cost Effectiveness 13
      i. Adequacy of the budget 13
      ii. Reasonableness of the Costs 13
   (6) Evaluation Plan 13
      i. Appropriateness 14
      ii. Objectivity and Generation of Quantifiable Data 14
   (7) Adequacy of Resources 14
3. Meeting Program Priorities 15
4. Conclusion 16

Appendix A Technical Aspects of the Project 17

Rough Draft

LIST OF FIGURES

Figure 2-3 Work Activity Task (PERT) Flow Chart.....7

Figure 2-3 Work Activity Task (Gantt) Time Chart.....8

Figure 4-1 Computer Course System.....2

Rough Draft

1. Abstract

The **FEAT** application seeks funding for assistance in conducting a **demonstration** of a new and unique type of educational course broadcasting technique which will ultimately provide services and benefits unparalleled by any other existing or proposed system. The **immediate** goal and subject of this proposal is to develop the incremental hardware and software links necessary to integrate recently available technologies and to do a full demonstration over a digital-based satellite link to one or more actual classrooms. The demonstration will deliver computer-course lectures (a new concept in course presentations), instructional materials, informational items, and other teaching and learning aids. This technology will also have applicability to distance learning using other types of satellite broadcasts, microwave transmission, and ISDN telephone links.

The **ultimate** goal is to use high-powered satellite signals, received by small antennas (2' in diameter), combined with microcomputers to offer perhaps the most impressive technological advance yet introduced into the classroom. This could allow as many as one hundred educational courses to be simultaneously broadcast through one satellite transponder where only one can be broadcasts by conventional methods. Eventually, a network of such services could reach throughout the United States, serving public and private educational institutions, industries, libraries, individual homes, hospitals and other similar users with instructional needs. The benefit-to-cost ratio is many times greater than that possible using other methods.

We have found that the concept of such a system, although very technically feasible, is so advanced that it is difficult to convey its operation and significance in words alone. It must be seen to be fully appreciated. Therein lies the immediate need--putting together a real system for a live demonstration in order to **show** people what it is all about.

2. Project Description

Introduction - Only truly innovative means can assure the continued advance of American education to meet the challenges facing students in the 1990's and beyond. Creative solutions will not

be developed and implemented overnight, but must be found, tested, and introduced as efficiently and effectively as possible. In this project application, a demonstration of a dramatic new technology is proposed which may eventually lead to an educational telecommunications network which can yield extraordinary benefits for the students of tomorrow.

The **Computer Course** service uses transmission which is considerably more efficient and less expensive than the TV courses, but can still be displayed on TV monitors or an overhead projector (using a computer adapter). The Computer Course also has vast additional capabilities that cannot be offered by any of today's TV course transmissions. A large number of services can be offered simultaneously within one satellite transponder (channel). Some of the preliminary work has already been described in the proposal[1] and final report[2] for a contract that ACE performed for NASA and the PSSC, in which ACE examined the utility of ACTS[3] for educational broadcasting.

FEAT (Foundation for Educational Advancement Today) will coordinate, oversee and fund the following entities in order to accomplish the goals stated in this proposal:

The Wilbur D. Mills Education Service Cooperative (WDM);
The University of Arkansas at Little Rock (UALR), an institution of higher education;
Advanced Communications Engineering, Inc. (ACE), a private corporation with the experience in developing, marketing, and operating satellite-based communications systems.
Causal Systems, Inc. (CSI), A minority owned corporation which designs, manufacturers and markets computer add-on boards using digital signal processors.

(1) How the Project Meets the Purpose of the Statute

i. Objectives - The objectives of the project are as follows:

(a) To integrate the hardware and software necessary for a demonstration of highly innovative distance learning techniques by computer;

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1 Advanced Communications Engineering, Inc., *Proposal to the Public Satellite Service Consortium and NASA ACTS Program*, October 21, 1987.

2 Advanced Communications Engineering, Inc., *Final Report: ACTS Educational Broadcasting*, Submitted to the NASA ACTS Program and Public Service Satellite Consortium, April 30, 1988.

3 Advanced Communications Technology Satellite, an experimental digital transmission satellite operating at K_a -band (20-30 GHz).