4.6 - Qualitative Analysis. Issues raised by the quantitative analysis will be explored by UALR in focus groups and interviews as a follow up to the classroom demonstrations. Teachers involved in the demonstrations will meet with partners and project advisors.

4.7 - Report on the Evaluations. The effectiveness of the project will be analyzed by all of the partners and advisors. The report will contain sections on technical analysis of the hardware and the utility of the technology in the classroom. Specifically, the major focus will be the results of the demonstration with Chapter 1 school students and their teachers.

ii. Management and Administration - FEAT will be responsible for the administration of the project including management, liaison, direction and coordination of the work tasks, reporting and evaluation, and will be the fiscal agent for the partnership. All administrative practices undertaken by FEAT on its own behalf and in behalf of the partners will conform to the cost principles and administrative provisions in 34 CFR, Parts 74 and 75, *Education Department General*

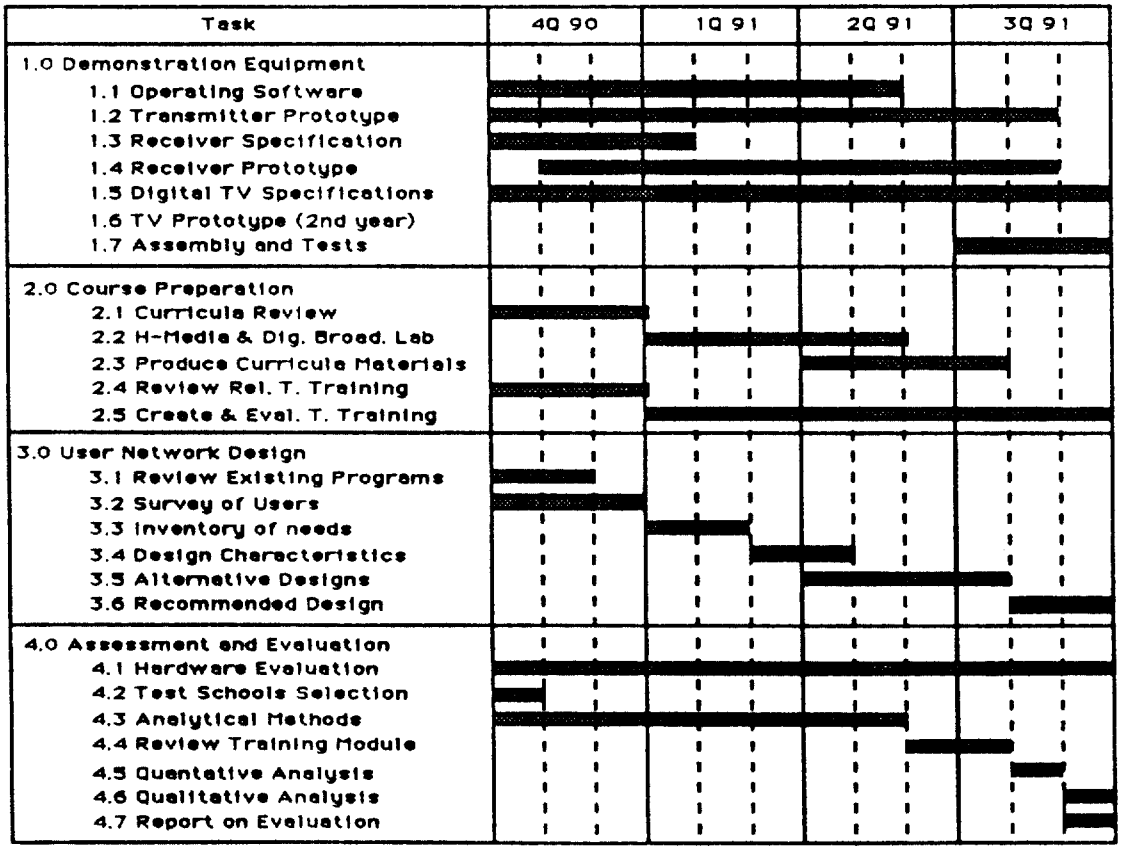

Figure 2-8 Work Activity Schedule Chart

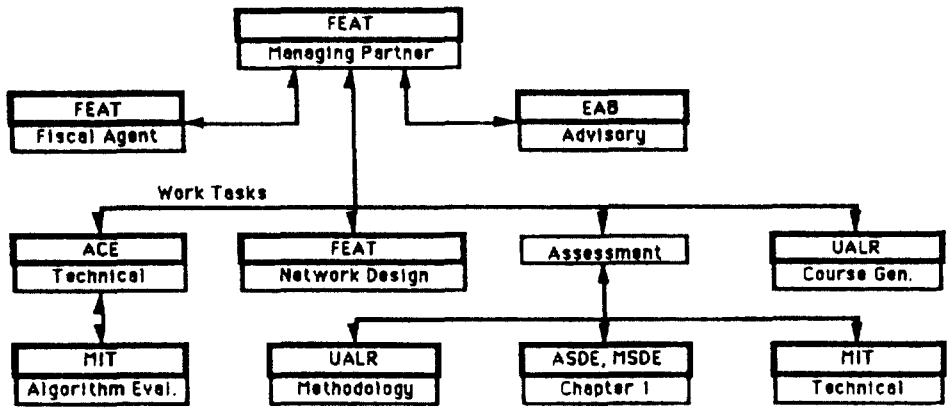

Figure 2-9 Project Organization

Administrative Regulations (EDGAR). Auditing of expenditures will be performed by Peat Marwick Main and Co., the largest international accounting firm (see Appendix G). Legal counsel to assure compliance with government regulations and cost principles will be provided by Michael Brustein, Esquire, of Brustein and Manasevit, P.C., Washington, D.C.

Management of the project will provide efficient coordination and direction of all partners in assisting them to perform their respective task assignments. The Project Director will have overall responsibility and will be aided by task leaders. Administration provides liaison with the USDE and among the partners and advisors. Reporting, legal, accounting, public involvement (primarily coordinating and soliciting the cooperation of advisory groups and other interested parties who will contribute to reviewing the project as it develops), and coordination in managing other tasks will be controlled through this activity. Assisted by counsel, the Project Director will assure compliance with all necessary regulations, cost principles, and conditions of the grant. Financial administration will be provided by FEAT.

The primary tasks to be tracked are shown in Figure 2-8. FEAT will provide regular quarterly reports to the USDE detailing progress toward task completion and outlining work expected to be performed during the next quarter. Copies of the reports will be available to the other YES partners and to the Executive Advisory Board (EAB). The EAB will contribute to evaluating the project's

based on personnel qualifications. Tasks to be performed under the Partnership project are described above in 2.(3)i, Plan of Operation. The assignment of responsibilities, personnel, and funding to each task will be further reiterated in each arrangement developed.

Provisions have been made for liaison and cooperation within the partnership, and extensive use of advisors is planned. This is intended to assure adequate public involvement and awareness of the project, contribute an invaluable additional resource of expertise, enhance planning, and guarantee a full, independent assessment of the project's benefits. The Project Director will monitor actual time spent on each task on a bi-weekly basis, comparing the predicted time allotment to the actual time being expended. In addition, microcomputer planning software will be used to plan, track, and allocate resources for specified activities. Monthly staff meetings will ensure group coordination.

The Project Director will use a systematic Cost Monitoring Chart for monitoring expenditure rate. It will be updated as necessary and at least once every month for monitoring activities as well as for assembling information for the quarterly Financial Reports. The Chart lists line items from the project budget, amounts allotted for each item over a three-month period, amounts used during that same period, and amounts overdrawn or underdrawn. This monitoring system provides sufficient time to make any necessary fund reallocations. FEAT will also monitor all of the Partnership's budget allocations and expenditures through its accounting system.

v. **Selection Plan** - The Partnership will employ personnel and purchase supplies without discrimination on the basis of race, sex, handicap, or age. This is consistent with the personnel policies of the educational institutions who are partners in this application.

(4) Quality of Key Personnel

i. Qualifications (Additional information is provided in Appendix D.)

(A) Partnership Director

Mr. Donald K. Dement - Project Director. Mr. Dement is founder and president of Novacom, Inc., a consulting company providing specialized telecommunications planning, market, and design studies in satellite system technology and applications. He has over 30 years of practical experience in planning and management of engineering development in communications systems and

technology. Following 30 contracts since 1981, clients now include NASA HQ, FAA HQ, and several commercial space firms in fixed, mobile, and broadcast satellite areas.

As Senior Director, Aeronautical Radio, Inc. Mr. Dement managed an office responsible for developing system design and specifications, business plans, satellite launch and integration plans for new aeronautical satellite communications system.

In his work in the public sector as Director of the NASA Headquarters Communications Division, (1975-81) he developed and promoted a new start for the first ten-year plan undertaken by NASA, now under way as the current ACTS and MSAT-X programs. As Manager, Advanced Communications Research, he managed technology developments of spectrum-efficient modulation and video techniques, a monolithic DBS receiver, and other projects. In twenty years from Student Trainee to Division Chief within the Defense Dept., he directed a range of ground station receiver engineering programs and contracts, and a major development of DoD's early satellite information efforts.

Mr. Dement is a graduate of Drexel University, has authored over thirty publications, and is an Associate Fellow of the AIAA, a Senior Member of the IEEE; a member of Eta Kappa Nu, AFCEA, SSPI; and a recipient of Meritorious Civilian Service Medals and other performance recognitions.

(B) Other Key Personnel

Dr. G. Gordon Apple - Principal Investigator for Technology. President of ACE, BSEE U. of Ark. 1966, MSEE 1967 and PhD 1970 Purdue U. He has over 20 years experience in digital communications including: NASA (research contract for a transform coding digital filter); Bell Telephone Laboratories (digital interframe coding techniques for PicturePhone® transmission); North Electric (Dept. head for transmission and synchronization for a new digital telephone switch); Automation Products Company (Director of Engineering). At TRW, Dr. Apple was a digital communication system engineer on several satellites, modem and data compression systems, and the Space Shuttle's primary communications system. He was then principal investigator and project manager for a contract with CBS Television for data compression for HDTV transmission via DBS. He was assistant Program Manager for VHSIC ground terminals for the MILSTAR satellite system.

Dr. Apple developed the conceptual and technical basis for the digital DBS educational system known as the YES Networks, and other services made possible by this new medium. He is presently active in hardware and software for personal computers and in "object-oriented programming" for embedded signal processors. Dr. Apple has several patents in error correction coding, digital transmission, synchronization, and video data compression. He also has various publications and

has made many presentations on these subjects. He is a Senior Member of IEEE, a member of Sigma Xi (research society), other honor societies, and the Society of Motion Picture and Television Engineers.

Dr. Alan VanBiervliet - Principal Investigator for Education. Dr. VanBiervliet is an Associate Professor of Education in the Center for Research on Teaching and Learning at the University of Arkansas at Little Rock. He is also President of Learning Express, Inc. a company specializing in research and development activities involving innovative computer-based educational programs and instructional technologies.In 1979, he received a doctorate in Developmental and Child Psychology from the University of Kansas. He has over 15 years experience developing and evaluating educational technologies, including designing a computer assisted language center at the University of Kansas in 1977, developing a model school incorporating microcomputer technologies at the University of Otago, New Zealand, in 1980, and developing a graduate course in special education technology at the University of Illinois in 1982. Since 1984 he has been an Associate Professor in Special Education at the University of Arkansas at Little Rock.

Prof. Jae S. Lim - Technical Director for Simulation and Evaluation of Video Compression. Dr. Lim receiver the S.B., S.M., E.E., and ScD degrees in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology in 1974, 1975, 1978, and 1878, respectively. He joined the M.I.T. faculty in 1978 as an Assistant Professor. He is currently a Professor in the Department of Electrical Engineering and Computer Science and is the Director of the Advanced Television Research Program.

His research interest include digital signal processing and its applications to image, video and speech processing. He has contributed more than one hundred articles to journals and conference proceedings. He is the editor of a reprint book, *Speech Enhancement*, and a coeditor of a reference book, *Advanced Topics in Signal Processing*, published by Prentice-Hall in 1973 and 1987 respectively. He is also the author of a textbook. *Two-Dimensional Signal and Image Processing*, published by Prentice-Hall in 1990.

Dr. Lim is the winner of three prize paper awards, one from the Boston Chapter of the Acoustical Society of America in 1976, and two from the IEEE ASSP Society in 1979 and 1985. He is the recipient of the 1984 MIT Graduate Students Council's EECS Department Teaching Award. He is also co-recipient of the 1984 Harold E. Edgerton Faculty Achievement Award. He is a fellow of the IEEE.

Dr. John McElroy - Partnership Technical Advisor. Dr. McElroy is currently Dean of Engineering at the University of Texas at Arlington. He received his BSSE from the University of Texas at Austin and his MSEE and PhD in electrical engineering from Catholic University of America. Prior to joining UTA as the engineering dean, he was Vice President of Technology at Hughes Communications, Inc. (HCI), Los Angeles. At HCI he was Director of Galaxy Mobilestar, and chief technical adviser to the President of HCI, and managed advanced space systems studies for civil and national security applications. Between 1982 and 1985 he was Assistant Administrator for Environmental Satellite, Data, and Information Services, NOAA, Washington, D.C. At NOAA he directed the national program in civil, operational earth observations satellites. From 1980 to 1982 he was Deputy Director, NASA Goddard Space Flight Center, Greenbelt, Maryland. He was the general manager of this important NASA center, supervising the work of 25 to 30 missions in stages of development simultaneously. From 1966 to 1980 Dr. McElroy held various other positions with NASA including Director, Communications and Information Systems Research and Development Programs, and Chief, Communications Technology Division. He has many honors and scholarly publications to his credit and is a Fellow of the Washington Academy of Sciences, IEEE, and AIAA.

Dr. Norman Abramson - Technical Advisor to the Partnership. Dr. Abramson is currently Professor of Computer Science at the University of Hawaii. He received his A.B. degree from Harvard University, an M.A. from UCLA and Ph.D. from Stanford University. Dr. Abramson was assistant professor and then associate professor at Stanford University between 1958 and 1962. He was visiting professor, University of California, Berkeley, Harvard University, 1965-1966, and professor at the University of Hawaii since 1966. He was visiting professor at M.I.T., 1981-1982. He is Chairman of the Board, Technology Education Associates, Sidney, Australia, and a director of the Public Services Satellite Consortium, Washington, D.C. He is a member of the Pacific Telecommunications Council, and a consultant to the International Telecommunications Union, Geneva, Switzerland. He is a respected author (*Information Theory and Coding*, 1963) and editor (co-editor, *Computer Communications Networks*, 1973). Dr. Abramson is a Fellow of the IEEE, and holds numerous patents in telecommunications.

Mr. Bobby P. Kerr - Chapter 1 School Selection Coordinator - Mr. Kerr Coordinates the Chapter 1 Office for the Arkansas State Department of Education. He received his BS from Middle Tennessee State College (1961) and his MA in Education Administration and Supervision from Memphis State University (1969). From 1966 - 1970 he was Title I, ESEA Director for the West Memphis School District. From 1970 - 1986 he was Supervisor for Title I/Chapter 1, of the Federal Programs Division of the Arkansas State Department of Education. Since 1986 he has been Chapter 1 Coordinator for the Department. He has received several federal grants for improving methods of

evaluation under Chapter 1 programs. He has served on the Advisory Council for Technical Assistance Centers since 1978. He will be assisted by Virginia Clark and Patsy Hammond of the ASDE staff, and the teachers and administrative personnel of the demonstration schools (25%, 25%).

Mr. Jack Baptista - Chapter 1 School Selection Coordinator - Mr. Baptista Coordinates the Chapter 1 Office for the Massachusetts State Department of Education. He has received several federal grants under Chapter 1 programs. He will be assisted by aids of the MSDE staff, and the teachers and administrative personnel of the demonstration schools in Massachusetts (25%, 25%).

Dr. Robert H. Bradley - Principle Classroom Demonstration Evaluator - Dr. Bradley received his AB from Notre Dame (1968) and PhD in Educational Psychology from the University of North Carolina, Chapel Hill (1974). Since 1982 he has been Professor and Director of the Center for Research on Teaching and Learning at the University of Arkansas at Little Rock. Also, he serves as adjunct Associate Professor of Pediatrics at the University of Arkansas for Medical Sciences (1979-present). He has been a consultant with the Parent Education Project, Kentucky State University since 1985. He was a member of the Review Committee, Office of Special Programs, USDE from 1982 - 1987. In 1983 he was a member of the Review Committee on Research Priorities, National Institute of Handicapped Research, and a Test Reviewer, Buros Ninth Mental Measurements Yearbook. Between 1979 and 1984 he was a member of the Research Advisory Group, College of Nursing, University of Maryland. He has received many research grants from various federal agencies and has published widely in scholarly journals. He will be assisted by two additional members of the College of Education (25%, 25%).

(C) Allocation of Personnel Resources

The key responsibilities in the Partnership are allocated so as to maximize the efficiency with which tasks are completed. Key personnel include the following:

Project Director - 100% - The Project Director will be responsible for administration, liaison with the USDE and among the partners, assurances and compliances with federal and departmental regulations including liaison with the fiscal agent, and insuring the cooperation and contributions of the advisory groups. The Project Director will have responsibilities in all tasks and will assure that schedules are adhered to.

Technical Advisors - 25%, 25%, 25%, 25% - There are four technical advisors assisting in the assembly, testing and evaluation of the hardware. They will provide assurance that technical tasks are followed by the manufacturer, that equipment is evaluated prior to the

demonstration, and will verify that the equipment operates according to the specifications for the project.

Manufacturer's Technical Director - 100% - The manufacturer of the digital equipment used for the demonstrations will provide a project leader who will be responsible for completing production tasks on schedule and according to specifications. He will be the liaison with the other partners. Sixteen technicians and professional engineers (100%) will be supervised.

Manufacturer's Task Director - 100% - The manufacturer's task director will directly manage the support staff of engineers and technicians who complete the manufacturing specifications for and produce the digital equipment used in the demonstrations.

User Network Design Task Manager - 100% - The user network design task manager will be responsible for managing all surveys, assessments, and data gathering subtasks, and directing the design of the educational network. He will be aided by an Assistant Investigator (100%) who will contribute to developing and reviewing alternative designs for the network.

Classroom Demonstration Evaluators - 25%, 25%, 25%, 25% - The classroom demonstration evaluators will be directed by a Principal Evaluator who guide the development of the quantitative and qualitative methodologies used to evaluate receptivity of the Chapter 1 Schools students and teachers to the digital technology in the demonstrations. The evaluators will also review the teacher training instructions for clarity and content, and will assist in the selection of demonstration Chapter 1 schools.

Chapter 1 Coordinators - 25%, 25% - The Chapter 1 coordinator will recommend selected Chapter 1 schools for the demonstrations and will provide liaison between these schools and the project. He will also contribute to the evaluation of the success of the demonstration, and will be assisted by two staff employees (25%, 25%).

(D) Non-Discrimination

The members of the Partnership pledge themselves to abide by the regulations of the U.S.D.E. governing non-discrimination in employment and purchasing.

ii. Additional Qualifications of Key Personnel

For additional qualifications of key personnel see full vitae in Appendix D.

(5) Budget and Cost Effectiveness

i. Adequacy of the budget - The funds needed for the project are allocated among four major project areas: (1) Demonstration Equipment (2) Course Preparation (3) User Network Design (4) Assessment and Evaluation. (For additional information, see Appendix F.)

Summary by Tasks	
1.0 Demo. Equip.	$3,457,110
2.0 Course Prep.	258,400
3.0 User Net	562,219
4.0 Assess./Eval.	771,115
Total Project Costs	$5,048,844
Fed. Grant Request	3,647,844
Matching Contrib.	$1,401,000
Percentage of Project	27.75%

Participant Contributions	
FEAT	$ 50,000
ACE	1,051,000
MIT	200,000
MSDE	25,000
ASDE	25,000
UALR	50,000
Totals	$1,401,000

ii. Reasonableness of the Costs - The above costs were developed from estimates of time and expenses required for completion of the tasks. Labor costs were derived from current salaries or estimates based on comparable wage rates. The provisional indirect rate used for the cost estimates is 28.84% of total costs and 40.52% of total direct costs. This figure represents a general overhead rate, and is considered conservative. A salary fringe rate of 19.79% of direct salary costs was used. These figures were based on rates of several partners and the rate reviewed and accepted by the fiscal agent - the Foundation for Educational Advancement Today. In-kind and matching amounts were estimated from actual salaries and overhead for offices and laboratories of the institutional partners, and are also considered conservative. The match estimated for ACE was calculated on the prevailing wage rates in the California market for engineering and technical employees, typical technology licensing fees and satellite transmission time costs. A full description of costs is presented in Appendix F, and in Part II of the application.

(6) Evaluation Plan

The hardware design phase of the project will inherently include simulation and evaluation of the video performance of the compressed signal. This will be done at MIT's Research Laboratory of Electronics using the facilities and equipment of the Advanced Television Research Program. Video tapes will be produced showing the performance at various levels of image compression.

A multiple assessment strategy will be used to evaluate the effectiveness of providing integrated math and science instruction via a digital broadcast system. This strategy involves simultaneously using several procedures to measure intervention outcomes and different dependent variables. Dr. Robert Bradley will assist project staff to evaluate the outcomes of this project.

The overall goals of the instructional modules are as follows: to increase the students' proficiency and understanding of targeted mathematics and science skills and concepts; to increase the students' beliefs that mathematics and science are valuable to themselves; to increase the students' skills in mathematic and scientific reasoning; to increase the students' abilities to read, to write, and to speak about mathematics and science; to increase the students' skills in using mathematic and scientific procedures to solve problems; and to develop the students' confidence in using of mathematic and scientific procedures to cope with the demands of life. One of the most important expected outcomes of the instructional modules is a positive change in the students' attitudes towards mathematics and science. This is particularly crucial, since longitudinal research (Simpson and Oliver, 1990[35]) underscores the pivotal role that adolescents' attitudes towards mathematics and science plays in their later participation and success in these fields.

The involvement and attitudes of both the participating teachers and school administrators will be important focuses of the evaluation processes. Regardless of the effectiveness of an instructional procedure or technology to change student behaviors and attitudes, these procedures will not be used unless they meet the requirements of teachers and administrators. For example, a particular technology may be extremely effective in teaching computational skills, however, if its space requirements, difficulty of operation, or disruption of other instructional activities are judged to be unsatisfactory by the teachers or administrators, that technology would not be adopted for use. The

expectations the teachers have regarding their students' mathematic and science performances will also be measured. In addition, the impact of the pre-service and in-service training programs will be evaluated.

The evaluation process will be achieved in three overlapping phases. The first will involve developing qualitative and quantitative data collection procedures and instruments. A thorough review of the literature will be made to identify procedures other researchers have used to evaluate distance learning, and mathematics and science instruction. Following this review, a plan for data collection and analysis procedures will be developed and submitted to the Advisory Committee for their recommendations. Due to the short time period available for field testing in Year 1 and due to the wide variance in participating student's skills, a data based case study and quasi-experimental approaches will be used. The quasi-experimental designs will include pre- and post-instruction measures of skill performances and attitude measures. Students in "matched" Chapter 1 classes and schools who are not participating in the project will serve as control subjects. A combination of standardized performance tests and custom created instruments will be used.

The second phase includes training research assistants and teachers on the procedures they will use to gather the evaluation data. This will be followed by the implementation of the data collection procedures. Measures will be taken both prior to, during, and after the use of the instructional modules. Although immediate changes produced by instruction are important, the maintenance of these changes over time is even more important. For this reason, a variety of evaluation procedures will be designed to monitor student changes throughout the second year of this project.

After the data has been collected from the field test sites, the project staff will summarize the data and conduct preliminary analyses. They will then produce a detailed report for submission to the Advisory Committee. The Committee will review the evaluation data and analyses, and make recommendations regarding further data analyses and revision of the instructional modules and procedures based on the evaluation.

i. **Appropriateness** - The objective has been established for each task. Personnel, financial, and time resources are allocated to meeting objectives. A quarterly progress report will document

resources expended, and describe accomplishments. This method is the most reasonable means of continually assessing project progress and demonstrating accountability. In addition, the EAB will review the project as it develops. Specific task products and milestones are scheduled. Their completion on schedule establishes a scale of progress which will be documented in quarterly reports to the USDE.

ii. Objectivity and Generation of Quantifiable Data - The Assessment and Evaluation task, discussed in the Plan of Operation, will generate quantifiable data. For example, the classroom test demonstration will measure for both students and teachers the appropriateness of the technology in a practical setting. Primarily, this will measure receptivity to the technology and its applications.

The tests will involve both classes of Chapter 1 students who are traditionally underserved and classes of non-Chapter 1 students who have benefitted from adequate educational resources. Qualitative research, including focus groups and individual interviews, will be conducted as a follow up and complement to the quantitative methods to reveal issues either not apparent from test results or unexplained by the quantified data. The instruments and methodology will be developed by UALR as a major component of the Assessment and Evaluation Task.

(7) Adequacy of Resources

i. Facilities - The tasks to be performed under the Partnership project are allocated to agencies, institutions or companies which have or can make available the space, personnel, materials and supplies, and other resources necessary to undertake their responsibilities. Facilities consist of offices, laboratories, and demonstration schools. Although some funding is requested for the project physical operations, all of the partners are established entities with appropriate resources. The cooperation of Chapter 1 schools, in which the demonstration of the equipment and software will be conducted, will be obtained through the Arkansas State Department of Education and the Massachusetts State Department of Education.

Necessary video compression algorithm simulations and evaluation will use the facilities of the MIT Research Laboratory of Electronics. The proposed research will be conducted at the Research Laboratory of Electronics. The Advanced Television Research Center is well equipped for

performing research in image and video processing. The computer facilities will be fully available for carrying out the proposed research. These facilities are currently used exclusively for High Definition Television research.

ii. Equipment - The major pieces of equipment to be obtained through construction by ACE and purchase by the project include digital-based transmitters and receivers, specialized software developed to complete the satellite-PC link and provide an operating system for the hardware, the personal computers (IBM or Mac II) used in the demonstration Chapter 1 schools, and related peripheral hardware. These items will be adequate for meeting the objectives of the partners, and tailored to meet the specifications of the YES demonstration project. In this regard, the developed software should not be confused with the "off-the-shelf" mathematics and science courseware which will be selected and purchased to provide instructional materials for the classroom demonstrations.

Video compression algorithm simulations and evaluation will use the equipment of the MIT Research Laboratory of Electronics in their Advanced Television Research Program:

- Main Computing Facilities
  - 2 Sun 4 workstations (UNIX).
  - 1 VAX 11/785 UNIX).
  - Vast amount of disk storage space.
- Peripherals for Video Processing
  - 2K x 2K Sony monitor.
  - 320 Mbyte Dataram semiconductor storage device.
  - 3 channel high speed digital interpolator.
  - Over 20 monitors (ranging from monochrome to high resolution color).
- Document Preparation Stations
  - Many Apple Personal Computers.
  - Laser Printers.

iii. Supplies - Other than for the manufacture of the digital hardware, all supplies are incidental to the operations of the various offices where the Partnership staffs are working. No specialized supplies are required. The supplies necessary for construction of the digital equipment are included in the costs outlined in the budget for this task, and as such are the responsibility of the manufacturer, Advanced Communications Engineering, Inc. (ACE).

3. Meeting Program Priorities

(a) Math, Science, and Foreign Languages—The Partnership project offers a major new opportunity to develop a network of users who will initially enjoy expanded access to existing **mathematics and science programming** and later to **foreign languages and vocational training** as a result of introducing advanced digital satellite technology to schools on a national basis. This type of technology, involving computer and television applications, is readily adaptable to the types of programming appropriate to these instructional areas.

A major aim of the project is to demonstrate a new communications technology which can demonstrably and dramatically reduce costs and make available educational resources to areas with high concentrations of **Chapter 1 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.

(b) Institutional Involvement—The YES partners include educational institutions (UALR/MIT), state agencies (ASDE/MSDE), public charity educational foundation (FEAT), and industry (ACE). In addition, the Executive Advisory Board (EAB) consists of leading associations representing educational interests in America. All of the partners and the advisory organizations have assisted in the planning and development of the proposed Partnership project.

(c) Breadth of Service Destinations—Although the immediate purpose is to benefit selected Chapter 1 schools, it is recognized that the proposed network will be most effective if **all educational users** are included. These will not be limited to public and private primary and secondary schools, but will include 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. Individuals and families will ultimately participate through learning libraries and the direct reception of educational courses and materials. The open architecture and policies of the YES Networks will guarantee that it will have the broadest range of applicability of any broadcasting system ever implemented.

(d) Number of Institutions to Use Service—Four educational institutions are formal partners in the Partnership project: The University of Arkansas at Little Rock (UALR), the Massachusetts Institute of Technology (MIT), the Arkansas State Department of Education (ASDE), and the Massachusetts State Department of Education (MSDE). Each has a significant role to play in implementing the project, and will commit significant resources in support of its successful implementation.

(e) In-service Teacher Training—The Partnership proposal will result in the creation of **teaching and training opportunities** for the useful life of the equipment and software utilized in the Chapter 1 school demonstrations. The equipment, teacher training plan, and software will remain in the participating schools after completion of the demonstrations. In addition to the **approximately 2,000 students and teachers who will participate in the demonstrations**, the equipment, instructional materials, and software can be used over a period of perhaps ten or more years to enrich the learning experiences of thousands of additional pupils and teachers. Another major component of the design of a user network for a digital-based telecommunications project will be a **continuing teacher training program.**

(f) Multistate Service—The project includes partners and advisory representatives from Arkansas, Texas, California, Massachusetts, Hawaii, Virginia, Maryland, New Jersey, Missouri, and the District of Columbia, and many national educational associations, and is truly national in scope. Service trials will initially be in **Arkansas and Massachusetts**. The operating network will subsequently make service available in **all states**.

(g) Inclusion of Traditionally Excluded—The major element of the user population who will benefit most from implementation of the Partnership project are those traditionally excluded from careers in science and mathematics whether because of inaccessibility, disadvantaged backgrounds, economics, isolation, or immobility. Educational resources made available for the training of these groups will be expanded through a reduction in costs afforded by new technology and the creation of a user network which will enrich programming, coordinate scheduling, and attract additional financial resources.

4. Technical Aspects of the Project

(1) TV Course

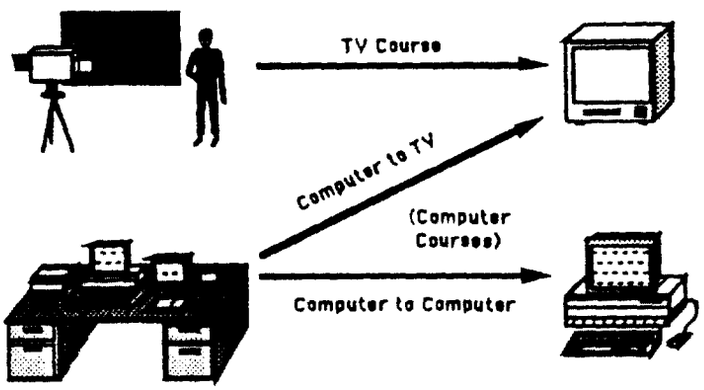

Figure 4-1 Course Transmission Types

All television broadcasting systems today (including satellites) use analog transmission. In the western world the predominant system is known as NTSC[36], a standard that was established about 40 years ago. The analog system has served us well for all types of programming from stationary test patterns (for adjusting the analog TV sets) to rapidly-changing images. However, it has long been recognized that this system is extremely inefficient in transmitting images in which change is the exception rather than the rule (e.g., business conferences and classroom lectures). Much work has been done over the last 20 years to improve the efficiency of transmitting such images.

The YES Networks TV Course system will use a combination of techniques that will allow very-high-quality video to be delivered to relatively inexpensive receivers while using a small fraction of the total digital transmission capacity of a single DBS transponder. The video compression techniques have been chosen to be compatible with that which is planned for digital transmission of commercial television programming in order to assure cost leverage from the latter.

The system is extremely flexible. A proprietary multiplexing technique allows a continuous spectrum of bit rates to be accommodated. Depending on the type of programming, the service originator can lease the bit rate that suits his needs and budget. All required operating parameters for this choice are automatically down-loaded to the user receivers. The reconstructed standard NTSC TV signal can be distributed to any number of TV monitors (or receivers) within a school.

(2) **Computer Course**

The means of presenting visual materials in classrooms and business is rapidly undergoing a revolution of its own. The ubiquitous transparencies used on overhead projectors are giving way to output directly from the personal computer to TV monitors and/or projectors. Numerous software packages now are readily available (e.g., Microsoft PowerPoint, Aldus Persuasion) for generating monochrome or color vu-graph images and then automatically sequencing them on the computer screen for the actual presentation.

In many cases, static slide presentations are giving way to dynamic animated presentations created with relatively inexpensive personal computer programs (e.g., MacroMind's Director, Apple's Hypercard, Silicon Beach's Supercard). These include special effects which keep the presentation visually stimulating and highly effective. Study aids created with these interactive programs can be downloaded through the classroom receiver to a computer for off-line study.

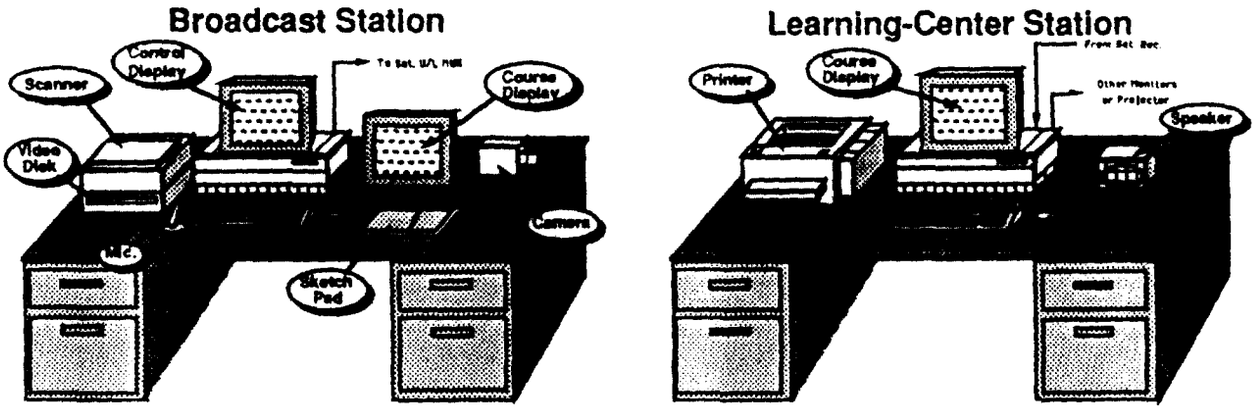

Figure 4-2 Computer Course System

Another trend is the use of image scanners and TV frame grabbers. Sketch pads are also being used by instructors as an electronic blackboard and for pointing to or annotating items on the screen. High-quality voice transmission (and music, when desired) can be provided by digital encoding. An illustration of this type of system is shown in Figure 4-2. Once prepared on the computer, the course (or segment thereof) could be presented entirely in real-time or by playback of a recordable CD (Compact Disc) or DAT (Digital Audio Tape).

The addition of an inexpensive printer will allow simultaneous reception of printed materials in the classroom teacher (or assistant). Only a single computer is necessary (although more might be desirable for other uses). The reconstructed signal can be distributed to TV monitors.

A vast number of additional teacher aids and learning aids can also be transmitted through the computer. 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.

(3) **User Training and Project Installation**

Whenever new technology is introduced into a non-technical environment, training and ease-of-use must be addressed. If a technology is not easy to use and provides only marginal benefit, it will simply be discarded and ignored. In the earlier decades of computer technology, humans had to change their mode of operation to conform to that of the ridged and unforgiving computer. However, personal computers required that the human interface be given highest priority. Indeed, today's market will rapidly reject any software or system which is not reasonably "user-friendly."

The TV Courses will not require any special training of either the course originator of the classroom users. However, **optimal** use of this medium may require training (e.g., a seminar or reception of a short training sequence, itself delivered through the satellite).

For **basic** computer courses reception, no special training will be required. One page of instructions should suffice (comparable to operating a TV set). Computer literacy is not required. Many of the supplementary services will also require no special training. Self-running tutorials will prompt the user to perform any necessary actions.

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 computers allows people with no previous computer experience to accomplish what is needed with little or no special training. Interactive animated computer media are increasingly being used for this type of training. Some of them span more than one computer

platform. For example, MacroMind Director 2.0 can be used on the Macintosh to generate interactive training programs which can also be run on IBM computers.

No installation crew or training program is necessary at the school site. Installing the antenna is easier than installing a standard TV antenna. In fact, the 1.5' antenna can be located indoors (for security reasons) and simply pointed through a window or a skylight.

The remaining training consideration is 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. Training time for using this system is expected to be about one day and requires no prior computer experience.

Use of more sophisticated presentation software (e.g., animation) is at the discretion of the instructor and can be done by a trained assistant. Because of the National scope of the course distribution, it could be cost effective to provide such assistants.

5. Programming

Existing mathematics and physics course materials will be acquired for demonstrations of the feasibility and utility of digital technology in Chapter 1 schools. The design of the user network will include descriptions of the types of programming which are most suitable to the medium of digital-based satellite communications. These are expected to represent instructional areas where deficiencies in the current educational system are readily apparent.

6. Survey of Needs

Discussions with state educational institutions concluded that prime beneficiaries of the project should be school districts with limited resources and extensive needs. In planning the Partnership project application, the partners sought to **characterize those students who were most in need** of improved access to educational resources, and insure that they were addressed in the project. The

ASDE has undertaken a multi-dimensional assessment of districts in the state to reveal those areas most in need. It was determined that most of the test demonstrations conducted in classrooms would be performed in schools with a **high percentage of Chapter 1 students.**

Basing the selection of the demonstration schools on data supplied by the ASDE and MSDE assures that in the short term the technology used in the project benefits most those students with poorest access to mathematics and science courses. The specific schools to be selected will be recommended by the ASDE Chapter 1 Office Director, Mr. Bob Kerr, and the MSDE Chapter 1 Office Director, Mr. Jack Baptista. Project participants will be selected without regard to race, color, national origin, gender, age or handicapping condition. However, the ultimate aim of the Partnership is to create a national user network providing inexpensive access to all.

7. Teacher Training

Teacher training will be conducted on two levels. First, those teachers who will participate in the classroom demonstration will receive **specialized training** for the purposes of the test. The teacher training will be carefully structured to assess both the level of instruction necessary to equip the teachers to use advanced technology in a realistic setting, and the effectiveness with which instructions assimilated by the teachers are communicated to their students. Specifically, of major interest is the level of exposure of the teachers to advanced hardware prior to the test, their receptivity to using new technology in the classroom, and their ability to create a positive learning experience for Chapter 1 students with advanced technology.

Quantitative and qualitative methods will be utilized in these assessments, and a **teachers guide** to using advanced technology with disadvantaged students will be produced. Although this guide will have been developed through the use of a specialized digital-based technology, it will be **adaptable to other more conventional applications** of technology in the classroom. Second, opportunities for **continuing teacher training** will result from the contribution of the test equipment to participating institutions after completion of the demonstrations.

8. The Financial Interest of the United States

The financial interests of the United States will be protected by the Partnership adherence to the intent and conditions of regulations as described in 34 CFR Part 74. All equipment purchased with grant funds shall become the property of the United States. It is proposed in the Partnership project that at the conclusion of the project any equipment and software will remain in Chapter 1 schools.

9. Benefits to Chapter 1 Schools

Courses selected for presentation with digital technology through the Partnership project will focus on **elementary and secondary schools with concentrations of educationally deprived students**. The students and teachers will experience mathematics and science course materials transmitted to personal computers in the classrooms via digital-based satellite communications. Testing the course materials in specially selected classes of academically and educationally disadvantaged students and the evaluation of this application is intended to benefit primarily Chapter 1-type institutions. The demonstration results, teacher training guide, and proposed user network all **would benefit Chapter 1 institutions more** than other schools with better resources and fewer instructional deficiencies.

10. Participation of Traditionally Underserved Students

The **traditionally underserved students will participate** in the Partnership project through a demonstration of innovative communications technology in a classroom setting, and will benefit from the teacher guide on the use of advanced technology in the classroom which is developed for and revised as a result of this experience.

11. Star Schools Funds as Supplementary Funds

The type of project proposed falls outside the scope of typical projects undertaken by any of the partners individually, and would not be undertaken without supplemental funding. However, all of

the partners acknowledge the substantial benefits to be derived from the project. The grant funds therefore are truly supplementary and not supplantive.

12. Other Pertinent Information

It is difficult at best to introduce new technologies and unique ideas - no matter how innovative and efficient they may prove to be. This must be done if educational resources are to be distributed uniformly with the greatest benefits.

Digital-based satellite communications can and will deliver educational programming more efficiently than current alternatives. New communications hardware using this technology will permit the transmission of many times the programming now available through analog delivery equipment.

Solving the technological hurdles is but one major step toward the realization of effective national distribution of educational programming of the scope needed to revolutionize the nation's school systems. Equally important is creating a network of users who will pool resources utilized more efficiently through the new technology. Ultimately, such a network will embrace every public and private educational institution in the country as digital technology reduces the costs of participation. The networks will standardize scheduling, identify needs and develop programming, provide training, attract funding, and create a forum for the exchange of ideas and recognition of teaching excellence.

Especially exciting for the prospects of establishing national educational networks, is the offer of transponder time and receiving equipment to be provided to the network and its member schools by the Foundation for Educational Advancement Today (FEAT). This contribution is valuable only after demonstrating the feasibility of implementing digital technology in the classroom and development of an implementation plan for the network. Such forward thinking and creative approaches offer the most effective means of productively altering the traditional course of American education to meet the non-traditional challenges facing students in the 1990's.

13. References

1 Dr. Frank Withrow,, "Star Schools Distance Learning: The Promise," *T•H•E Technological Horizons in Education Journal*, Volume 17, No. 9, May 1990.

2 U.S. Congress, Office of Technology Assessment, *Linking for Learning, a New Course for Education*, OTA-SET-430, November, 1989.

3 U.S. Congress, Office of Technology Assessment, *Linking for Learning, a New Course for Education*, OTA-SET-430, November, 1989.

4 U.S. Congress, Office of Technology Assessment, *Power On—Tools for Teaching and Learning*, OTA-SET-379, September, 1988.

5 Anatopolis, D.P. (1985). Student characteristics, learning and curriculum in Japan. *ERIC Document Reproduction Service No. ED 271-378.*

6 Ferko, A.M. (1989). *An Analysis of United States Advanced Science Student Achievement.* Ed.D. Dissertation, Columbia University.

7 International Association for the Evaluation of Educational Achievement (1988). *Science achievement in seventeen countries. A preliminary report* Author. Washington, D.C.: National Science Foundation.

8 McKnight, C.C., Crosswhite, F.J., Dossey, J.A., Kifer, E., Swafford, J.A., Travers, K.J., & Cooney, T.J. (1987). *The underachieving curriculum: Assessing U.S. school mathematic from an international perspective.* Champaign, IL: Stipes Publishing Company.

9 Riddle, W. (1986). Comparison of the achievement of American elementary and secondary pupils with those abroad: Examinations sponsored by the International Association for the Evaluation of Educational Achievement. *ERIC Document Reproduction Service No. ED 299-314.*

10 Borchardt, E.R. (1987). Impediments tio teaching science in elementary schools in South-Central Minnesota with comparisons to findings in the National Science Foundation. *Dissertation Abstracts International, 48*(3), 623A.

11 Tobin, K.(1987). Exemplary practice in science classrooms. Technical Report No. 143. *ERIC Document Reproduction Service No. ED 281-741.*

12 Bloom, B.S. (1976). *Human Characteristics and school learning.* New York: Mcgraw-Hill.

13 Simpson, R.D., & Oliver, J.S. (1990). A summary of Major Influences on Attitude Toward and Achievement in Science Among Adolescent Students. *Science Education, 74*(1), 1-18.

14 Apple, G. Gordon and Samuel A. Covington, *Gutenberg II: Tomorrow's Revolution in Education Today*, July, 1988.

15 Apple, G. Gordon, "Digital DBS Television Transmission," Advanced Communications Corporation, June 5, 1987.

16 Apple, G. Gordon,"Final Report: High Definition Television Data Compression; Algorithm Analysis and System Design," TRW, June, 1982, prepared for CBS, Inc.

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

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

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

20 Allen, T. (1987). Identifying Behaviors of the Master Teacher. *Spectrum, 5*(2)42-47.

21 Coughlin, R. (1986). Master Teacher/Mentor Teacher: Two Approaches to Educational Excellence. *Thrust for Educational Leadership, 15*(5), 41-43.

22 Klein, M.F. (1985). The Master Teacher as Curriculum Leader. *Elementary School Journal, 86*(1), 35-44 .

23 Lawrence, F., & McCreath, H. (1988). Integrating Quantitative and Qualitative Evaluation Methods to Compare Two Teacher In-service Training Programs. *Journal of Research in Science Teaching, 25*(5), 397-407

24 Bell, T.H. (1983). Science, mathematics, technology and the brain drain. *ERIC Document Reproduction Service No. ED 231 609.*

25 Ewell, Y. (1982). Use Technology to Cope with the Scarcity of Math and Science Teachers. *American School Board Journal, 169*(9)26

26 Benson, G.M., Jr., & Hirschen, W. (1988). Rural School Tap into High Tech Learning. *PTA Today, 13*(6)19-21.

27 Kitchen, K. & Kitchen, W. (1988). Two-way interactive television for distance learning: A primer. *ERIC Document Reproduction Service No. ED 312 094.*

28 Pease, P.S. (1989). Strategies for Implementing Distance Learning Technologies: Why, When, and How. *School Business Affairs, 55* (10), 15-18.

29 Dr. Frank Withrow,, "Star Schools Distance Learning: The Promise," *T•H•E Technological Horizons in Education Journal*, Volume 17, No. 9, May 1990.

30 Wilson, T.C. (1989). The Open University at the University of South Florida: An assessment of distance learning procedures. *ERIC Document Reproduction Service No. ED 306-862.*

31 Kapisovsky, P.M.(1990). Network science: A new approach to science and math education. *What's New On Campus*, 10-14.

32 Jaffe, C.C., & Lynch, P.J. (1989). Hypermedia for Education in the Life Sciences. *Academic Computing, 4*(1)10-13, 52-52 .

33 Hofstetter, F.T. (1989). Podium: Presentation Overlay Display for Interactive Uses of Media. *Academic Computing, 4*(3)10-13, 48-50.

34 Apple, G. Gordon, "Digital Demodulator for a Satellite Ground Receiver," Advanced Communications Engineering, Inc., May 30, 1988.

35 Simpson, R.D., & Oliver, J.S. (1990). A summary of Major Influences on Attitude Toward and Achievement in Science Among Adolescent Students. *Science Education, 74*(1), 1-18.

36 National Television Standards Committee

APPENDICES:

Appendix A. Foundation For Educational Advancement Today (FEAT) - Documents.

Appendix B. Correspondence in Support of the YES Partnership Star Schools Proposal.

Appendix C. Advanced Communications Engineering, Inc. (ACE) - Documents.

Appendix D. Vitae of Key Project Personnel.

Appendix E. Assurances of Compliance with Federal Regulations and Statutes.

Appendix F. Task Resources, Allocation and Methods.

Appendix G. Partnership Internal Accountant