also a computer. We can simply tell the receiver's imbedded computer to draw images on the screen, such as presentation charts or animation. This eliminates the middle man (the TV signal) and obviates the need for video compression while providing superior graphics at much lower bit-rates. This process can be done completely under the control of the instructor or from pre-recorded sequences. In either case the system is totally transparent to the teacher and students.

Is this sort of like slow-scan television?

No. ACE's system has very fast response time and allows many types of multimedia including full-color, full-motion video when needed. Statistical properties of transmitted information can used to great advantage. For example, the telephone system is designed under the assumption that only 5 to 10% of telephones are active at any given time. Your particular phone may be active 30% of the time today and not at all tomorrow (maybe you took a mental health day). But the average usage over your area's telephones may be quite stable. To design otherwise (e.g., for 100% usage) would radically increase your basic phone bill. Likewise, ACE's system allows individual high-peak transmission rates when needed, but takes advantage of (monitored) statistical usage to keep down the user's transmission bill.

Won't such a sophisticated system be expensive?

A few years ago the answer would have been "yes." Today, advances in digital integrated circuits and personal computer technology are making such things not only possible but potentially very inexpensive. Everything in this educational system uses the same equipment that is intended for the home market. These units will be produced in the tens of millions. Integrated circuit memory density and processing power consistently quadruple every three years while prices per IC remain quite constant. Each generation of devices integrates more features and lowers system costs.

Does it require expensive studio time?

What studio? Sure, if you're re-doing "Cleopatra" you may need a studio and a staff of slaves (otherwise known as graduate students). A desk, PC, scanner, and a HandyCam will do nicely for most program generation. We're not talking "Masterpiece Theater" here unless you really want, need, and can afford that sort of thing. Use the computer for most of the graphics; Use animated presentations; Download interactive hypermedia materials, computer programs, and simulations for the students to use; Inset live video into a portion of the screen. Egos not withstanding, once the students' curiosity over what the instructor looks like is satisfied, an occasional reassurance that the instructor is alive and quite real may be all that is actually necessary—but again, that choice is available to the instructor.

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Do we have to do everything your way?

ACE is developing the transmission framework, overall receiver and system architectures, an assortment of "get started" software, a variety of system tools, and some examples of how the system can be used. However, the system is basically a bit-pipe into which you will be able to pump whatever information you wish. You will be able to use many types of software and peripheral hardware. This is an open system. Although ACE may continue to develop new authoring and presentation tools, we expect this system to spawn an entire new third-party industry and new categories of educational products. Many of these will be developed by the people who are actually using the system, i.e., instructors, and even students.

What does it take to uplink programming?

(The necessary program generation facilities are treated elsewhere.) Sending the signal to the satellite, unfortunately, it is not as easy as receiving it. The ACE DBS transmission system is unique in that it will allow multiple simultaneous uplinks into the same transponder. However, maximum satellite efficiency occurs when many courses can be uplinked from a common facility. For example, a state school system or university might concentrate several course bit-streams into a single higher-rate bit-stream before uplinking to the satellite. Aggregate capacity for an uplink is automatically controlled from a master uplink facility for that transponder. Uplink capacity allocations can be reassigned as needed and even some dynamic allocation is possible between uplinks, although satellite transit delay prevents this from being done as fast as a video frame-by-frame basis. Within a single uplink facility, dynamic capacity allocation can be done on a sub-frame basis, improving transmission efficiency for motion video. LANs (Local Area Networks) can be used to collect the bit-streams from one location. ISDN, fiber optic cables, microwave, and other satellites can also be used to get the program to an uplink facility. The wide-band fiber optic backbone system proposed for major universities could prove to be the ideal feeder system for DBS course programming.

How about teacher training?

Training in using the system, or training in general? Introductory courses and seminars will be offered on the system at frequent intervals in order to help teachers explore and learn the system's operation and capabilities and get maximum utility from it. Class previews and supplementary course materials for upcoming classes can be privately provided outside of normal class periods. Teachers can also take courses and seminars for their own self improvement. In-service and recertification programs can be included.

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Can it be used for professional organizations?

Of course. National or local teachers organizations and other professional groups can use this system to keep in touch with their constituency, no matter how remote. This system will likely be the same as the one the teacher and students are using at home for normal television. ACE's high-security access control will allow access to be restricted to dues-paying members of these organizations (or open access when recruiting new members).

Conclusion

ACE's Digital broadcast system on ACC's DBS satellites will make it technically possible for FEAT to implement the YES Networks for the most innovative, effective, and economical educational system ever attempted.

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WEDNESDAY, NOVEMBER 14, 1990 VOL. 10, NO. 220

Today:

FCC TELLS NECA TO HIRE OUTSIDE AUDITORS: Commission has 'grave concern' over actions of NECA directors in allegedly misdirecting revenue pool funds. Carriers involved express innocence, dispute need for fines. (P. 1)

ATRC OFFERS 2ND ALL-DIGITAL HDTV SYSTEM, leaving NHK as only all-analog proponent. Group 'confident' it can meet test schedule to be announced today. (P. 2)

PALEY MEMORIAL: TRIBUTE TO COMPLEX MAN by Stanton, Rockefeller, Kissinger, Tree, sons. Enormous turnout of 'big names.' Contrast with new biography. (P. 2)

K PRIME CLAIMS GOOD SIGNUP RATE for satellite TV service in first week, sees breakeven in 3 years, expects video compression 1992. (P. 3)

EDUCATION INTEREST PIQUED BY DBS PLAN: Nonprofit aims to distribute free receivers to schools and libraries for digital system on which it would command 4 transponders. (P. 3)

Wilbur Mills Involved

EDUCATORS INTRIGUED BY DBS PLAN WITH DEDICATED INSTRUCTIONAL CAPACITY

Planned direct broadcast satellite (DBS) system that would have dedicated capacity for instructional uses is stirring interest in educational circles. U.S. Education Dept. recently awarded small planning grant to Your Educational Services (YES) Networks to study plan under which, among other components, small (1.5-ft.) dishes would be distributed free to 125,000 schools and libraries. Dishes would receive high-powered digital signals transmitted by two $100-million digital satellites being built for Advanced Communications Corp. (ACC) by GE Astro. Birds, with 16 transponders each, have been approved by FCC for launch in 1993 and 1994.

YES Networks, which would be operated by nonprofit group Foundation for Educational Advancement Today (FEAT), would have long-term access to 4 of 180-w transponders. Video compression combined with birds' high power could make possible simultaneous transmission of 100 distance learning courses, ACC Pres. Daniel Garner said. He's former broadcaster and investment banker and longtime associate of Wilbur Mills, ex-chmn. of House Ways & Means Committee who heads FEAT. Garner said FEAT is "more than halfway" toward goal of raising $100 million from corporations that he said would be used for antenna giveaway program.

YES/FEAT plan comes amid spate of recent educational telecommunications ventures, most prominent of which is Channel One, Whittle Communications' commercially sponsored high school video network (see story elsewhere in this issue). Washington nonprofit EDSAT Institute also has announced effort to obtain dedicated satellite for field (PBR Sept 7 p10), while Hughes earlier disclosed plans to develop noncommercial satellite-based instructional TV service for elementary schools (PBR June 8 p6).

YES/FEAT concept has generated interest in high quarters. Garner said he, Mills and ACC senior adviser James Beggs, former NASA administrator, met with President Bush in June 1989 and there has been "true enthusiasm" in periodic meetings since with Administration and senior Education Dept. officials. He said concept has earned preliminary support of several groups, including American Federation of Teachers, NASA, National Education Assn., Public Service Satellite Consortium.

Christopher Cross, Education Dept. asst. secy.-educational research and improvement, sees "a great deal of interest in services that could be provided by something like this." Nevertheless he and other educators said YES/FEAT, like other instructional telecommunications ventures, "will not amount to much" for education unless substantial attention is directed to programming aspects.

"The ultimate questions are the software," agreed Jim Mecklenburger, dir. of National School Boards Assn.'s Institute for the Transfer of Technology to Education (ITTE) who is heading Education Dept.-funded planning study. Among questions he said need to be addressed are whether: (1) YES/FEAT concept would spur production of sufficient educational fare to justify substantially increased capacity ACC birds would provide. (2) Schools as now constituted could use service in practical way. Mecklenburger said venture could be "extraordinarily beneficial" for education, but would require "a long learning curve" for many educators to grasp concept and "frankly, the jury is out to whether this is truly feasible and viable."

Garner hopes educational component of service will stir interest in its commercial segments. For example, consideration is being given to development of related DBS service in which students would earn points exchangeable for merchandise by participating in video- and computer-based homework incentive program. ACC's commercial service will include basic service of "30 plus" channels offered for $13.95, Garner said, as well as "$3-$3.50" pay-per-view movies and other events. Less conventional services such as delivery of Compact Discs, computer software and electronic publishing are at lesser stages of development, he said.

In paper submitted to Education Dept. recently, YES/FEAT contended they might be able to deliver such additional educational services as data streams to libraries, instructional fare to day care centers, professional requalification as required by individual states. Garner said that schools could be charged annual fee "in hundreds of dollars" to participate in YES/FEAT and that its programming, while noncommercial, could include PBS-like corporate underwriting.

Others involved in overall DBS project include Gordon Apple, YES senior adviser and former TRW and Bell Labs engineer; Wayne Wells, former General Dynamics treas.-board member; Donald Dement, former dir. of NASA communications programs.

THE DBS REPORT

DBS and cable hybrids?.p.1
Hughes, ACC lock slots.p.2
Astra covering Europe..p.3
FCC competition ruling.p.7
Breakeven scenario.....p.9
Comsat+SkyPix mixed...supp

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December 31, 1990

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WANTED: PRIME DBS REAL ESTATE

It is widely agreed that only two DBS orbital slots--110 and 101 degrees--are optimal for full coverage of the continental U.S. (full-CONUS).

Reception from a third slot, at 119 degrees, is considered adequate in much of the U.S., but marginal, at best, for much of the northeast. At present, the claims on these three orbital slots look something like this:

Orbital Slot	Applicant	# of Transponders	Coverage	Status
101	Hughes Comm.	16	Full/East	Approved
		11	Full/East	Expected (1)
	USSB	5	Full/East	Approved
110	Advanced Comm.	16	Full/East	Approved
		11	Full/East	Expected (1)
		5	Full/East	Requested
	USSB	3	Full/East	Requested
119	Dominion Video	8	Full/East	Approved (2)
	Echostar	11	Full/East	Expected (2)
	Directsat	11	Full/East	Expected (2)

(1) Based on FCC channel awards and relative timing of due diligence filings for orbital slots. (2) Request for three additional channels at 119 denied by the FCC. © 1990 THE DBS REPORT. Table compiled by Paul Kagan Associates, Inc., Carmel, CA, based on FCC documents and information provided by licensees.

As the table shows, Hughes and Advanced Communications (ACC) have a lock on the bulk of the full-CONUS transponders. By early 1991, each should lay claim to 27 of the 32 channel assignments at its respective orbital slot.

United States Satellite Broadcasting (USSB) had originally been granted eight transponders at 110, which would have left only 24 for ACC.

In April of 1990, however, USSB petitioned to move its satellite and five of its eight channel assignments to 101, with the possible intention of piggy-backing on one of Hughes' satellites.

Earlier this month the FCC granted USSB's request, which locked up the last of the 32 channels available at 101. It also allowed ACC to expand its 110 degree assignment to 27 transponders.

The status of the last five spots at 110 degrees is uncertain. USSB has been awarded channels, but, legally speaking, may no longer satisfy the FCC's due diligence requirement at 110. It had planned to use one of STC's original three-channel birds at 110, but that has since gone to the Japanese.

At the same time, ACC has requested the last 5 chs. at 110. With a contract for two 16-transponder birds, it can claim due diligence for the full 32 channels. To date, however, the FCC has granted it only 27 channels.

The remaining slots, 66.5 degrees to the east, and 148, 157, 166 and 175 degrees to the west, are only suitable for half-CONUS operation. Among the advantages of half-CONUS operation are more graceful management of time zone differences and service to even smaller antennas.

But, given the near doubling of capital costs associated with half-CONUS operation, and some lingering doubts about DBS, most believe full-CONUS operation at launch is the only way to attract financing.

The feeling is that a DBS operator will be able to finance additional birds for half-CONUS operation only after establishing a track record at full-CONUS. If that's the case, those with channels at 101 and 110, particularly Hughes and ACC, enter the latest phase of the DBS derby with a clear edge.

ACC: DIGITAL BEFORE DIGITAL WAS COOL

Amidst all the hoopla over the digital compression schemes proposed by Skypix and Sky Cable, it's worth noting that the first DBS licensee to propose an all-digital system was Advanced Communications Corp. (ACC).

While keeping a fairly low public-relations profile, ACC has gained control of one of two key DBS orbital slots (see story P. 2).

At the same time, it has developed a digital transmission scheme that can support a wide array of entertainment and educational services.

Though ACC's digital plan may have struck some as too futuristic when first made public in 1987, the recent surge of interest in compression and in "multimedia" systems suggests its planned 1993 launch may be timed just right.

Other proposed digital systems--such as Skypix's eight channels per transponder scheme--rely on fixed channel assignments and compression levels.

ACC has designed a more flexible system, in which "bits" rather than channels are the unit of measurement.

Each ACC transponder will be able to support a variety of program types. Capacity will be dynamically assigned to each format (e.g., full motion video, still-video, audio) to match its particular bit rate requirements.

With this kind of flexibility, an ACC transponder could carry any of the following formats, or a mix of many, depending upon demand.

- three to six channels of ultra-high quality video
- eight to ten channels of VCR-quality video
- up to 100 channels of talking-heads or animated video
- hundreds of channels of still-slides with voice-overs
- hundreds of chs. of multimedia computer programs blending audio, video and text that can later be used in an interactive mode
- text, computer software and CD-quality audio

These will be beamed to 18-inch antennas tied to software-upgradeable digital receivers with the processing power of state-of-the-art personal computers. Add-ons like keyboards and floppy-drives could also be accommodated.

ACC believes the system, with its multimedia capability (e.g., mixing video, audio and data), is ideal for "distance learning" in homes, schools and libraries and for business and professional training.

In recent years both distance learning and multimedia systems geared for education and training have experienced rapid growth. ACC aims to integrate these two powerful technologies into a single system.

Educational programming, in addition to generating revenue and public benefits, would help get ACC receivers into U.S. homes--opening the door to sales of its assorted entertainment services, including a $14.95/mo. 30-ch. basic and 50 chs. of premium-quality pay-per-view at $3.00-$3.50/movie.

To realize its educational ambitions, ACC has helped form a non-profit public charity, Foundation for Educational Advancement Today (FEAT).

FEAT, headed by Wilbur Mills, ex-chmn. of the House Ways and Means Committee, will enjoy use of four of the 32 transponders on ACC's two GE Astro birds. These will carry a range of educational services under the umbrella of YES (Your Educational Services) Networks, which FEAT is underwriting.

The YES Networks recently won a grant from the U.S. Education Department. FEAT has gained preliminary support from the Bush Administration and

(continued on next page)

EDUCATIONAL PROGRAMMING IS CENTRAL TO ACC PLANS (continued from P. 3)

from educational groups such as the National School Boards Assn., American Federation of Teachers and National Educational Association.

FEAT intends to provide free satellite receivers to the nation's 125,000 public and private schools and libraries. To finance this, it has set up an innovative mechanism to attract $100 mil.-$150 mil. in corporate funds.

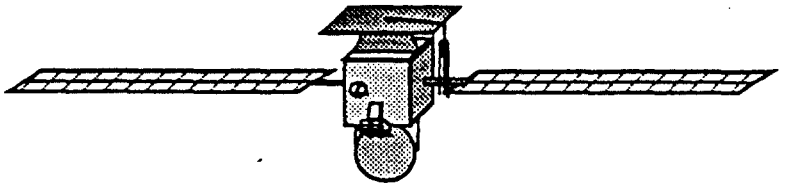
At the same time, ACC pres. Dan Garner, a former broadcaster and a long-time associate of Mills, is busy raising the nearly $600 mil. needed to launch the first phase of ACC's DBS service.

Dr. Gordon Apple, pres. of Advanced Communications Engineering (ACE), an ACC subsidiary, is the key man behind ACC's digital transmission system.

With more than 25 years of experience in digital communications, Apple has patents in several areas, including video compression. In 1982-1983 he headed a joint TRW/CBS effort to develop HDTV compression schemes for DBS. Apple also worked on PicturePhone compression systems while at Bell Labs.

Among the other members of ACC's core team are senior vp Donald Dement and James Beggs, ACE chmn. and a member of ACC's board.

Dement has served as director of Aeronautical Radio Inc. and NASA's Communications Division. Beggs was NASA Administrator from 1981-1985.



Planning for the YES* Networks

*(Your Educational Services)

A Grant Proposal to the United States Government

by the

Foundation for Educational Advancement Today

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To Develop an Initial Blueprint for the YES Networks

September 13, 1990

Planning for the YES Networks

Abstract

Education, and particularly distance learning, is rapidly approaching crossroads of historical proportions.[1] Decisions made and directions taken in the next few years will set the course for decades to come. The **YES Networks** is being developed for the purpose of simultaneously providing a large number and variety of innovative educational services to schools, libraries, hospitals, and homes using digital transmission through high-power direct broadcast satellites. The quantity and variety of services provided through the YES Networks will vastly exceed that possible through prior technology. Innovative in-service instruction will be provided for both instructors and other educational professionals.

The Foundation for Educational Advancement Today (FEAT) will inaugurate the YES Networks and will make available two high-powered Direct Broadcast Satellite (DBS) transponders for more than a fifteen-year period, increasing dramatically the volume of programming which can be made available to schools and other institutions throughout the United States. Transmission costs will be greatly reduced— an enormous gain for our education resource base. Additionally, FEAT intends to provide a satellite receiver to each of America's 125,000 public and private schools and libraries.

The YES Networks envisions creating a user friendly environment which will allow the easy introduction of new technology to the teaching professional and the classroom. Planning and establishing the steps for the operational network requires creation of the appropriate infrastructure at the earliest possible date. FEAT requests funding for the purpose of creating a blueprint for implementing this innovative educational technology through the YES Networks.

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1 Foundation for Educational Advancement Today, "A Means to Re-establish America's Leadership in Technology and Education", prepared for President George Bush, March 1989.

Introduction and Background

In its original DBS (Direct Broadcast Satellite) filing[1] with the FCC in 1984, ACC (Advanced Communications Corporation) stated its commitment to providing innovative nationwide educational programming for reception through antennas of less than 2 ft in size, making it virtually universally accessible to all homes, schools, and businesses. ACC was the first broadcaster in history to commit to using totally-digital transmission. In 1987, it issued its original white paper outlining the potentially enormous benefits that digital transmission could provide for educational course broadcasts.[2]

Based on this paper, the Foundation for Educational Advancement Today (FEAT) was formed and the YES Networks concept was initiated. Since then, numerous papers, proposals, and presentations have been made promoting the YES Networks.

The Foundation for Educational Advancement Today is a 501(c)3 public charity which was formed for the purpose of planning and establishing the YES Networks along with donating a receiver to each school and library in the United States. ACC is donating to FEAT the use of two of its DBS transponders for their useful life to broadcast the YES Networks. ACE (Advanced Communications Engineering, Inc.) was formed for the purpose of providing engineering support for ACC, FEAT, and any other entities requiring the specialized technical expertise of this new broadcasting medium.

The **YES Networks** is being developed for the purpose of simultaneously providing a large number and variety of educational services using digital transmission through high-power direct broadcast satellites. These services will be received by inexpensive, easy-to-install receivers in schools, libraries, hospitals, and homes — virtually anywhere needed. It combines a variety of existing technologies[3,4] to very efficiently send voice, video, computer files, control, and configuration information. The YES Networks will provide to anyone in the nation a wide-band data pipe for access to many conventional and innovative educational services.

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1 "ACC Application for Authority to Construct and Operate a Direct Broadcast Satellite System," FCC DBS 84-01.

2 Apple, G.Gordon, "Digital DBS Educational Services", ACC white paper, July 31,1987.

3 FEAT, ACE, ACC, "An Integrated-Services Digital DBS Receiver," Submitted to NASA, October 13, 1989.

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

Narrative

The **YES Networks** will enhance educational course broadcasts in the following areas:

Capacity - The YES Networks will insure that adequate satellite course transmission capacity will be available to meet the needs of today and tomorrow for all types of courses, especially math, science,[1] foreign languages, and vocational education;

Economy - It will substantially reduce the cost of providing both teacher training and student instruction by fully utilizing the capacity of satellite transponders through digital techniques; and by making possible the use of very small receiver systems that are easily mounted on any building structure, including indoors;

Flexibility - It will enhance the widest use of the transmission capacity by offering superior video quality when it is needed, and by transferring supplementary materials that can be interactive and used off-line by both students and teachers;

Accessibility - It will expand the penetration of valuable courses into areas where special-area instruction is not otherwise possible because of isolation, funding, transportation, available time or other reasons; and to the industry worker who simply cannot otherwise find the means and time to improve skills and personal facility with everyday tasks. The multiplicity of courses on each satellite transponder and the low cost of the receiving terminals make this augmented accessibility possible.

The YES Networks will demonstrate how, by greatly reducing acquisition and dissemination costs, the introduction of a new technology will expand access of these students to a wider variety of new and improved educational resources. This will include courses by master teachers from across the country who are recognized nationally for their instructional excellence. It will also involve realistic simulations and problem solving situations emphasizing integration and application of knowledge, and state-of-the-art "hypermedia" techniques for obtaining and sharing information.

The needed growth of distance learning will soon be stymied by high delivery costs, lack of related capabilities (little or no capability to down-load supplementary materials, limited interactivity) and especially a coming **shortage of affordable satellite transponders.**[2] Current analog transmission and reception techniques are capable of carrying only one or two TV courses per

---

1 Apple, G. Gordon,"Math, Science, and Engineering: A New Means to Achieve Our National Goals," December, 1988.

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

transponder. There is an obvious need to increase this capability and improve efficiency in current and future satellites to ensure that each transponder can simultaneously broadcast many services.

The relevance of digital DBS to distance learning cannot be overemphasized. It will bring unparalleled flexibility, efficiency and **economy of operation** to educational course broadcasting. It will allow introduction of a vast number of **new educational services never before possible**—all received with antennas convenient to install because they are not much larger than a student's opened notebook. The system under development by the YES Networks **will assure the future economic availability of adequate satellite delivery capacity** for traditional-type distance learning for the entire nation.

Distance learning has been proven effective[1] and is growing at a rapid pace. As noted by Dr. Frank Withrow of the U.S. Dept. of Ed., "It is possible to use these technologies to reach very isolated students, i.e., handicapped homebound students, students in prisons, students on Indian reservations and even students who are in the workplace..."[2]

Research is clearly demonstrating that American school children at all grade levels perform poorly in math and science on achievement tests in comparison to students from other industrialized nations. In addressing this problem, the NCTM developed its "Math Framework"[3] to provide a cohesive national plan for upgrading math education. However, there is a shortage of teachers possessing master teaching competencies in mathematics and science, particularly in rural or small school districts.

Several barriers exist to implementing the needed changes. These include: teachers being poorly prepared to provide science and math instruction; current text and workbooks not containing sufficient material to allow students to develop and practice higher-order thinking; and computers primarily being used only to provide drill and practice of basic facts.

According to Ewell,[4] one solution is to use distance-teaching technologies to share master teachers among many schools and classrooms. These specialists exhibit exceptional teaching strategies, superior motivation and communication skills, sound curriculum knowledge, interpersonal competence and classroom management proficiencies. This can provide an effective

---

1 E. Kent Ellertson, et al, "Report on Distance Learning, A National Effectiveness Study," Pennsylvania Teleteaching Project, 1987.

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

3 "Curriculum and Evaluation Standards for School Mathematics", National Council of Teachers of Mathematics, October 1987.

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

alternative to traditional instruction in terms of student satisfaction, content mastery and cost effectiveness.

Following are only a few of the more obvious educational services and programs which will benefit the public as a result of implementing the YES Networks:

- Satellite educational programming to all public and private elementary and secondary schools in America;
- Much improved access of rural schools to educational programming;
- In-service training to teachers;
- Information data streams to all libraries in America;
- Transmission of informational and innovative materials to/for schools, PTAs, school boards, administrators, teachers, their national associations, and the U.S. Dept. of Ed.;
- Specialized programs for vocational-technical schools;
- Drug prevention and rehabilitation education;
- Specialized programs for disadvantaged, gifted, talented youth;
- Training and educational advancement programs for businesses and industries;
- Lifelong education, including graduate studies through the University of America;
- Educational programming to all child-care centers in America;
- Emergency Broadcast System to schools (tornados, earthquakes, floods, fires and other catastrophes);
- Adult literacy;
- Student remedial programs;
- Senior citizen learning opportunities;
- Support of the Job Corps and other federal programs;
- Professional re-qualification as required by state laws;
- Medical information interchange among medical facilities;
- Education and data transmission to support migrant students;
- Assist prison inmates rehabilitation programs;
- Relay of educational programming to Department of Defense-operated schools;
- Professional training and informational services (legal, accounting, financial, medical, engineering, etc.);
- Parent education in home or school.

During after-school and evening hours the YES Networks will implement a student incentive program delivered via DBS to homes. It will provide student and teacher assistance including "point" accumulation for a variety of rewards for participation, ranging from commercial products to

comparison Table and Figure show some of the differences between the YES Networks' system and the types of limited services available today.

Tasks and Budget

The YES Networks concept is an innovative application of technology for the instruction of both students and teachers. In order to identify, implement and evaluate the network requirements, several project tasks must be considered:

Task 1: Receiver Distribution Plan

- Consult with professional educational organizations to determine how to best organize the actual distribution of the receivers.
- Plan for initial user orientation.
- Provision of user support for initial receiver installation.
- How to use the system to further train users in its effective operation.

Task 2: User Network Design Plan

- Characterize the user audience.
- Develop a plan for parental involvement.
- Determine the needed network elements.
- Determine Network organization

Task 3: Curriculum/Course Development Plan

- Access existing course content and software.
- Outline necessary modifications.
- Characterize resources available to implement a field demonstration of operation.
- Evaluate effectiveness of demonstration project in the field.

Task 4: Financial Planning

- Identify the economic factor of a functioning system.
- Develop a pro forma to implement plan.
- Identify the continuing financial requirements of the network.

Task 5: Final Report and Demonstration Video

- Written final report
- Instructional video tape version of final report using video techniques similar to that which will be used in classes over the YES Networks.

The final report preparation will entail both a written document and a video tape, the latter of which will not only present results, but will also be instructional in the services envisaged. Travel funds are requested for trips to and from Washington, DC by individuals associated with the project scope. The proposed duration of the planning study is six months.

FEAT personnel will perform much of the actual tasks and will subcontract portions, as appropriate, to ACE or its personnel for evaluating technological factors. FEAT will provide an accounting of expenditures of funds in the final report. Vitae of the main personnel of FEAT and ACE are included in Appendices A and B respectively.

1.	Receiver Distribution Plan	$ 4,000
2.	User Network Design Plan	$ 8,000
3.	Curriculum/Course Development Plan	$ 7,000
4.	Financial Planning	$ 5,000
5.	Final Report and Demonstration Video	$ 7,000
	Administration and Overhead (40 %)	$ 12,400
	Travel	$ 3,300
	Professional Fees	$ 3,300
	Total Funds Requested	$ 50,000

Conclusion

It is difficult at best to introduce new technologies and unique ideas - no matter how innovative and efficient they may be. This must be done if educational resources are to be distributed uniformly with the greatest benefits. The YES Networks can multiply the effectiveness of each school dollar spent for distance learning by a significant factor. Imagine a classroom where the student operates in a world of color, sound, and animation — a world where master teachers are made equally available to children in the smallest rural or largest urban schools alike.

Digital-based satellite communications can and will deliver educational programming much 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 and will allow inclusion of innovative services that are not presently possible. Implementation of the YES Networks will improve the learning opportunity for all students and teachers.

Solving the technological hurdles is a major step toward the realization of effective national distribution of educational programming of the scope needed to revitalize and revolutionize the nation's school systems. Ultimately, YES Networks 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.

Technology has changed the world forever. The future belongs to those who make appropriate use of this technology. The place to begin is the schools of America — with the YES Networks. The requested funds will allow the Foundation to do the planning necessary to implement these technologically innovative educational services.

Appendix A Foundation For Educational Advancement Today

Trustees:

The Honorable Wilbur D. Mills - Chairman, Foundation for Educational Advancement Today. The representative from Arkansas' 2nd congressional district in the 76th-94th Congresses, Mr. Mills provided extraordinary service to the nation as the longest serving 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 interests.

Appendix B Advanced Communications Engineering, Inc.

Dr. G. Gordon Apple

President — Dr. Apple was principal investigator and project manager for a joint effort with CBS Television to develop data compression for HDTV using digital transmission via Direct Broadcast Satellites. He was assistant Program Manager for VHSIC (Very High Speed Integrated Circuit) ground terminals for the MILSTAR satellite system. He was then principal investigator for IRAD programs for small, light-weight EHF (Extremely High Frequency) terminals and developed a system design for an ultra-small VHSIC Phase II EHF satellite communications terminal.

In recent years Dr. Apple has devoted his efforts toward concept development, system design, and promotion of digital transmission for DBS television, HDTV, educational services (e.g., the YES Networks), and others. He has promoted personal computers for receiving (digitally) broadcast services directly using a flexible combination of data compression, file transfer and control, and transmission of drawing primitives. He is actively engaged in extending the concept of "object oriented programming" across boundaries between diverse processors and dedicated hardware.

At Purdue, Dr. Apple developed a transform-coding digital filter for NASA. He then worked at Bell Labs on digital-interframe-coding video-compression for PicturePhone® transmission. At North Electric his group developed transmission, synchronization and multiplexing systems for a digital telephone switching system. He then was Director of Engineering for Automation Products Company. At TRW, Dr. Apple was a project manager for digital communication system projects including satellites, modems, and data compression systems. He was a system engineer on Space Shuttle communications and other satellite programs including an Intelsat VII proposal. He was the system engineer for a project that developed a television satellite transmission scrambling system.

Dr. Apple received his BSEE degree from the University of Arkansas in 1966 and an MSEE and PhD from Purdue in 1967 and 1970 respectively. He has over 25 years experience in digital communications and has patents in the fields of error correction coding, digital transmission, synchronization, and video data compression. 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. He is a Registered Prof. Engineer and an instrument rated pilot.

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Mr. Donald K. Dement

Vice-Chairman and Director, — Mr. Dement received his BSEE from Drexel University, Washington, DC in 1959 and was an MSEE candidate at George Washington University, Washington, DC in 1966. He has over 30 years of practical experience in planning and management of engineering development in communications systems and technology. He is a member of many professional associations, a Senior Member of IEEE, a member of Eta Kappa Nu, an Associate Fellow of the American Institute of Aeronautics and Astronautics, and has served on IEEE's "Spectrum" and "Institute" editorial boards. Among other awards and honors, he is a recipient of the Air Force Meritorious Civilian Service Medal.

As President of Novacom, Inc. Mr. Dement has provided satellite systems engineering, management, planning, and evaluation for a wide variety of clients. Novacom executes design and integration studies, prepares regulatory filings, develops plans and schedules for tests and operation, and operates proprietary and customized planning software. Products have included studies, evaluations, specifications, and detailed plans for system developers and on-orbit operators, and for medium-orbit remote sensing platform communications systems. Recent clients include NASA HQ, FAA HQ, and commercial space firms in fixed, mobile, and broadcast areas.

As Senior Director of Aeronautical Radio, Inc., Mr. Dement operated the systems architecture and engineering development office at ARINC for new aeronautical satellite communications systems, developed system design and specifications, business plans, satellite launch and integration plans for shared payloads, ground and airborne earth terminals, and overall integration and launch schedule planning.

As Director of NASA Headquarters Communications Division, Mr. Dement developed and promoted a new start for the first ten-year plan undertaken by NASA as the current ACTS (30/20 GHz) and MSAT (mobile) programs. He developed operational concepts for technology development programs. As Manager, Advanced Communications Research, he managed technology development for new hardware and techniques: compressed video, spectral-efficient modulation, monolithic DBS receiver.

As Engineer and then Division Chief at U.S. Dept. of Defense, he directed a range of ground station receiver engineering programs and contracts, and a major development of DoD's early satellite information efforts.

James M. Beggs

Chairman — Mr. Beggs was nominated and confirmed as the sixth NASA Administrator in June, 1981, shortly after the first flight of the Space Shuttle Columbia. Currently, he is also chairman of Spacehab, Inc.

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 increased to over 20% of the NASA budget. The Hubble space telescope, the Galileo Jupiter orbiter and probe, and several explorer spacecraft were completed.

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 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 Amtrak 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.

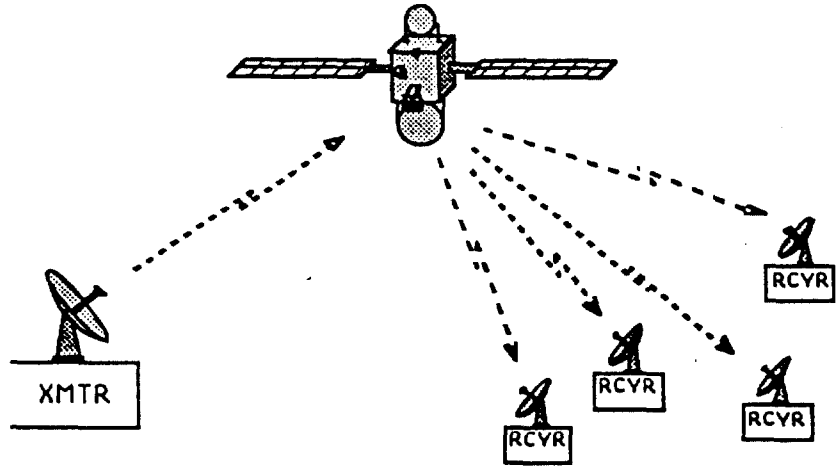
He is a 1947 graduate of the U.S. Naval Academy and in 1955 received an MBA from the Harvard Graduate School of Business Administration. He was awarded six honorary doctorates.

Access Control for ACC's Digital DBS

August 8, 1990

Advanced Communications Engineering, Inc.

G. Gordon Apple, PhD



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Abstract

Access control is examined both as it has been implemented up until now with analog scrambling systems, and as Advanced Communications Corporation (ACC) intends to implement it in its new Digital DBS system. A comparison chart is presented. The following is established:

- No system is totally secure but some are substantially more secure than others;
- ACC's digital transmission is inherently more secure than any analog system;
- ACC's Digital DBS will not suffer from the severely limited control channel data rate which has crippled previous analog scrambling systems.;
- Because digital encryption is inherently simpler to implement, all security processing can be encapsulated in a single chip, thereby vastly increasing physical key security;
- The available thousand-fold-higher authorization data rate will allow individually secure access control for **multi-tiered** and many low-to-medium-rate services;
- **Impulse Pay Per View (IPPV)** will be much easier to implement with Digital DBS.

Introduction

Home Box Office (HBO) was one of the first to seriously consider protection of its satellite broadcasts, and issued an RFP (Request for Proposal) in 1982. The introduction of satellite television scrambling on some channels in January 1986, and the prospect of scrambling on other channels, was very effective for a while. Within a very short time, sales of the once booming industry for individual home ground stations slowed to a trickle, even though most programming was available for subscription or still was unscrambled. Satellite viewers, who had spent thousands of dollars on receivers, felt that they had an inalienable right to continue receiving satellite broadcasts. A modified-scrambler pirate market developed and today it is estimated that there are between one and three pirate units in place for every legitimate unit. Now, in view of the upcoming markets for Direct Broadcast Satellites (DBS) and High Definition Television (HDTV), we can design our DBS sustems so that this will not occur again.

No system is 100 % secure or completely tamper-proof. However, as long as the difficulty and cost level of defeating it is higher than that of the service offering, then there is no need to fear massive signal piracy. Fortunately, ACC's totally-digital transmission inexpensively solves many of the security implementation problems and allows concentration of efforts and resources on the more difficult problem of transmission "key" control.

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The author's experience in establishing the transmission formats for the STU-II (Secure Telephone Unit) communication system, between units and to the KDC (Key Distribution Center), has been applied to this endeavor. His experiences gained in serving as system engineer on TRW's video scrambling program, and in writing a definitive paper opposing Syndex for the SBCA (Satellite Broadcasters and Communications Association), have also proven valuable in the study.

Present Scrambling Systems

Analog Video Scrambling

Analog television signals are quite fragile. In addition, there are often other considerations in a system such as video repeaters and other amplifiers that expect the signal to behave in certain ways and have certain characteristics. These constraints severely limit the number of things one can do to the signal to make it unwatchable through unauthorized receivers. All of them have the potential of causing signal degradation. Some of the available techniques are:

- Suppression of synchronization to prevent reception by a normal television;
- Pseudo-Randomly jittering the sync timing to prevent synchronization;
- Video polarity inversion;
- Pseudo-Random video polarity inversion;
- Addition of a known low frequency waveform (e.g., a sine wave);
- Pseudo-Random time reversal of a line;
- Pseudo-Random "line spin";
- Pseudo-Random line shuffling;
- Combinations of the above.

Of all these techniques, the cleanest one with the least signal degradation is line shuffling, which was also the most expensive to implement in the past due to its storage requirements. At the time the HBO RFP was released, cost target considerations required rejection of this technique.

Key Control and the Piracy Problem

Each service, for a defined interval of time, has a transmission key (see Appendix B) which must be transferred from the authorization center to all legitimate subscribers while simultaneously denying access to those not entitle to receive the service. There are many ways to accomplish this, all of which have their vulnerabilities.

Security begins at the chip foundry. Each access control chip must be individualized during the processing cycle or by burning-in an individual ID code using a PROM (Programmable Read-Only

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