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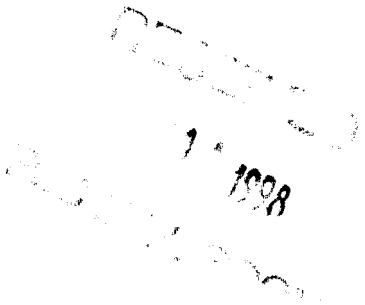
FOUNDATION FOR EDUCATIONAL ADVANCEMENT TODAY
Office of the Secretary-Treasurer
10 Brookridge Cove, Little Rock, Arkansas 72205
Telephone 501-224-5383 (Voice) 501-224-8910 (Fax)

June 10, 1998



Ms. Magalie Salas
Secretary, Federal Communications Commission
1919 M Street NW
Washington, D. C . 20554

REFERENCE: MM Docket 93-25
Telecon. R. Chiara/G. Gordon Apple, Advanced Communications Engineering

Dear Ms. Salas:

We appreciate Ms. Rosalee Chiara's invitation to submit the following information for FCC review.

Enclosed please find pamphlets mentioning how DBS would have helped satellite communications and children's education.

There is a letter from Mr. Richard L. Mays, former Chairman of our Foundation, and former member of the Arkansas Supreme Court, to FCC Chairman Hundt. Our current chairman is James M. Beggs, former NASA Administrator.

There is also a series of publications by G. Gordon Apple, Ph.D., and others explaining the advantages of satellite broadcast education and the techniques thereof. These papers were previously submitted to the FCC by Advanced Communications Corporation in its semi-annual reports over the years.

The enthusiasm regarding this educational initiative, felt by all of us connected with the project , is clearly evident in Dr. Apple's papers. The State of Arkansas, the City of Little Rock, the Foundation, as well as ACC and its engineering affiliate, were all most appreciative of the FCC authority granted to ACC. I am personally aware that Mr. Garner, President of ACC and the late Congressman Wilbur Mills , felt that the educational initiative would be a worthy fulfillment of the corporation's public service obligation, though none was officially required in the award of ACC's authority.

The Foundation for Educational Advancement Today would be most appreciative of the Commission's taking another look at the facts and factors surrounding the revocation of ACC's license. It is our position that over 10 percent of ACC's expected capacity was dedicated to education through our Foundation and the Commission approved, at least tacitly, that commitment.

Thank you for your attention to this matter. We would certainly appreciate a response.

Yours truly,

Bill Williamson

BILL M. WILLIAMSON
Secretary-Treasurer

cc:
Rosalee Chiaras

YOU CAN HELP ESTABLISH THE GREATEST EDUCATION SYSTEM EVER CONCEIVED...

AND RIGHT HERE IN ARKANSAS

THE BEGINNING

In the early 1980s, satellite broadcast services were still in their infancy. A few companies used low-power satellites to broadcast weak-signal television programming to rural residents who purchased huge satellite receiver dishes in order to receive the signals. These dishes are still seen today, though few are used and most have been abandoned.

A new and better technology was on the horizon: direct broadcast satellite service (DBS), which is the broadcast of strong signals from satellites to small receivers (about 18 inches wide or smaller) placed unobtrusively on or in homes, schools and office buildings.

Although this improved DBS system was a relatively unexplored technology in the early 1980s, it was quite familiar to the founders of Advanced Communications Corporation (ACC), based in Little Rock. For years, the people at ACC had been studying DBS technology, as well as digital broadcasting via satellite.

From 1984 through 1991, the Federal Communications Commission awarded a number of satellite frequencies and an orbital position to ACC, **which was the only license applicant that voluntarily included sweeping educational aspects.** ACC envisioned sending a virtually unlimited variety of educational services and programs to children in all 50 states.

MILLS FOUNDATION JOINS THE PROJECT

In 1988, former Congressman Wilbur D. Mills organized the Foundation for Educational Advancement Today (FEAT), an educational charity dedicated to exploring the use of new technologies to improve education from kindergarten through college, with both campus and home education options. Because ACC and FEAT were so closely aligned in their goals for education, ACC dedicated a significant portion of its satellite capacity to FEAT.

Both ACC and FEAT began working toward launching the satellite system. FEAT developed a long-range plan that created the YES ("Your Educational Services") Networks, and would furnish satellite receivers to every American school and library at no charge. The YES Networks would then transmit several hundred simultaneous channels of educational programming to the receivers throughout North America.

FCC CHANGES THE RULES — 'IN THE MIDDLE OF THE GAME'

As Advanced Communications Corporation and FEAT worked diligently to put together the various components of the satellite system, the FCC began changing the rules. Under the terms of the licenses, ACC and FEAT had until the end of 1994 to build the satellite system. But satellite technology was changing so fast that nobody was ready to commit the necessary hundreds of millions of dollars. Because of this, the FCC routinely granted construction extensions to all license holders. It was considered a mere formality.

In April, 1995 the newly created FCC International Bureau recommended denial of ACC's request for a permit extension, deeming that ACC had failed to exercise "due diligence" in developing its satellite system and had merely ""warehoused" the license. The Bureau clearly ignored the fact that ACC spent years pioneering digital satellite technology and even battled such giant industries as General Motors to prove digital technology was feasible and practical.

In October 1995, the full FCC took up the issue and voted, 3 to 2, to deny ACC's permit extension. The Commission had never before denied an extension for building satellites. The license was then auctioned by the FCC for $682 million to MCI, intended for use by an Australian affiliate of MCI. This action and later FCC approval of a proposed British Telecom/MCI merger represent a serious national security issue at the very least.

Additionally, James H. Quello, one of the two senior FCC commissioners who dissented against the majority in the decision to rescind the license, stated in his dissent:

> *In its decision today, the majority has changed the DBS due diligence rules in the middle of the game, unlawfully and unfairly disadvantaging an innocent participant...*
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> *...This result is patently unfair to Advanced [ACC] and the other DBS licensees and permittees who invested time and money 15 years ago when the possibilities that this service would become viable were minimal, at best.*

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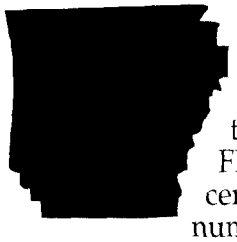

IMPACT ON ARKANSAS

What does this mean for Arkansas? For one thing, much of the operation and administration of FEAT's educational project was to be centered in Arkansas. This meant numerous top quality jobs as well as a brighter profile for our state in the high technology industries. Both were lost.

Second, it means that FEAT, the educational charity founded by Congressman Mills, will lose more than $100 million, which is the estimated value of its percentage of the FCC license. Through grants from the U.S. Department of Education and the state of Arkansas, FEAT has taken giant strides toward making its dreams a reality — dreams of harnessing the positive power of the telecommunications revolution and applying that power to education and the public interest. Those dreams cannot be realized without a satellite system.

IMPACT ON EDUCATION IN AMERICA

MCI has announced only minimal plans to serve the American public interest. Only FEAT and ACC offered a plan of such scope and sweep that it potentially could reach every schoolchild in America.

The FCC's rescission of ACC's license is a serious setback for education in Arkansas and the rest of the United States. The FEAT/ACC plan has been on the drawing board for more than ten years. Because there are no other plans ready for implementation, and few organizations willing to devote the time, finances and energy required to realize such a comprehensive project, educational technology in America could be held back for years, perhaps even another decade or more.

THE PRESENT STATUS

Officials at the White House have become concerned about national security issues created by foreign ownership of direct broadcast satellites in key orbital positions over the United States. They are also concerned about whether the public's interest, i.e. education, is being served by the licensees of digital satellite broadcasting. For these reasons, the White House has asked for two probes into the licensing of DBS systems.

The first investigation is being conducted by the U.S. State Department, which is looking into national security considerations surrounding the influence of American satellite services by foreign companies. The second probe is looking into how the public interest, including education, can best be served by satellite technology.

CRITICAL ISSUES

The critical issue in both cases is whether a domestic or foreign company is doing what is best for the American public regarding educational reform and our ability to compete in the world of the future.

We cannot be sure that those who have repealed the educational reforms presented in the original application are looking after the best interests of the American public, and we cannot depend on foreign interests to deliver the necessary educational reforms.

To merely hope for the best is folly. Corrective and decisive action is necessary.

WHAT FEAT WANTS

We at the Foundation for Educational Advancement Today want to accomplish what we set out to do in the first place — establish a highly sophisticated satellite-based education program that reaches each and every classroom in America. We have come so close that we are not willing to give up.

FEAT has searched for alternative ways to provide satellite transponder time and funding to carry out Congressman Mills' dream of supplying satellite receivers to all schools and libraries at no cost to those institutions. While we remain receptive to other proposals and ideas, it now appears that the way to accomplish the goal is through nullification of the FCC's action, and the return of the license to Advanced Communications Corporation, which still stands by its pledge to FEAT.

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RESPOND — NOW

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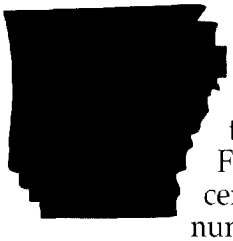

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FOUNDATION FOR EDUCATIONAL
ADVANCEMENT TODAY
1925 N. Lynn Street, Suite 1101
Arlington, Virginia 22209

August 15, 1995

Reed E. Hundt
Chairman
Federal Communications Commission
1919 M Street, N.W.
Room 814
Washington, D.C. 20554

Dear Mr. Chairman:

I am writing on behalf of The Foundation for Educational Advancement Today ("FEAT") to urge the Commission to approve the extension request of Advanced Communications Corporation ("ACC").

FEAT, a charitable organization was originally conceived by the Honorable Wilbur D. Mills, and implemented by Congressman Mills and Dan Garner, President of Advanced Communications Corporation. FEAT was created to encourage use of satellite broadcasting to every school and library in the nation and to help provide a receiver for every school, library and home in America. By using DBS, we will be able to bring a virtually unlimited variety of educational services and programs to children and adults in all 50 states and the Caribbean. It will also mark the first time that Alaska and Hawaii will receive any DBS service. Largely, through Chairman Mills' efforts, the Department of Education gave a starter grant to FEAT in 1990. To continue these efforts, however, it is vital that FEAT obtain a dedicated commitment of DBS frequencies for its educational mission.

Since 1988, Advanced Communications Corp. agreed to donate two transponders for use by FEAT and the YES ("Your Educational Services") Networks. This would initially provide 12 channels towards our educational goals. ACC is now working with Tempo Satellite, Inc. to dedicate two transponders to educational uses as Advanced originally proposed.

The donation of DBS transponders will allow an accelerated schedule for FEAT and YES to begin delivering educational, informational and other digital services. In addition, Advanced Communications has committed to contribute $15,000,000 to FEAT. With these resources, our non-profit organization will be able to provide our wide array of services to the nation.

I am enclosing a copy of an article entitled "DBS - The Time is Now", written for NAB by Michael S. Alpert, which chronicles ACC's approach to education. I urge you to re-read this objective report on the value and need for Chairman Mills' concept.

Sincerely,

Richard L. Mays
Chairman

Enclosure

cc: Commissioner James H. Quello
Commissioner Andrew C. Barrett
Commissioner Susan Ness
Commissioner Rachelle B. Chong

DBS

THE TIME IS NOW

MICHAEL S. ALPERT
President
Alpert & Associates

MARCIA L. DE SONNE

National Association of
NAB

MAY '94

CATEGORY II: PROSPECTIVE OPERATORS/SEEKING CAPITAL

Advanced Communications Corporation (ACC)

BACKGROUND/STATUS

Of the second group of DBS players, defined here as those seeking investment capital, ACC offers an attractive opportunity. The company is committed to operating a DBS business and has been one of the DBS innovators from a technology and programming perspective. It was the first of the DBS applicants to propose digital DBS transmission and it has developed the framework for providing enhanced educational capabilities using DBS satellites. The company's president is Dan Garner, a broadcaster and real estate entrepreneur who has recognized the potential of DBS since its beginning. Garner has surrounded himself with two highly qualified technical experts—Gordon Apple and Don Dement. These two individuals have assisted Garner in developing the technological framework that will allow ACC to offer a variety of special interest services that are designed to distinguish ACC's offerings from those proposed by other DBS operators.

ACC has applied and received from the FCC both an attractive orbital location at 110°W and a total of 27 channel frequencies representing 84% of the capacity at that orbital slot. The company has a contract with Martin Marietta Astro to construct its satellites. ACC is seeking strategic partners to make the necessary

investment in order to allow Martin Marietta to accelerate the construction of the satellites, and then begin DBS operations.

STRATEGY HIGHLIGHTS

In seeking strategic partners, the company is positioning itself as being in a "preferred position," that is, having an excellent orbital location for either full- or half-CONUS service, and a large number of frequencies which avoids having to negotiate with up to two other DBS licensees. Although ACC's position is compelling, mutually satisfactory arrangements between ACC and prospective investors have yet to be consummated.

As mentioned, ACC was the first to propose a digital system for DBS and has an approach that differs from other DBS proposals. ACC has developed a digitally integrated broadcast system that will be able to provide not only standard and enhanced television entertainment, digital radio, and high definition television (HDTV) services, but also many new types of services such as the delivery of electronic publications and a large number of low-cost interactive educational programs and courses. Overall, the system is directed at both inexpensive processor-based TV receiver/decoders and at powerful personal computers. The system is far beyond today's popular concepts of entertainment, multimedia and software applications, and intends to make effective use of receiver processor power and memory. This will allow ACC to provide services from high data rate HDTV to low data rate messaging services. Its system allows enhancements and augmentation of standard broadcast programming with features such as local interactivity, customized interactive advertising, and specialized language or handicapped services (e.g., picture in-set hand signing for the deaf.)

One of ACC's foundation strategies centers around education. The company believes that DBS will allow it to provide low-cost transmission of an unprecedented number of educational services to homes and schools anywhere in the nation. There will be two basic types of services offered—one a television-based educational course, and the other a computer-based course. Both will include seminars, educational games, and other educational materials using live instructors, video, audio, interactive multimedia, computers, and other techniques. ACC believes its system vastly improves the benefit-to-cost ratio over current distance learning distribution methods.

Accordingly, the company is developing what they call "Your Educational Services" (YES) networks. The purpose is to provide a large, varied amount of

educational services using digital transmission and ACC's satellites. These services will be received by schools, libraries, hospitals, and homes. In addition, the Foundation for Educational Advancement Today (FEAT) is tax-exempt public charity formed to encourage the use of this new type of educational broadcasting. To further this goal, ACC has pledged to donate up to four of its transponders to the educational foundation. Thereafter, the foundation will underwrite the development of the YES programming networks which will possess the potential of transmitting hundreds of educational courses and seminars nationwide. Another major goal of the foundation is to provide a free receiver to every school and library in the nation. A major strategic issue for ACC relates to the ability of FEAT to secure the necessary funding to achieve its ambitious goals. Table 7 provides a list of the types of potential services ACC might offer on its educational network.

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

Another of ACC's major strategies is to differentiate its digital transmission capabilities from others, thus giving the company a competitive edge even though it might be third or fourth into the market. ACC's digital integrated broadcasting system uses a flexible video compression format. It has the ability of combining a variety of transmission bit rates, quality levels, and specified screen

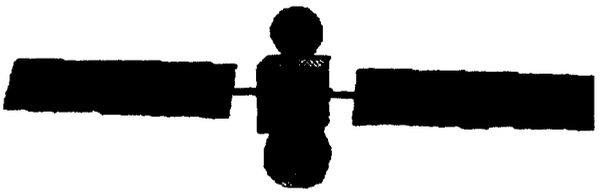
Table 7
Potential DBS Educational Services

- Satellite educational programming to all public and private schools in Americas
- Much improved access by rural schools to educational programming
- Specialized programs for extended education on public policy issues
- The extension of free air-time to the major political parties
- Cost-effective distribution of serial publications via electronic means
- Drug prevention and rehabilitation education
- Specialized programs for the elderly, especially issues relating to health
- Video and electronic publishing for training and education in business
- Life-long education, including graduate studies using multimedia techniques
- Educational programming to all child-care centers in America

video regions. ACC believes that it will likely be the only DBS transmission system taking advantage of dynamic multiplexing. In addition, ACC's system is designed to be the only DBS transmission system with total reallocation flexibility and the capability of multiple uplinks into the same transponder. With ACC's commitment to transmitting educational courseware with a large number of offerings on each transponder, multiple uplink capability into a transponder is important. ACC also believes that it is unique by being the first, and probably only, broadcasting system based on the principles of Object Oriented Programming (OOP)—a concept with origins in the computer software field. This approach will allow the company to provide new services based on interactive capabilities. Local interactivity will be attained by including an inexpensive but powerful processor in the receiver. Sufficient memory and software intelligence will be available for the receiver to operate almost autonomously while under the general direction of received commands that use received data and live, decompressed video and audio.

Another aspect of ACC's niche strategy is to provide for the delivery of electronic publishing. The company takes a long-term view of this opportunity and sees the time when someone designs a phased-array DBS antenna which can be kept pointed to the satellite while imbedded in the roof a car, boat, truck, or side of an airplane. Given the capability of ACC's digital integrated broadcast system, the company plans to deliver national and customized local news. General information will be delivered and will be either dynamic or static. Specialized information will be delivered to specific groups of people, such as professional organizations, hobby groups, humanitarian groups, religious organizations emergency services, or any other group of people who desire to have virtually instantaneous nationwide information dissemination. Finally, ACC plans to provide information on request. This information could be requested by modem and then delivered at high data rates through ACC's digital DBS transmission system.

In sum, ACC is in a unique position. It is not tied to a huge organization such as Hughes, a broadcaster like Hubbard, or a large cable MSO. Instead, it is a small, qualified group of entrepreneurs who have seen the enormous opportunity of DBS, have obtained valuable orbital real estate, and have developed the strategic framework for entering the DBS arena with differentiated technology and services.



ACE's DIBS* on ACC's Direct Broadcast Satellites vs. Alternatives

(*Digital Integrated Broadcast System)

May 28, 1993

by

G. Gordon Apple, PhD
Advanced Communications Engineering, Inc.
722 S. Broadway #30, Redondo Beach, CA 90277
310-540-6532 C/S: 71311,2544 AppleLink: D4887

Summary

ACC's digital Direct Broadcast Satellite system, employing ACE's proprietary DIBS (Digital Integrated Broadcast System) technologies, will be the most advanced broadcast delivery system ever known. While being able to provide standard and enhanced TV entertainment fare, digital radio, and HDTV to any location in the nation, the system will also offer many radically new types of broadcast services such as large numbers of low-cost **interactive** educational programs and courses. Directed at both inexpensive processor-based TV receiver/decoders and at powerful personal computers, the system is targeted far beyond today's popular concepts of entertainment, multimedia and software applications, making copious use of receiver processor power and memory.

ACC's satellites will be able to deliver these sophisticated services almost immediately upon launch of its first satellite, and do so for only a few hundred million dollars. Compare this with the **20 to 30 years and tens or hundreds of billion dollars** required to implement a fiber optic delivery system which will still not reach everyone. The ACC/ACE approach clearly delivers far more bang-for-the-buck and does it in a time frame (i.e., three years) that will make a difference, not only in entertainment, but in meeting the educational needs of the nation.

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1. Introduction

Advanced Communications Corporation (ACC) is one of two licensed Direct Broadcast Satellite (DBS) operators having a large number of channels and a premier orbital location for transmission to small antennas (e.g., 18 in. dish) anywhere in the nation. Advanced Communications Engineering, Inc. (ACE) was organized to design the system and develop the appropriate technologies to make new types of services possible.

Although ACC committed to using digital transmission long before any other broadcast entity in the world, in the past two years virtually the entire industry has fully embraced that concept. Now, the fully-flexible DIBS (Digital Integrated Broadcast System), designed by ACE, again significantly "raises the bar" by using and advancing state-of-the-art in signal-processing, transmission techniques, and Object-Oriented Programming (OOP) computer techniques to provide what is effectively a redefinition of the entire concept of broadcasting.

DIBS allows the efficient combination of disparate, variable-rate broadcasting services spanning high-data-rate HDTV, down to low-date-rate messaging services with many new types of services in-between. In particular, it allows enhancements and augmentation of standard broadcast programming with features like local interactivity, customized interactive advertising, and specialized language or handicapped services (e.g., inset signing). It also allows extremely efficient-but-effective low-cost educational broadcasts, including interactive simulations and off-line capabilities in addition to course lectures. These can be used for K-12, college, adult, remedial, occupational, industry, or group-specific applications (e.g., training emergency personnel such as police, fire, and medical).

Digital transmission and computer techniques have made many of these capabilities technically possible through a variety of media, some of which will be examined here. However, factors of **overall cost, cost effectiveness, accessibility, schedule, and overall utility** skew the comparison heavily in favor of DBS, and particularly ACE's DIBS on ACC's DBS.

2. Alternative Delivery Systems

The divisions between many of the systems discussed here are becoming increasingly blurred due to rapidly changing technologies and politics. We will treat them mostly independently, but note that most comments will apply similarly to hybrid systems.

Cable

Cable systems are the most obvious competitor to DBS for conventional television programming. Although about 60% of American homes are now passed by cable, the remainder may never be served by cable due to various economic factors such as geographic inaccessibility, low population density, or low economic density. Of those having service, problems with signal quality, unresponsive maintenance, and continually increasing rates are legendary. They were the primary reason for the recent re-regulation bill that is now being openly flouted and contested by the cable companies.

Some of the larger cable companies have made a commitment to convert their systems to digital, compressed video. This will allow them to offer more channels of standard programming, have better control of access, and to improve video and audio quality. However, it requires a substantial increase in investment in cable plant for head-end equipment, distribution repeaters and set-top converter boxes, and will not in itself add capabilities for any new interactive services.

Several companies are trying to get into using cable systems for delivery of various types of interactive services. Some proposed services are as mundane as channel switching between different camera views of an event or switches in a story line — services which could be provided today by using more than one TV channel and a standard remote control. Others are quite sophisticated but require the use of a very expensive computer-server and depend quite heavily on achieving sufficient local subscription density to become economically viable.

Pay-Per-View special events and movies-on-demand is another highly touted service Using any number of possible distribution means, the usual technique for the most popular first-run movies is simply to use multiple channels with staggered movie start times every 30 min. so that the average wait for a new movie would only be 15 min. There is also occasional discussion of high-speed burst transmission, particularly on fiber channels. However, that technique requires extremely large, fast-cache memory, capture, and longer-term storage means — something that does not exist today, nor will it by any extension of foreseeable technology.

Standard coaxial cable distribution is inherently a one-way distribution medium, i.e., point-to-multipoint. It is difficult to provide a return path through the same cable medium. Telephone or very-low-bit-rate RF links (e.g. the new IDTV services) are usually required for requesting services or otherwise interacting with the signal or program source.

Fiber Optics

Optical transmission through fibers can theoretically convey vast amounts of information, usually in digital form. Fiber itself is relatively low-cost and is low-loss. The latter means that many installations do not need regenerative repeaters between the information source and destination. For two-way, high-data-rate communication such as video telephones, optical transmission through fibers is the hope of the future. Also, it may eventually replace coaxial cable for home television reception. Because of the inherently high bandwidth transmission capacity and two-way capability, direct-access on-demand interactive multimedia is possible. Certainly, in any new installation it makes sense to consider installing fiber in lieu of coax or wire pairs. However, replacement of existing wire plant is a very expensive, long-term proposition.

Fiber is being promoted at several layers of the system: the nationwide distribution backbone; head end to local distribution nodes; Local-node to end-user/subscriber. The first is the subject of much discussion and possible government support for interconnecting major universities and industries. The second is being promoted by some of the telephone and cable companies, which would use existing coax or wire-pair plant for the infamous "last mile". This would require some fairly sophisticated equipment at the nodes. The third would take fiber link all the way to the subscriber and would be the best solution if it were not so expensive to do.

It should be noted that so far we have only treated the outside physical plant, not the terminal equipment, servers, and system/control software.

So far, estimates for outright replacement of the existing cable physical plant with fiber generally are in the **$400 Billion** range. Even the most egregious incremental-upgrade models are at least in the **tens of Billions**. In either case, the estimated schedule for replacement is **20 to 30 years, losing an entire generation.**

Wire Pairs

Until recently, using available modems for personal computers, the standard home telephone line was capable of data transmission of only about 2400 bps (bits per second). Due to new modem processor chips, this now has been raised to 14,400 bps which is getting close to the limit for data transmission on a voice channel. The big advantage is that voice telephone lines are universal world-wide, and although not 100% compatible, are standard enough that data can be exchanged with almost anyone having a similar modem. The existence of the telephone network and data modems has allowed the emergence of data service companies such as Compuserve and AOL (America On Line) who provide downloadable information, searchable information data bases (e.g., on-line encyclopedias), E-mail messages, and discussions — all accessible by local or long distance phone call from almost anywhere in the world. It is also possible to take courses via modem from some Universities.

On the same type of telephone lines, ISDN service (Integrated Services Digital Network) is starting to become available in some areas. "Basic" rate or "2B+D" service can provide up to 64 kbps or 128 kbps. This is still a point-to-point dial-up service, and then only between compatible terminal equipment. No dial-up information services or data services are available, and many believe that basic-rate ISDN is "too little, too late".

The most recent attempt to extend use of this vast wire plant is "Video Dialtone", which uses video compression and approx. 1.5 Mbps digital transmission to deliver VCR-quality movies on demand without interfering with a telephone call on the same wire pair. Normally, this transmission rate would require a repeater about every mile. However, using more sophisticated digital modulation techniques and taking advantage of transmission being unidirectional and single-link, repeaters can be avoided for most homes within telephone service areas. Service is requested by modem or by using the buttons on the telephone. Avoidance of new cable plant means that lower subscription densities could be economically viable. However, the technique is technically marginal at best and likely incapable of being extended to normal broadcast video quality, much less to HDTV. It could be technically viable for many types of interactive multi-media services such as home shopping, but again requires expensive centralized computer servers and switching plant.

Microwave

For some areas, localized relatively-low-power microwave transmission can be used for distribution. This can be analog or digital, although the latter has the potential of delivering locally-interactive services possibly delivered to the transmission site by satellite or fiber. It is feasible everywhere and suffers many of the problems of normal local TV transmission such as shadowing and multipath, but in the extreme. With digital transmission and adaptive demodulators, multipath (mostly reflections) can be used to advantage to increase local coverage density so that the bottom-floor apartment will not have to run a cable to the roof for reception.

Local Broadcasts

Standard, locally-broadcast television today is an expensive proposition requiring studios, equipment, personnel, very high power transmitters, and tall transmission antennas. For various historical, compatibility, and regulatory reasons, the signal transmission format is very rigid. The most customization possible is within a few lines in the vertical synchronization band to carry "closed captioning" information.

Terrestrial HDTV (digital) transmission will use the same over-the-air channel structure but with relatively low-power signals so as to allow use of a broadcast area's otherwise unavailable channels while not interfering with existing TV services. This standard has not yet been established, so it is not clear how rigid its data format structure will be. Because the personal computer industry is now starting to get some influence in this process, hopefully the format will be flexible enough to allow many other types of local broadcast services eventually to be offered.

C-band/Ku-band Satellites

For general home television service, C-band satellites, with or without video compression, can pretty much be dismissed. Terrestrial interference limits the these to low power. This, and the relatively low frequency and close satellite spacing, limit receiving antennas to fairly large units which are not allowed in most residential settings today. They are useful for program distribution to terrestrial distribution points and for two-way communications at much lower data rates.

The availability of medium-power Ku-band satellites has led several companies to consider using these for home video service. However, receiving antenna sizes are still relatively large and close satellite spacing still limits how small a receiving antenna can be used.

All 50 states now have some type of television "distance learning" program operating on C-band and/or Ku-band satellites. These all require substantial receiver antenna installations. Digital video compression is now being used by a few operations such as NTU (National Telecommunications University) to provide up to 5 or 10 simultaneous courses in one transponder.

Other High-Power Direct Broadcast Satellites

According to the limited information publicly available, the Hughes DirecTv DBS system is designed primarily for delivery of standard TV programs and movies — the latter possibly in wide-screen EDTV format. Each transponder will carry a usable information rate of about 23 Mbps. Using MPEG-II video compression, each transponder can carry three or four standard TV programs. Initial receivers will be able to extract data needed for only one of these programs at a time. (In contrast, ACC's approach is to demodulate the transponder's entire bit-stream and then select what is desired.) No interactive, enhanced, or innovative services have been announced for the Hughes DirecTv system. An RS-232C serial computer port will be able to route data files or computer programs to other devices. An upgrade or new receiver will be needed later for HDTV, which will occupy most or all of one transponder. The program offering is likely to be mainly standard cable-TV type fare plus pay-per-view movies, some time-staggered over multiple channels. Like all true high-power DBS systems, programs will be received on relatively small (e.g., 18 in.) antennas anywhere in the nation.

3. Interactivity

There is a lot of talk today about "interactive" television. It means entirely different things to different people depending on what they are capable of offering. Here we discuss a few of them and try to at least establish the range of capabilities that they encompass.

Channel Switching

Its hard to imagine switching TV channels with the remote control being touted as "interactivity", but that is precisely what is often meant by the term. With video compression allowing the number of delivered channels via cable or satellite to be substantially increased, service providers are working overtime to try to figure out what to do with this extra capacity.

One suggestion is that sports channels can have multiple views of the action, allowing the subscriber to choose a view. This is like switching news channels to get more info on an event, except that the particular type of views could be better defined such as the view from the end zone, the blimp, or the 50 yard line.

Another suggestion, actually being tested in a theater, is to offer parallel story line segments, allowing a subscriber (or a group of subscribers) to determine in what direction the storyline will progress from that point. While being an interesting experimental concept, it requires careful planning by the program producer, much expense, and offers the chance to irritate whoever else is watching.

Service Requests and Polling

This is the ability to either request delivery of a program, service, or product or to authorized reception of a program or service. We also include in this category the ability to respond to polls or game shows. A limited amount of this is now being done by using "800" or "900" telephone numbers for requesting pay-per-view or for doing home shopping. **The key factor is that the data rate is extremely low** from the subscriber back to the system or the originator. This return path can theoretically be done through cable systems, but is not easy to implement. Some have proposed using part of the RF spectrum for this type of return-link capability and is in fact the focus of the IDTV services such as "TV Answer". It is an expensive proposition for its very limited capabilities, requiring set-top boxes which transmit to cellular-type community receivers that are then linked by VSAT terminals.

Off-line

Off-line use of the TV set involves everything from Nintendo games to existing CD-I and the recently demo-ed graphics-effects-laden offering from 3DO. The medium of choice is the Compact Disk (CD) which is by far the most economical form of digital distribution and playback. Once purchased, it has the advantage of not incurring connect charges of any kind, and is an interactive medium that is available anytime for use at the owner's leisure. In addition to library reference materials, many programmed-learning titles are becoming available for many different disciplines. And it is not just math and

science. Many interactive Hypermedia disks are available for teaching music appreciation, history, and current events.

As recordable CD and other recordable media become the norm, it will be possible to download off-line interactive multimedia through digital broadcast systems, either on request or in conjunction with real-time broadcasts such as educational courses. For example, this is how you may receive your customized multi-media newspaper which could be removed and used from your portable computer while getting ready for work and commuting to work.

On-Line On Demand

This is what most people mean today when referring to interactive systems accessible through telecommunications. The subscribe pushes a (screen) button or enters a keyboard command which sends a message to a remote server system which accesses the requested information and returns it to the subscriber. This can be as simple as spell-checking a word to something as sophisticated as returning a locally-interactive laboratory experiment simulation with built-in voice and video instructions on how to set-up a series of experiments. The advantage of this approach is that the information could be available at any time. Obscure information could be accessed when and only when needed. IBM has already made massive investments in this type of interactive multi-media and is presently attempting to involve cable companies.

There are many on-line information server systems available by telephone data modem. Compuserve and America On Line (AOL) are the prime examples. The latter has recently launched local on-line newspaper access in conjunction with major newspapers in several cities. These systems today are almost exclusively text based, although image files and even movie clips can be downloaded. The latter can take a substantial period of time to transmit over the phone line. Even though the data rates are relatively low, from 2400 bps to 14,000 bps, access time on these systems is very expensive, ranging from $5/hr to $30/hr. Thus, **one measly hour on-line can cost the same as an entire month's cable or satellite TV access bill.**

On-line interactive multimedia will require vastly higher data-rates. **The problem with this approach is not just the cost of the transmission medium** which is the emphasis in the discussion of **fiber optic networks.** The server-computer hardware, software, access switching equipment, and network operation are expensive and must be geographically dispersed in massive quantities to avoid choking the long-haul networks. On-line interactive multimedia could be viable at some time in the future if **all** of these expenses decrease rapidly enough and if it ever reaches critical market mass, which is highly questionable.

DBS distribution does not have all of the advantages of on-line impulse access. However it has the obvious cost advantages of only needing a single or limited number of distribution points, does not need any of the network control and switching, is totally independent of the massive terrestrial distribution plant, and what else can we say except that "by comparison, it's dirt cheap". In addition, DBS distribution does not preclude the use of expensive on-line services when absolutely necessary, e.g., you require manual archival research or an endangered species decides to nest in your antenna dish.