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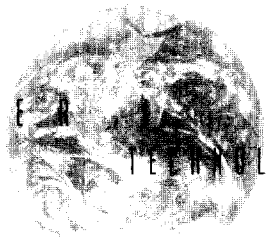


CHAPTER 1 TECHNOLOGY TRENDS & SERVICE IMPLICATIONS

INTRODUCTION

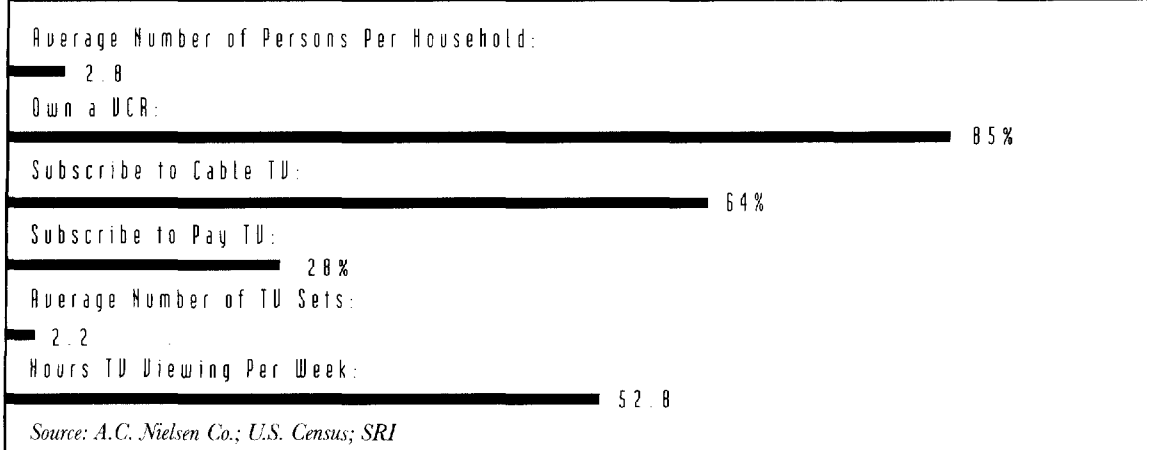
A fundamental shift is taking place in the way that television programs and related video, data and text services will be delivered to homes and schools. This shift has been captured in a broad metaphor: public television is becoming public telecommunications. The programs and services we provide are delivered by many forms of electronic communication, not just broadcast television.

Behind the simple metaphor lies a dizzying array of technologies that are affecting not just public television but commercial television, cable, computer service providers, publishers and telephone organizations. These technologies include digital video, online networks and the Internet, direct broadcast satellites, fiber optics, video servers, and multimedia computers, among others. Equally daunting are the proposed services that will be delivered to homes and schools: video programs retrieved from a special storage device on-demand, interactive programs, 500 channels of niche services, multimedia databases, and video telephone calls.

At the same time, there is a great deal of hype and pie-in-the-sky promises being generated by technology marketers. In this environment, how can public television management come to grips with what is really happening and create a plan of action to move forward? *The New Plain English Guide to Technology* addresses these issues. It does not provide a technical analysis for station engineers. Rather, it provides a layman's guide to new technologies and services for station managers in programming, production, education, planning and other nontechnical departments.

The Guide describes major technology trends and the implications of these trends for consumer services. It also reviews new technology activities by commercial groups such as cable operators and telephone companies as well as how these activities may affect public television. A strong emphasis is placed on the telecommunication trends within public television and the many activities and services that are utilizing new technologies. The Guide concludes with a discussion of practical and strategic issues for managers as they plan for the future.

A SNAPSHOT OF U.S. HOUSEHOLDS, 1995



Source: A.C. Nielsen Co.; U.S. Census; SRI

Some of the major questions addressed in the Guide include:

- Which of the new technologies and services are most likely to affect public television?
- How will viewers' relationship to television change over the next few years?
- What opportunities are presented by the emerging technologies for public television to provide new or improved services to homes and schools?
- Are stations developing new services by themselves or in partnerships with other organizations? Who are potential partners for joint ventures and how do stations find these partners?
- What are the risks associated with developing new services and what are the risks associated with doing nothing?

TECHNOLOGY TRENDS AND SERVICE IMPLICATIONS

A series of technological developments is leading to dramatic changes in television. These include digital compression, advanced television, fiber optics and direct broadcast satellites (DBS). Another set of technological developments presents opportunities to enhance television services or, alternatively, to compete with television for the attention of audiences. These include interactive TV, CD-ROM and online systems.

Many new services build upon these technological developments, including video-on-demand, interactive program guides, telecommuting services, multimedia education content and electronic bulletin boards.

It is important to understand the major terms and acronyms that represent these new technologies and services, e.g., video servers, DBS, electronic program guides, ADSL and video dialtone. It is even more important to understand the realities behind the new technologies–to distinguish real trends from the hype that inevitably surrounds new technologies. In addition, many timing and pricing issues need to be addressed: when will the technologies be available; how soon will service providers and consumers adopt them; and, what will they cost? It is also useful to track the groups that are developing the technologies and services along with the industry convergence that is occurring among broadcast, cable, computing and telecommunications organizations.

From a public television perspective, it is essential to follow these trends and assess their implications. What opportunities are provided by the new technologies? Do any of the new technologies or services pose a competitive threat? Should public television move forward quickly and provide new services or wait a few years when more consumers and schools will be able to receive the new services? Different stations serving different types of needs are taking a number of approaches. In this sense, there is no single answer to the question–what should a station do? At the same time, several clear and consistent trends among stations are emerging.

To help you come to terms with technology trends and understand their implications both for public television and our audiences, this chapter will explore:

Technology Trends

This section treats several important trends in telecommunication technologies–online networks, video servers, upgrades to cable systems and telephone networks, multimedia, direct broadcast satellites and digital TV– that are changing the types of services that broadcasters, cable operators and telephone companies can provide as well as how users access services.

Consumer Service Implications

This section describes some of the new services that can be provided in the emerging telecommunications environment–teleshopping, tele-education, telemedicine, interactive TV programs, electronic program guides, video-on-demand, personalized media and multimedia.

TECHNOLOGY TRENDS

Online Networks

Online networks are electronic text information services that are usually accessed through a personal computer and modem hooked up to a regular telephone line. Most services available to consumers and businesses are subscription-based and provide a variety of fea-

tures and topics such as news, electronic mail, shopping and reference resources managed by an online service company. In order to access an online service, a dedicated software package is generally used. The software allows you to make the communication connection to the service and access any of the features provided by the particular company.

The first online services (or videotext services as they were originally known) started commercially in the U.S. in the late 1970s. Newspaper companies were among the first information providers to see online services as a logical new delivery vehicle for their editorial content, advertising and features such as crossword puzzles. Many new services were created out of partnerships between news or information providers and communication companies. Over the first decade, online services grew at a slow pace. The recent rapid development of the personal computer (PC) market, combined with lower costs for high-speed modems and the wide availability of the Internet, however, has boosted the popularity of online services. Several companies launched new services in 1994-1995 as the number of potential customers increased.

Today, online services offer a wider variety of advanced communication features to their subscribers:

- Electronic mail (e-mail), a traditional online feature that originally provided communication between subscribers on the same service, can now be sent through interlinked networks to members of other online services. Individuals on any public online service, therefore, are now interconnected to one another through e-mail.

- Bulletin boards are a form of communication for groups. Typically, bulletin boards are organized around topics such as travel, parenting, investing in stocks, etc. People post messages in a bulletin board for all users to read. Others can reply to specific messages or add new comments.

- "Chat" is yet another form of communication among online users. Chat is a real-time text conversation between two or more people who log on to the same online service at the same time. Messages typed on the screen appear instantly for anyone who is participating in the chat session. While most uses of "chat" involve conversation and socializing among people discussing hobbies and general topics, there are also managed forums and "meetings" which involve community, education and entertainment themes. For example, a doctor, politician or TV celebrity can be scheduled to participate online and to "chat" in real time about a specific topic.

The Internet

In simple terms, the Internet is a connection among computer networks around the world. It is a "network of networks." The standard computer language or protocol by which the thousands of networks and millions of computers on the Internet are linked makes it possible for them to communicate with each other. All linked networks have a unique Internet address. By entering its address, an Internet user is connected to a particular network anywhere in the world to search through information, request files or send messages. The computer networks accessed can be located virtually anywhere in the world at a government department in the U.S. or at a university library in another country, for example.

The Internet began in the 1960s as a military project funded by the U.S. Department of Defense. The U.S. Government wanted to establish a system to link computers and communications together in a network with no primary or central control point that could be obliterated in a nuclear attack. The set of standards and protocols used to link these computer networks became the basis for the Internet today. Through the years, several nonmilitary research organizations around the world, including the National Science Foundation and various universities, began to fund extensions to the system.

Today, the Internet has grown to thousands of interconnected networks. There is still no ownership of the Internet although most networks that connect to or provide access to the Internet are privately owned. A vast majority of networks and businesses operating on the Internet provide information free of charge to anyone who enters their site. A few companies, however, charge a subscription or membership fee to retrieve data or search through their files. The market is wide open and the long-term structure of the Internet is hard to predict.

Within the Internet, there are a few specific features and general capabilities. A very popular feature of the Internet is the World Wide Web (WWW). The World Wide Web is one aspect of the Internet that is enhanced with graphics and user-friendly navigation. Many companies and organizations that are joining the Internet have established themselves with a WWW presence exclusively. In addition to allowing colorful graphics and stylish screen design, WWW pages contain "hyperlink" connections. A hyperlink is a word, phrase or image that is underlined or highlighted on your screen to indicate that it will lead you into another area within the Internet if you use your PC mouse or keyboard to select it. By selecting the link, you are either connected to a specific screen with more information on the item or you are presented with a list of related Internet locations from which you may make a selection. For example, a paragraph on education may mention libraries. If the word "library" is highlighted, you may select the word to see a listing of Internet sites that relate to libraries. Additional features and characteristics of the Internet include:

- FTP (File Transfer Protocol)–a feature that allows you to access another computer for the purpose of downloading files.

- Usenet Newsgroups–a bulletin board-like feature with thousands of topics and sub-topics.

- Search Tools–databases of Internet sites where you can enter a key word or phrase and be directed to a list of matching locations.

- HTML (HyperText Markup Language)- the computer language for pages on the World Wide Web. HTML is what allows WWW pages to be linked together.

- GIF (Graphics Interchange Format)–a widely used graphics format developed by CompuServe. It used to be the primary graphics file format supported on the World Wide Web.

- JPEG (Joint Photographic Experts Group)–a standardized image compression mechanism. With its ability to support a wider range of colors and and generally smaller file sizes, it has begun to supplant GIF as the dominant Internet graphics file format.

- URL (Uniform Resource Locator)–the address for a site, page or resource on the Internet. A typical URL is a long string of letters and punctuation marks, e.g., http://www.pbs.org.

A technical issue that is key to Internet usability is connection speed. A high percentage of activity on the Internet involves downloading files and viewing screens with extensive graphics. Slower speed modems, therefore, make Internet access prohibitively slow. As higher speed modems become readily available at reasonable prices, screen access and downloading time will become less of an issue. Some online service providers are counting heavily on integrating Internet features into their offerings and are looking into ways of providing even faster access to their subscribers. One idea is to make services accessible through Integrated Services Digital Network or ISDN (a high-speed telephone connection). Since ISDN requires special phone equipment, it may take a few years for truly fast Internet access to become commonplace among users.

INTERACTIVE TELEVISION

A Brief History of Interactive Television

Interactive television has become a popular buzzword for a futuristic television environment in which people can play video games in competition with other households, choose from a library of movies on demand and participate in telecourses where a teacher and students can see and hear each other. There have been many attempts to launch interactive TV services in the past, with mixed results; however, some simple forms have been operating for many years.

The earliest interactive TV program was *Winky Dink and You*, a 1955 CBS cartoon program for children. In order to interact with the program, children were supposed to buy a

special plastic screen and place it over their TV screen. When the cartoon character ran into trouble, children were asked to draw on the TV screen to help him. Unfortunately, some children failed to buy the plastic screen and simply drew on the TV set, leading to an early demise for Winky Dink.

Interactive TV has been tried many times over the past few decades and produced mixed results. In the late 1970s, the National Science Foundation and other federal agencies supported a number of trials for education and social services. The trials were successful in demonstrating what could be done with interactive TV, but technical problems, high costs and organizational barriers prevented most of them from becoming regular services. The trials employed many forms of interactive TV including two-way video between locations and one-way video with a return data signal from end users, e.g., to answer multiple choice options presented in the video.

Warner Amex Cable also tried interactive TV in the late 1970s and early 1980s. Their QUBE system was installed in Columbus (Ohio), Pittsburgh and Dallas, among other cities. QUBE employed one-way video and a return data signal from homes: people could press one of four buttons to vote on options in a program, participate in polling and answer questions in educational programs. QUBE shared a similar set of experiences as the NSF trials: high costs, technical problems and relatively low usage levels. It too was withdrawn after a few years.

During the 1980s, a simpler and cheaper form of interactive TV began to emerge in public television and other educational video. It used one-way video and return audio (via telephone calls) to the live host or teacher and, in some cases, return data. Many of these services have been successful and are in regular use, although they have received little attention in discussions about interactive television. The outlook for interactive television has improved more recently as many very large broadcast, cable, telephone and computer software companies enter the market. These companies are offering a wide range of new products and services ranging from the simple and inexpensive to the very complex and expensive. It is difficult to imagine how some could possibly survive, yet others are doing quite well.

What Is Interactive TV?

There are many terms associated with interactive television. The first important set of terms is "downstream" and "upstream." Downstream is the TV signal and anything that accompanies it as it travels from the source of the programming, e.g., a cable operator or a TV station, to users in homes or schools. Upstream is the return path which allows the user to respond to questions or ask for changes to the program being shown. The request for changes would be sent back to the TV station or cable system, or in some cases, merely provide instructions to the TV set, interactive videodisc player, VCR or special purpose terminal box. It carries video, audio or data as people make choices, answer polling questions or talk back to the host of a program. With these distinctions in mind, it is possible to classify interactive television systems under four categories:

Pseudo-Interactive TV

These systems include additional information within the downstream signals from the station or other delivery system. The additional information does not show up on the screen except by viewer command, and is stored in a local terminal device and updated by the delivery system as needed. Early examples include teletext, which is widely used in Europe but was never successful in the U.S. More recently, a variety of specialized terminal products have begun to appear in the market. These products offer services such as viewer guides, automated VCR control, video games and expanded advertiser information. Most of these services make use of the same coding structure that public television has used for many years to provide closed captioning services. Public television can take pride in being the champion for this technology, including recent leadership in convincing Congress that caption decoders be built into all TV receivers over 19 inches. This action has been responsible for much of the renewed commercial interest in broadcast data services. A number of the new services appear to be fairly successful. The PBS/Sony-sponsored timing signals to set VCR clocks and PBS Enterprises/National Datacast customer program guide and games services offer some recent examples of services carried by many public television stations.

The National Association of Broadcasters has sponsored testing of several approaches to add much higher capacity data services within existing television broadcast signals. The NAB expects the necessary industry standards for such a system to be completed soon. One of the senior NAB executives was recently appointed CEO of a new company established by a consortium of commercial television stations to exploit new services which could be carried by this system.

Another type of pseudo-interactivity is provided by the interactive laser disc. PBS Video and the associated producing stations have introduced several very successful interactive disc titles for educational use such as *Eyes on the Prize*.

While most people would not include multiple, time shifted schedules as a form of interactivity, its purpose is to offer the viewer more "control" of program schedules in a simplified form of video on demand. The program schedule "control" device in this case is the remote control channel selector. HBO and Cinemax have found time shifting to be very successful and a cost-effective way to improve viewership and profits in any cable operator who has a system capacity of at least 36 channels. Even more frequent schedule shifting is likely to become far more common in the so-called 500 channel world. Bundled sets of channels dedicated to a common theme are also likely to appear. For example, in news programs, viewers will be able to select more in-depth coverage of a few topics after the initial news program introduction rather than continuing to watch "sound byte"-style coverage of all the topics covered by the standard program. Each selected topic would be covered in a style more like *The NewsHour with Jim Lehrer*; in sports programs such as golf, a viewer will be able to select a channel which spends more time covering a specific player, or during the Olympics, simultaneous events can be covered on different channels. (This was tried unsuccessfully on pay-per-view, but as the producer has confirmed, unacceptably high prices discouraged most interested viewers.)

Low-End Interactive TV

Low-end systems include one-way video downstream signals with upstream audio, e.g., a teacher in a telecourse provides the downstream video and students at a distant location provide upstream audio via a live telephone call to the teacher. It also includes video downstream and upstream data. The upstream data may be in real time, as when students answer multiple choice questions using a special upstream data terminal, or it may be in non-real time, as when students use electronic mail or computer bulletin boards to communicate with a telecourse instructor between televised programs.

High-End Interactive TV

High-end systems allow each individual end user to request different video segments from a program provider. The video segments might include hundreds of movies, a specific news story from a menu of stories in a news program, or one of several versions of a TV program–each with a different ending.

In high-end interactive TV, hundreds of channels and potentially thousands of video segments are stored on a video server or within a network of linked video servers. Individual users can request one of the channels or video segments and it is delivered to their specific home or location at the time of their choosing. By contrast, in regular cable TV or broadcast TV, a group of prescheduled channels is transmitted together to all homes with a TV set or all homes hooked up to cable. With high-end interactive TV, users also can play video games against other households, do home banking and shopping over TV, and interact in other ways directly over the TV system.

How It Works

High-end interactive TV can be provided over an advanced telephone or cable network. In both cases, a very high capacity video storage device called a video server stores video segments in digital form (the zeros and ones of computer technology). When an end user requests a video segment, the data are pulled from the video server in discrete packets and sent over a high capacity transmission system to homes or other locations. The video is sent through a switch that links the source of programming and the end user in a way similar to a telephone switch that links two callers. The end user requires a special set-top box that can receive the packets of data as they are sent, convert them back to regular analog TV and put them together to form video programming.

Hybrid Interactive TV

Many interactive TV systems do not fit simply into the low-end or high-end categories. For example, one recent unsuccessful system added interactivity to regular programs such as game shows or sporting events. There was nothing interactive within the programs. Rather, the interaction took place on a separate terminal and display screen where questions were posed and viewers could answer. One major commercial broadcast network has recently launched a very successful online data business around categorized news clips from its broadcast news and cable business news services. It offers these clips tagged with special content identification labels and content sorting software as a pay service to computer terminals for industrial subscribers. The clips can be sorted by topic, company name, industry or by a variety of other means decided upon by the users. The network can send alert notifications to any user terminal about major events about to be broadcast concerning the user-selected categories. Videotape copies of the program segments also are available at extra cost. Another system–one with a good track record–uses four channels on a cable system to provide viewers with some choices. For example, in sports programs, viewers can pick one of four camera angles by switching to one of the channels; in news programs, viewers can pick the order of stories they watch and get more in-depth coverage of a story by picking one of the four channels.

Technical and Financial Issues

There are many technical and financial issues surrounding interactive TV. The most difficult is in trying to predict consumer acceptance and response to any new service. It is clear that there are varying limits to how much most people are willing to pay and how much complexity they will tolerate in the home in order to receive different types of services. Caption decoders provide a good price barrier example. The portion of the middle-income audience making use of captioning services has grown since caption decoding receivers have entered the market. This is surprising because most of us would have characterized captioning as the type of service which would already be available in such households. VCRs are an excellent example of how to exceed complexity tolerance. Very few people use time offset recording, for example, the typical VCR owner cannot even remember how to set the clock. Cost and complexity are the only way to explain why the general public has not responded well to home recording or pay-per-view television but has funded the creation and growth of a very large videotape rental and sales industry. It is worth noting that people will overcome both cost and complexity barriers if they place sufficient value on the resulting service. For example, video games and the Internet have fueled an explosion in sales of personal computers which are not always easy to set up or operate and which sell at more than twice the price of television receivers.

Clearly, the industry must continue to study and try a variety of new interactive services to find its way through the unpredictable maze of consumer attitudes.

High-end interactive TV has captured most of the media attention, with its promise of an almost infinite quantity of programming on demand and two-way video. System trials in various parts of the country are very impressive but leave many unanswered questions, such as:

- What will the equipment cost for system providers and end users? For system providers, there are many costs including video servers, video switches, new transmission lines and storage costs. These equipment costs will be very high in the near term, e.g., $1,000 to $2,000 per subscriber. So, a system built for 50,000 users might cost $50 to 100 million. These costs are expected to drop over time and they can be further reduced by employing a clever strategy in building the architecture for the network. For end users, one significant cost will be the new set-top box that will be needed to decompress and convert digital video packets into regular television signals. Estimates vary between $200 and $700, although early set-top boxes in trials cost considerably more. A second issue is the cost of interactive TV service. This is largely unknown and will not be clear until after a few trials have determined what system provider costs are and what users will be willing to pay.

Video Server Costs	Cost for nCube Servers		
	Level 1	Level 2	Level 3
Price	$1 Million	$4 Million	$15 Million
Storage Capacity	190 Hours	885 Hours	3,500 Hours
Number of Simultaneous Video Streams	1,800	7,200	28,800

Source: Multichannel News

- What is the best system architecture for interactive TV services? Cable operators and telephone companies are investigating many technical options in building systems. For example, should they build new fiber optic networks that go directly into homes and schools, rely on existing coaxial cable or twisted-pair telephone lines with more sophisticated compression of signals, or create hybrid networks that mix some new fiber optic cable with existing coaxial cable and twisted pair? Similarly, should they put most of the "intelligence" required to offer interactive TV in the computers at cable systems and telephone companies or place more intelligence in the set-top box? These engineering questions will have significant impacts on costs and the timing of service developments.

- Managing user traffic and other new problems. In broadcast TV, there is no question about how many people can simultaneously receive a TV signal everyone within the range of a broadcast transmission can receive a TV channel. In interactive television, things are very different. If too many people simultaneously try to access an interactive service, some may get a video "busy signal." If an interactive TV system becomes overloaded in trying to send the appropriate video packets to everyone, the television picture may stop in some homes or there might be a jump in the action. The only way to resolve these issues and determine how many people will do what, as well as how much equipment is needed to service them, is through rigorous testing in real world trials and tests.

All of the uncertainties surrounding high-end interactive TV suggest that service development is likely to be slower than many companies have predicted. Further, initial costs for system providers and end users are likely to be high. These costs will drop over time and large scale manufacturing of equipment will lead to lower prices, as engineers better understand the most efficient ways to provide services. While near-term interactive consumer services are likely to be geared to more modest systems, there are many other applications for this technology that are likely to be developed soon. These include interactive TV for corporate training, for the purpose of ordering movies in hotels, and the use of video servers to insert ads or promotional announcements in regular television programs. These applications, in turn, will help to reduce costs and increase knowledge about the best ways to design interactive TV systems.

Upgrades to Cable Systems

Traditional cable TV systems in the 1980s provided a modest number of television channels (10 to 35). Today, cable TV systems are being upgraded to provide many more TV channels as well as data, voice and two-way video services. They are preparing for competition with telephone companies and direct broadcast satellite services. The components in the upgrading process include fiber optics, digital compression, switched video, cable modems and personal communication services (PCS).

Fiber optic cable is replacing traditional coaxial cable in many cable systems. The advan-

tages of fiber optic cable include lower maintenance costs, higher capacity and better signal quality. Most cable operators are not replacing all of their traditional coaxial cable. They are replacing part of the older plant in order to keep the cost of upgrading manageable. As a result, many new terms are emerging that reflect where the fiber is located in the cable architecture: fiber-in-the-backbone, fiber-to-the-neighborhood, and fiber-to-the-pole. For example, fiber-in-the-backbone means that the cable system has fiber in its main trunk lines only; fiber-to-the-pole means that fiber lines go right to the pole outside a subscriber's home. The closer a cable operator brings fiber to a subscriber, the higher the capacity of the service and the more it is likely to cost. Also, some cable multiple system operators (MSOs) are using fiber to link their cable systems in a region. This allows them to share the use of some expensive equipment and reduce the demand on the cable headend of each system.

Digital compression is another technique to increase the capacity of a cable system. By converting analog TV pictures to digital signals and compressing them through complex electronic processing, a cable operator can effectively squeeze more signals through the same pipeline. The amount of compression employed by a cable operator varies by the type of programming (e.g., a talk show can be compressed more than a football game) and the quality of picture that a consumer is willing to accept.

Digital compression is a key element in the promised "500 channel" cable environment. However, it has proceeded more slowly than some had predicted because it requires special equipment in homes to "de-compress" the compressed signals and display them on regular TV sets. The estimated cost of this equipment is $300 if it is in a separate box. More recently, some companies have offered a set of computer chips that could be placed in VCRs or TV sets. This would reduce the cost significantly and may speed up the implementation of digital compression.

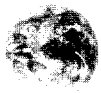
Two-way switched video is at the heart of advanced interactive television systems or "full service networks," such as Time Warner's experimental system in Orlando. Switched video allows each household to receive separate video programming under their command and control, e.g., to order a movie from a library of hundreds of movies. However, switched video is very expensive. In early experimental systems such as in Orlando, the household equipment costs approximately $5,000; headend equipment costs are in the millions. Even when switched video is implemented on a large scale, the cost for cable operators will be significant–approximately $850 per subscriber. Such costs are more likely to be justified in a multiple service environment where a wide variety of video, data and voice including telephone services are offered.

Cable systems are beginning to offer data services to homes, businesses and schools, e.g., access to the Internet and commercial online services. It is also possible to download video games to home game terminals. The long-term advantage of cable in offering data services is very high speed (see chart).

ESTIMATED COST OF A FULL SERVICE NETWORK
(LARGE SCALE IMPLEMENTATION)

Technology	Estimated Cost Per Subscriber
Home Equipment	$300
Cable Infrastructure	$300
Video Servers & Headend Electronics	$250
Total Cost Per Subscriber	$850

Source: Multichannel News



MODEM TRANSMISSION SPEEDS	TIME TO TRANSMIT A 6 MEGABIT FILE	
	(10 Megabits equals approximately 10 seconds of compressed video)	
	Regular Telephone Line	
	9.6 Kilobits (Kbps) per second	138 minutes
	14.4 Kbps	93 minutes
	28.8 Kbps	46 minutes
	Enhanced Telephone Line	
	56 Kbps	24 minutes
	128 Kbps (ISDN)	10 minutes
	1.54 Megabits (Mbps) per second (T-1)	52 seconds
	Cable TV System	
	4 Mbps	20 seconds
	10 Mbps	8 seconds

Source: Convergence Systems Inc. & Cable World

In the near term, cable systems are transmitting data services at more modest speeds–closer to ISDN speed over a telephone network. Some early trials experienced problems in sending data at very high speeds. In addition to these technical problems, the barriers to very fast cable data services include the high cost of early cable modems and a need to have a return signal from homes or schools. Most current cable systems are not two-way. In order to implement data services, a cable operator has to add a return signal from end users or use the telephone network to obtain return signals. This latter hybrid arrangement of downstream data through cable and upstream data from end users through the telephone network requires a complex installation.

Personal communication services (PCS) are a form of telephone service. Just as telephone companies want to offer a form of cable TV service, many cable operators want to compete with telephone companies in providing telephone service. PCS is actually a hybrid telephone service because it uses both the cable system and some radio spectrum to provide two-way audio. There are many technical issues that must be resolved for PCS to be viable, including standards, backup power supplies and interoperability (i.e., how PCS interconnects with regular telephones as well as cellular telephones). Further, some question the technical skills of cable operators to provide telephone service. In order to deal with this issue along with the high cost of building the new infrastructure, some cable operators plan to form joint ventures with telephone companies from outside their region to offer PCS.

Upgrades to Telephone Networks

Not too long ago, the telephone network was used to provide plain old telephone service (POTS) and little else. Then came faxes, electronic mail, voice mailboxes and other services that used the traditional telephone network. In the near future, the telephone network may provide high-speed multimedia services, video telephone calls, cable TV and interactive TV. How can the telephone network handle all of these new services? The answer lies in how telephone companies are upgrading their traditional networks into modern telecommunication highways.

During the past decade, telephone companies have been replacing old copper telephone lines with fiber optic cables and introducing new digital switches that connect one household to another. Today, virtually all telephone transmission lines between cities are fiber optic; more than half of the transmission lines to local central offices are fiber optic; and many transmission lines into local neighborhoods are fiber optic. However, to complete the job and bring fiber optic cables into every home will cost $200-$300 billion and may take another 20 years.

[illegible]				
FIBER DEPLOYMENT*				
Thousands Of Fiber Miles				
1990	1991	1992	1993	1994
5,397	6,826	8,270	10,230	11,930

Source: FCC
**(Includes Long Distance, Local Operating Companies & Urban Fiber Systems)*

Telephone companies do not have to complete the job of wiring America with fiber optics before offering advanced services. The infrastructure that is currently in place will support many new services. Further, by adding other components to the telephone network in selected markets, they can offer advanced services to those markets.

Integrated services digital network (ISDN) is one example of a service that is widely available within the current telephone network infrastructure. ISDN is made possible by the electronic digital switches that have been installed in telephone company central offices. Essentially, ISDN offers a complete digital path from one end user to another. Basic ISDN service provides two moderately high speed voice/data channels and an additional lower capacity data channel. These channels can be used separately, e.g., for two high fidelity telephone lines, or they can be combined into a single 144-Kpbs data channel that will support low-end video telephone service or a very high-speed access to multimedia content such as photographs and sound on the Internet. ISDN service costs $30-50 per month for the line plus six to ten cents per minute of use.

The toughest decision facing telephone companies is how to offer video service. There are four basic options. Two involve upgrading the telephone network and two involve going outside the network.

- VIDEO DIALTONE is the most sophisticated and costly option. It involves upgrading the telephone network with fiber to a point close to homes (the signal going into homes can be carried by fiber or a coaxial cable like the one used by cable TV systems) and installing video servers (discussed earlier) as well as asynchronous transfer mode (ATM) packet switching technology. ATMs manage digital traffic and move packets of data at very high speeds to their intended destinations where the packets are re-assembled.

  In addition to high cost, video dialtone has many regulatory implications for telephone companies and their customers. Under video dialtone, telephone companies are common carriers. This means that they must allow anyone to offer video services just as anyone can make a telephone call. This lack of control is not attractive to telephone companies. For this reason, as well as high cost, they have been slow to implement video dialtone.

- ASYMMETRICAL DIGITAL SUBSCRIBER LINE (ADSL) is a second option for upgrading the telephone network to provide video service. It is much less costly than video dialtone but also provides a lower quality video signal. ADSL uses existing twisted-pair copper cables in homes as well as on poles in neighborhoods and the existing fiber optic backbone of the telephone network to deliver highly compressed digital video. ADSL requires little or no upgrading to the telephone transmission lines but it does involve costs for video servers and requires special hardware in homes.

  A few telephone companies have tested ADSL (e.g., Bell Atlantic) and claim that the "VCR quality" picture it delivers is acceptable to consumers. Some critics argue that early adopters of new video services will demand very high-quality pictures at least as good as their cable TV picture. Others warn that faulty telephone wiring in many homes (often installed by consumers) will seriously degrade ADSL video signals even though it is good enough for regular telephone service.

- OVERBUILDS or constructing regular cable TV systems in competition with an existing cable TV system, are an

option outside the telephone network. Under this scenario, a telephone company may decide that video dialtone is too expensive and ADSL service won't work. Instead, it goes into the cable TV business in direct competition with existing cable operators. A more feasible alternative from a technical perspective would be to integrate the fiber optic telephone network infrastructure with existing coaxial cable networks. This was the planned arrangement between Bell Atlantic and TCI until the cable industry was re-regulated. This alternative continues to have appeal to both industries and may re-emerge as a result of recent moves toward deregulation.

- WIRELESS CABLE is the second option outside the regular telephone network. Wireless cable uses microwave transmission to deliver television channels to homes that are equipped with special receiving antennas that look like small satellite dishes. Wireless cable has been available for a long time, although it has been plagued by many technical problems. Recently, some advances in wireless technology along with digital compression that greatly expands the capacity of a wireless cable system have made the technology more attractive.

Evolution of the Personal Computer

The personal computer has become a mainstream consumer electronics item for the home. It is estimated that by 1995 more than 40 percent of the homes in the U.S. had a personal computer. Further, the number of PCs sold to consumers each year has been growing rapidly. According to the Electronic Industries Association, the amount of money spent by consumers on PCs in 1994 ($8.07 billion) nearly equaled the amount spent on television sets ($8.4 billion). When the IBM PC was first introduced in 1981, the approximate cost (monitor, keyboard and computer) was $3000. Today, the cost of a PC for the home has dropped significantly while the processing speed, memory and other features have advanced past the levels of some mainframe computers that were sold before 1981.

PROJECTED GROWTH FOR COMPUTER HOUSEHOLDS, 1995-1998

Year	Computer Households (Millions)
1995	40.0
1996	43.0
1997	46.0
1998	48.0

Source: Veronis, Suhler & Associates

Two of the most significant enhancements to the personal computer are modems and CD-ROM drives. Modems transform the PC from an information storage and data processing device into a communication tool. Modems link a PC to other PCs and large mainframe computers over telephone lines and, in some cases, cable television networks. Through these links, users in homes, schools and businesses can send electronic mail, exchange opinions on electronic bulletin boards, obtain information from large databases and play games with other PC users. Approximately one-third of PC households have a modem and the percentage is growing rapidly since almost all new PCs sold are equipped with a modem.

PROJECTED GROWTH FOR CD-ROMS IN HOUSEHOLDS

Year	Millions of Households
1995	9
1996	12
1997	16
1998	21
1999	24

Source: Multimedia PC Marketing Council & Cable World

The CD-ROM drive is a storage device with very high capacity. One CD-ROM can hold an encyclopedia or a large database. CD-ROMs can also store audio and some limited video segments. As CD-ROMs evolve and digital compression improves, video storage capacity will expand to include movies and other full-length video programs.

CHANGES IN COMPUTER COST & PROCESSING SPEED

	Approximate number of instructions per second	Price
1975 IBM Mainframe	10,000,000	$10,000,000
1976 Cray 1	160,000,000	20,000,000
1979 Digital VAX	1,000,000	200,000
1981 IBM PC	250,000	3,000
1984 Sun Microsystems 2	1,000,000	10,000
1994 Pentium-Chip PC	66,000,000	3,000
1995 Sony PCX Video Game	500,000,000*	500*
1995 Microunity Set-Top Box	1,000,000,000*	500*

Sources: Company reports; The New York Times
** Estimated*

The addition of modems and CD-ROMs as well as microphones and speakers is rapidly changing the PC into a multimedia terminal with significant new capabilities for education, entertainment and communication. This is made possible by the extraordinary increase in computing power over the past decade, as prices have declined.

The computing power found in PCs is also finding its way into televisions, VCRs and video games. These are sometimes called "smart TVs" or "smart VCRs" because they can process information much like a computer. For example, computers are facilitating new combinations of home entertainment and information linked to TV sets. Such home information centers allow viewers to use their television to display interactive text versions of news, sports and weather as well as provide banking services, electronic mail and shopping. Also, new TV set top converter boxes with computer technology are being distributed by cable and direct broadcast satellite service providers.

Some industry analysts believe the TV and PC will merge over the next ten years. They argue that one device will serve both functions. Others believe that the functions of TVs and PCs will remain distinct but, at the same time, each device will share many features, i.e., TVs will have computer power and PCs will be able to play video and sound.

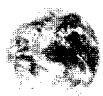
Direct Broadcast Satellite

Satellite transmission of TV signals began in the mid 1970s as a way for broadcast networks and other distributors of TV programs to reach local stations and cable headends. Public broadcasting led in the use of satellites for distribution of TV signals to local stations. Consumers first became aware that they could pick up TV signals directly from satellites in the late 1970s when Neiman Marcus advertised a satellite dish in their catalogue for over $30,000. There were no buyers at that price, but soon companies began to offer TV receive-only (TVRO) satellite dishes for a few thousand dollars. The dishes were 10 to 12 feet in diameter and could pick up dozens of TV signals (eventually, over 100 TV channels). A small market emerged during the 1980s, primarily in rural areas where there were no cable systems and relatively few over-the-air broadcast channels. TVRO dishes also became popular in hotels, bars and other businesses that wanted to attract customers by providing many TV channels.

In the early 1980s, several companies announced plans to launch a new generation of high-powered satellites that would serve consumers directly and require much smaller dishes. After examining the cost of launching the satellites and developing services, however, each of the companies dropped its plans. By the early 1990s, the costs associated with launching high-powered satellites had dropped and plans were renewed to launch direct broadcast satellite (DBS) service for consumers. These plans were helped significantly by the 1992 Cable Act that required program suppliers to sell their programming to non-cable distributors. This prohibited cable MSOs from denying access to their programming by satellite service providers.

As plans for DBS moved forward, cable companies attempted to beat the high-power service providers to the punch by launching their own DBS service on a medium-powered satellite. The medium-power service required a six-foot receiving dish whereas the high-power services could be picked up with 18-to-20-inch dishes. But in other respects, the services were similar.

By 1995, approximately five percent of U.S. households had a satellite dish. Most of these were the older and larger TVRO dishes, but approximately one-third were the new generation of DBS medium power or high-power dish receivers. This is low compared to some countries, e.g., 40 percent of homes in Ireland have a satellite dish, but it is a greater percentage than in most countries. High or low penetration of satellite dishes varies enormously and is affected by country regulations, cable penetration and the ability of households to pay for the technology.



PENETRATION OF SATELLITE DISHES IN SELECTED COUNTRIES - 1995

Country	Percentage of Households With Satellite Dish
U.S.*	5 percent
Ireland	40
Germany	16
Japan	19
France	1
India	1

Source: The New York Times *& Electronic Industry Association*
** Includes TVROs, Medium Power and High Power DBS*

The advantages of DBS are that it is cheaper to build a system compared to cable (there are no wires on streets), so a company can reach the entire U.S. very quickly. Also, DBS service providers have been the first group to use digital compression. This has increased sharply the number of channels they can provide and it produces a superior picture and sound compared to cable. (It should be noted that some DBS customers complain that the picture can break up momentarily during fast-action sporting events.) The extra capacity has also allowed some DBS operators to offer 50 channels of pay-per-view movies, which has been attractive to many customers. In addition, the next generation of digital receiving equipment will have some interactive capabilities.

The disadvantages of DBS include a lack of local broadcast signals–DBS provides a single national service. Consumers can subscribe to an off-the-air alternative DBS package that includes an affiliate for each of the networks as well as one public TV station. Under current FCC rules, the DBS provider can do this without approval of the local station so long as the DBS service is blocked in any household where the network programming can be received from broadcast signals from a network-affiliated station. It is not clear that there has been strict compliance to this rule in some DBS markets. Several of the high-power DBS service providers require potential subscribers to pay approximately $700 for the hardware to feed one TV set and $900 for the hardware to feed two TV sets. These costs are expected to decline in 1996 when additional manufacturers offer equipment in the marketplace. Medium power DBS service providers currently include and install the equipment as a part of their subscription service. In either case, program service fees are slightly higher than equivalent packages offered by local cable systems.

When DBS services were launched in 1994, it was assumed that the early adopters would be people in areas with no cable service and people who were dissatisfied with their local cable operator. While these groups have been prominent among early DBS subscribers, a surprisingly large percentage of early adopters have been people who also subscribe to cable. That is, they are video aficionados who want more of everything.

Some analysts believe that DBS has a narrow window of opportunity to establish itself before cable upgrades are completed and new wireless cable services are offered by telephone companies. DBS system operators argue that they do not require a very large number of subscribers to be viable—five to ten percent of U.S. households would provide a profitable business. However, it is unclear how many DBS service providers can survive if the total audience is 5 to 10 percent of U.S. households.

Digital TV

Television is about to change from analog to digital. Our current system established by the National Television Systems Committee (NTSC) uses analog waves to capture and trans-

mit images as well as sounds. Over the next decade, television will move towards a digital system in which images and sounds are captured and transmitted as zeroes and ones–the digital code used in computers. Digital television has many advantages. It does not degrade through many generations of editing and it also can be compressed to provide four, five or more channels in the same bandwidth required for one channel of NTSC television. It also provides a crystal clear, snow-free picture to all TVs that can receive a minimum level signal. There are limitations, however, and any TV receiving a signal below this minimum gets no picture at all. In this sense, pictures do not degrade with distance as with NTSC television. They "drop off a cliff" when the signal does not meet the minimum requirements for a complete picture. Even so, field tests conducted by PBS show that the advanced television coverage provided within the service area is much greater than the coverage provided by the current NTSC service. Everyone associated with the ATV development process was surprised by the number of locations within the service areas where reflections or interference made the over-the-air NTSC picture unwatchable. Some cable subscriber drops located furthest from the headend exhibited similar problems with several NTSC channels. The ATV services did not exhibit such problems. Similarly, a poorly installed coaxial cable in a home–one that would provide a ghost-filled image of NTSC television–might not produce any picture at all with digital TV.

There are several important issues associated with digital television, including its role in high definition TV (HDTV), how digital TV signals can be compressed, what advanced television alternatives are made possible by digital technology, how TV studios are changing to digital, and what new set-top boxes in homes are necessary to receive digital signals.

- DIGITAL COMPRESSION is a technique to squeeze video, audio and data signals into a smaller transmission pipeline or storage device. It is used to store computer programs on a smaller number of diskettes than would otherwise be required and to hold more audio on a compact disc. In television, digital compression takes advantage of the fact that many things do not change from one video frame to the next. For example, the background may remain the same as an actor moves his face and body. A compressed signal only transmits changes in the video. This sounds simple, but it is a very complex process.

  Digital compression has evolved slowly. Many different systems have been introduced. However, it now appears that a common standard is emerging for the television industry–MPEG II, a standard set by the Motion Picture Experts Group, an industry technical committee. The process of digitally compressing a signal has improved significantly in the past few years. The cost of equipment to digitize and compress video also has come down significantly.

- HIGH DEFINITION TV (HDTV) will provide much sharper images, better quality sound and a different picture shape (more like a wide-screen motion picture in theaters than a traditional TV picture) compared to the 50-year-old NTSC television system that is now in use. The FCC began the process of looking for a next generation TV system in 1987. Over the next few years, 23 different HDTV systems were proposed. Most of the early proposals were for analog HDTV. The analog proposals followed the lead set by the Japanese, who launched an HDTV system in Japan via direct broadcast satellite in 1989. Sales in Japan have been slow due to the high cost of HDTV sets and the lack of good quality HDTV programming.

HDTV IN JAPAN

HDTV SET COSTS & SALES, 1991-1994

	Average Cost of Sets (US Dollars)	Estimated Number Sold
1991	$25,000	100
1992	$12,000	8,000
1993	$8,000	12,000
1994	$6,000	30,000

Price of HDTV Sets in 1995 = $4,500

Sources: Wall Street Journal; The New York Times; Broadcasting & Cable

Over time, however, the advantages of digital HDTV became apparent and most industry groups rallied around digital HDTV. Eventually, a "grand alliance" was formed at the urging of the Technical Committee of the FCC Advisory Committee in order to combine the best features of each of the four proposed digital systems. The combined system has completed testing and has been judged to meet or exceed all industry requirements. The FCC Advisory Committee Technical Committee has unanimously approved this system and recommended that the grand alliance system be adopted by the FCC and approved the industry standards describing this system. The latest FCC timetable for adoption of the ATV standards has been delayed through congressional action until late 1996 or early 1997 in order to evaluate the potential for carrying out an auction of the new channels. This delay should not have an impact either on the cable or DBS industries, which are likely to proceed with plans to introduce ATV by the fall of 1997. One preliminary estimate by Zenith is that early HDTV sets will cost $1,500 above the cost of a current TV set. So, a 30-inch NTSC set that costs $1,000 today will cost $2,500 as an HDTV set.

An encouraging development recently announced by Hitachi uses a slightly expanded MPEG II decoder to filter the incoming HDTV signal in an inexpensive way to match the resolution of pictures to smaller or existing TV sets. Such an approach could significantly reduce the costs of more conventional sized ATV sets and make it practical to upgrade existing TV sets.

One of the problems facing the FCC in trying to implement HDTV has been how to find spectrum for the high-bandwidth signal. The original analog HDTV proposals would have required at least four times the bandwidth of NTSC TV. With digital HDTV, the signal can be compressed into approximately the same space as a regular NTSC channel. The broadcast industry determined that it was feasible to assign the currently unused channels within the existing TV broadcast band to each existing station to broadcast in HDTV without causing interference to existing NTSC channels. The coverage areas of the new channels could match the coverage areas of existing channels in nearly all cases if a very carefully constructed channel assignment plan were followed. This approach was recommended to the FCC so that the industry could simultaneously transmit in NTSC and HDTV. In this way, consumers with old NTSC TVs would not have to throw them away. The marketplace could slowly move over to HDTV. After a number of years, when everyone had purchased an HDTV set, broadcasters would be required to give back the extra spectrum they had received for the transition period. The proposal has met with much opposition, as the concept of advanced television emerged.

▲ ADVANCED TELEVISION was initially coined by the U.S. broadcast industry as a term to cover a variety of ways in which the existing NTSC service could be improved, added to or replaced with a separate higher quality service. At that time, it was assumed that true HDTV could not become a broadcast service because it contains five times the information of NTSC. The eventual development of digital HDTV has demonstrated that it is possible to provide all this information within a single broadcasting channel. This in turn has highlighted the inefficiencies and waste associated with existing broadcast channels. If one digital channel can carry five times the program information, why not carry five different programs of existing program quality?

This recognition has led to a redefinition of the term "advanced television" to cover all the possible uses for the digital channels and has thrown both HDTV and the channel assignment process into greater confusion. In theory,

a broadcaster could offer four or five channels of programming instead of one. Similarly, a cable operator could significantly increase the capacity of a cable system and "multiplex" pay services such as HBO, i.e., transmit HBO on three channels so that each movie is shown several times per month. Others have argued that in a digital world there is no need for a single standard. There could be many picture resolutions depending upon the need and willingness to pay. For example, some extra digital channels could be transmitted at NTSC resolution, others could have slightly higher resolution, and still others could be transmitted with full HDTV.

- DIGITAL PRODUCTION STUDIOS AND TRANSMITTERS are likely to be commonplace early in the next decade, as stations and cable operators evolve towards a future that is completely digital. However, it involves some very large expenditures for capital equipment. Broadcasters estimate that the full conversion of production and transmission of HDTV may cost about $10 million. Fortunately, the digital conversion can enable stations to significantly improve production and broadcast quality and, at the same time, reduce some operating costs. In the near term, many stations are moving towards a digital environment in stages. Among the first pieces of digital equipment that have been broadly adopted are digital graphics workstations. In addition, many broadcast groups including PBS have purchased digital insertion equipment. Commercial stations use this equipment to insert commercials efficiently. PBS and some public TV stations use it to insert promotional announcements and underwriting messages. Some new cable networks, e.g., Home and Garden TV, have built fully digital studios. Many groups are beginning to adopt digital recorders and digital editing suites. Digital compression technology has provided the foundation for the huge expansion of satellite transmission channels by both public television state networks and by PBS. Automated digital program feed systems and the large number of highly compressed digital satellite channels form the foundation that makes the start-up of commercial DBS services financially feasible.

- DIGITAL SET-TOP BOXES are expected to be introduced on a large scale in 1996-1997. Cable set-top boxes were originally used to provide cable TV service to TVs that were not cable-ready. Later, set-top boxes became addressable. This allowed cable operators to activate channels in a home without having to physically visit the home, e.g., for pay-per-view movies or when someone ordered a premium movie channel such as HBO. Recently, a new generation of set-top boxes has been introduced. These accept digital signals and provide a variety of sophisticated features. The boxes are analog devices enhanced by computer technology to provide some digital processing. An important business decision facing service providers is whether to use the enhanced analog boxes now or wait for the next generation of fully digital boxes. Some of the largest cable operators have decided that the risks of waiting are simply too great. These large operators currently have standing orders for more than ten million digital boxes.

  Some of the advanced features offered by enhanced analog and fully digital set-top boxes include graphic and text display of electronic program guides and the ability to allow various software downloads to change what the set-top box can do. Fully digital boxes will support these functions as well as process digitally compressed video. They also can be configured for interactive television and video telephone calls over cable.

  One of the problems in designing a set-top box in today's environment is that it must be flexible enough to adjust to rapid changes in technology. It must also be inexpensive enough–under $250–to be viable in the marketplace. Cost can be reduced if the components

CABLE BOXES 1983-1995

Year	Millions Of Cable Households
1983	1.7
1985	2.4
1987	5.4
1989	13.0
1991	17.6
1993	20.9
1995	23.0

Source: Showtime Event Television

of the set-top box are built into a TV set or VCR.

CONSUMER SERVICE IMPLICATIONS

Competition and New Services

The communication marketplace is filled with new competitors: direct broadcast satellite is competing with cable, cable is competing with telephone companies and online services are competing with print. In an environment with high levels of competition, lower prices and innovations that will lead to new services are expected. So far, consumers have not seen lower prices. DBS is more expensive than cable, and cable operators have not lowered their prices in the face of competition from DBS or telephone companies. Innovation also is illusive. Generally, new competitors have offered consumers more of the same types of services they already have. When examined more closely, however, innovations are emerging. Some are genuinely new services offered in market trials and tests, others are advances to existing services, and still others are a new wave of services that were tried in the past but not broadly adopted.

Telebanking/Commuting/Education/ Medicine/Shopping

There has been an explosion of interest in providing services to people who are far from a bank, school, hospital, etc. Many of these services were touted in the past as the next wave of technological innovation, but then failed to find a market. As in the past, it is not clear which services will become a permanent part of the landscape and which will find too little support to become viable. Some of the services that are emerging include:

- TELESHOPPING seems to have become a permanent part of television programming through QVC and HSN. Another form of teleshopping involves the selection and purchase of products through telephone-based online services such as Prodigy or America Online. Many groups have announced or begun online shopping services over the Internet, although questions remain about the security of credit card information sent over the Internet. The next wave of development is teleshopping on fully interactive television systems. In these shopping services, users can control what products are displayed and can place an order using a special interactive television remote control.

- TELEBANKING or "virtual banking," also is emerging as a new consumer service. Home banking has been available for more than a decade, but it has received only modest acceptance by consumers. More recently, a number of large and small financial institutions have announced plans to provide a new generation of money management services including checking accounts, money market and mutual fund accounts, credit and debit cards, brokerage and bill payment services. These financial services do not require a visit to a branch. Rather, they are available through a combination of telephone and computer-based delivery systems. Customers can choose to do their banking in conjunction with readily available money management software for their computers or use special software provided by the financial institution.

- TELECOMMUTING is another concept that has been around for a long time. Serious attention to telecommuting started in the early 1970s during the

OPEC oil embargo, but the cost of telecommuting technology was prohibitive 20 years ago. Telecommuting has gained momentum recently because of the increased penetration of personal computers in homes and lower costs for devices such as fax machines. The availability of low-cost office equipment for homes has transformed working remotely from an exotic activity to a natural extension of the office.

- TELE-EDUCATION has been part of the technology and media environment for more than 50 years, beginning with the use of radio for distance learning in rural areas during the 1930s. It gained some momentum in the late 1970s when satellite technology made it possible to distribute live video instruction almost anywhere in the U.S. and further momentum in the 1980s when low-cost computers and modems were adopted by many schools. It also has established a good track record. There is now renewed interest in sharing scarce teaching resources through telecommunications not just in rural areas but in all school districts and college campuses.

- TELEMEDICINE continues to hold the promise of easier access to scarce resources–both medical specialists and expensive diagnostic equipment–at a site that is remote from the patient who is being treated. As with tele-education, economic pressure is creating a favorable atmosphere for using telecommunications to give doctors and patients access to expensive resources located at a distance. The increased use of visiting nurses to care for patients in their homes also has created new applications of telephone-based support for health care professionals.

Interactive Programs

The promise of interactive programming is to place video under the complete control of viewers. This might include choosing which segments in a news program to watch first and the ability to call up extra video segments about a story. It also could include choosing how a mystery program will end, participating in game shows from home or competing in a TV game of chess against someone in another household. Interactive TV also is likely to include many commercial applications such as home shopping shows in which a viewer can choose which products will be shown and the ability to select what version of a commercial will be shown, e.g., a commercial for a station wagon, sports utility vehicle or an economy sedan. Most of these applications of interactive programming are still in market trials or trade show demonstrations. The most common form of interactive programming in the marketplace is educational, e.g., live telecourses in which students at a distant site can communicate with the instructor. Some interactive programming in education also allows teachers to give exams over TV (students answer questions with special data terminals), poll student opinions and even see the students at remote sites.

Killer Applications

There is much talk about "killer applications" for interactive TV and other advanced communication services. This refers to a service or program offering which is so compelling and profitable that it renders the entire service a success. In the cable industry, some argue that HBO was a "killer application." When cable was entering major cities in the mid-1970s, HBO was a very compelling offer that led many to adopt cable. Today, there is much debate about what might be a killer application for interactive TV, e.g., interactive games, home shopping or movies-on-demand. It is also possible that there is no killer application. Often, new services win acceptance in the marketplace by offering a broad collection of reasonably attractive services at a moderate price.

Video-on-Demand (VOD)

Video-on-demand is a potential "killer application" in the minds of some. With VOD, a large selection of movies or television programs is stored on a video server. Users can order a specific movie or video program and see it immediately. VOD can accommodate many users at the same time–the actual number depends on the capacity of the video server. Further, many people can watch the same movie or TV program, each starting at a different time. Some VOD systems also provide VCR functions

for end users. They can stop, rewind and fast forward through content on the video server.

Near-Video-on-Demand (NVOD)

Near-video-on-demand is a less expensive alternative to VOD. With NVOD, a moderate number of movies are carried on special pay-per-view channels. Each movie is carried on three or four channels, with starting times 10 or 15 minutes apart. As a result, each movie is available "nearly" on demand—it will always be starting within a few minutes. A large capacity cable system (or a moderate capacity system with digital compression) might assign 60 channels to NVOD and carry 15 movies, each on four channels.

Electronic Program Guides (EPG)

With the promise of cable systems offering hundreds of channels to their customers, a variety of EPG services are moving into the marketplace. Electronic program guides provide viewers with listings of TV shows for the current day and several days ahead. The on-screen guides can custom-sort programs by themes and subjects. This feature may be used to sort a day or week's worth of programs into specific categories such as "sports" or "movies." In addition, some of the more sophisticated functions provided by EPG services include point-and-click VCR recording, program searches by title and features that allow the viewer to sample segments of movies and shows prior to making a selection.

The program guide field is crowded and very competitive. Several companies are trying to win acceptance; only a few are likely to succeed. Delays in the roll-out of digital set-top boxes recently have prompted a few aspiring service providers to drop out of competition.

There are three critical issues associated with electronic program guides:

- How many consumers will be willing to pay $50 per year (the subscription cost for some on-screen TV guides) plus the initial cost of hardware to receive the service?

- There are many companies competing for this market and many complex marketing arrangements. The field of EPG service providers has narrowed recently and is likely to narrow even more. Winners and losers may be sorted out more by marketing alliances than by who offers the best service.

- The way EPGs present program choices could have a significant impact on program providers. An EPG can "steer" viewers toward certain programs and highlight or promote specific programs. Marketing affiliations may affect who receives prime shelf space in the program guides. Also, EPGs are likely to encourage more program viewing by content category. For example, sports fans could program their guide so that they see sports programs predominantly.

Multimedia

What does the term "multimedia" mean? It implies that two or more forms of media are used in a service or device. Television and films have pictures and sound, but are not called "multimedia." The term has become an all purpose descriptor for new combinations of sound, pictures, text and data. Often, "multimedia" is used to describe an enhancement to a familiar medium, e.g., a computer that can play sound and video is called a multimedia computer. As these enhancements become more common or popular, the new combination may come to be known by a unique name or simply be integrated under the old name.

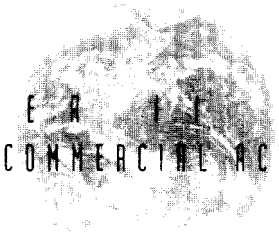
Personalized and Customized Services

In the same way that telemarketing personalizes a sales presentation ("Good evening Mr. Burns, I'm calling you tonight because....") and direct marketing customizes advertisements by including your name in the text of a letter, new media are providing many ways to personalize and customize their services. For example, online services encourage users to set up their own "path" to go to the services and content areas that interest them. With games and other participatory activities, the names of participants and the winning scores are posted and shared with other players. Channel selection on TV systems also can be customized so users can surf through their favorite channels and skip

over channels they do not like. Over the next few years, there will be many new ways to personalize and customize media.

Multiple Channels

Video compression technology enables more than one channel to be broadcast within the same bandwidth. Broadcasters are beginning to think about expanding their franchise by supplementing their prime feed with additional channels. For example, a public TV station could take its existing content and create three or four services, e.g., an education service, a children's service, a news and documentaries service and a nature service, each broadcast on a separate digitally compressed channel. The proper extent of and mix of such services will represent a major challenge to the station programming organizations. Multiple channels–even if originated from the same public television station–can compete with each other for the same audience if they have similar audience appeal. The acquisition of more programs can complicate an already difficult problem of obtaining high quality primetime programming. Even so, a well-organized schedule containing a variety of properly selected standard resolution programs, combined with some high-quality single channel primetime programs offered in HDTV, might prove to become a very successful broadcast service for many public television stations. In a cable or telephone environment supported by video servers, some channels could be created temporarily. For example, if a major news story broke during coverage of a sporting event, a station could create a temporary second channel and provide the news story for those who wanted to view it, while others could continue to watch the sporting event.



CHAPTER 1: COMMERCIAL ACTIVITIES & QUESTIONS FOR PUBLIC TV

COMMERCIAL ACTIVITIES

Online Services

Dozens of commercial online services offer access to large information databases, electronic mail, games, education services, shopping, banking, bulletin boards on special interest topics and live chat sessions. After growing slowly during the 1980s, they expanded rapidly in 1994 and 1995. They have benefited from the increased number of homes with PCs and faster speed modems as well as lower costs for computing equipment. Over the next few years, users will be able to access online services at even faster speeds via ISDN (a high-speed data service over the telephone network) and through broadband cable networks. Some of the major services and their focus of activities include:

- COMPUSERVE–The oldest of the main online services, CompuServe, an H&R Block company, began in the early 1980s. It was established originally to make use of the spare capacity of a large computer system during off-hours. CompuServe quickly established itself as a service for working professionals to share information about topics of interest to specialized groups. Employing a bare bones, text-only format and an emphasis on communication, CompuServe grew at a moderate pace and was one of the first services to become profitable. Later, it added graphics capability and began to provide access to the World Wide Web.

- AMERICA ONLINE (AOL)- Started in 1989, America Online grew rapidly to become the most popular online service in the U.S. It accomplished this through lower pricing and strong marketing that placed AOL in the basic software package of many PCs sold to businesses and consumers. AOL also established relationships with many strong information providers. *The New York Times, Omni* magazine, Scholastic and American Express are a few of the companies that have established feature sections on America Online. Such an arrangement is mutually beneficial for the sponsoring company and AOL. That is, this type of participation allows a company or organization to control content and promotions within its unique section as if it had its own online service. Through this, AOL has been able to provide a larger variety of features to its subscribers without having to create the content. Like other major online services, AOL recognized the growing popularity of the World Wide Web and began to offer Web access to its customers in 1995.

- PRODIGY -Prodigy, an online service owned jointly by IBM and Sears, began in the mid 1980s. It started as an information and entertainment service targeted to a wide audience of adults, teens and children. For this reason, it adopted a strong graphics look and feel from the beginning. Prodigy has expanded some of its content areas through partnerships with third party information providers. Companies such as ESPN and CBS now sponsor and update featured sections within Prodigy.

  Prodigy also became the first major service to provide a fully operational World Wide Web browser to its subscribers. With increasing interest in the Internet, the Prodigy Web browser attracted a large number of new users who wished to explore the rapidly growing number of graphics-oriented Web sites. Prodigy also moved rapidly to increase access speeds, including access via high speed ISDN. The biggest need for ISDN lines comes from customers who are interested in