

**The Elephant and the  
Blind Men: The Phenomenon  
of HDTV and Its  
Would-be Stakeholders**

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***Program on Information Resources Policy***

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of HDTV and Its Would-be Stakeholders**

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## Executive Summary

- A body of commercial users is far ahead of consumer entertainment interests in implementing HDTV technology. These HDTV applications – many of which are already computer-based – represent a range of well financed, innovative users including the military, medical community, and automotive/aerospace and printing/publishing industries. Users justify the high initial cost for using HDTV through cost savings and productivity increases over older video technologies or processes. As early adopters of HDTV technology, these users are driving its commercial implementation and have a significant effect on HDTV-based hardware and software development.
- Hollywood and several players in the "distribution" business (interexchange and satellite carriers, private fiber companies, and the telcos) are already in a position to make money from HDTV.
- Local exchange companies (RBOCS and independents), while perhaps viable in commercial distribution of HDTV, face a difficult technology path and significant regulatory hurdles in providing consumer-oriented HDTV services.
- The broadcasters and cable TV industry have little incentive to play in and many problems to overcome before they can become players in the consumer HDTV arena.
- Watch the television manufacturers. They are driving consumer HDTV and have a clearly-identified strategy for a succession of advanced TV receivers to replace the embedded base.
- The computer industry, while expressing concern over HDTV's evolution, has yet to articulate a clear, affirmative role for itself.
- Prompted by HDTV, the television and computer industries may be on a collision course. These industries diverge on technological and market perspectives, but they converge on identical functional requirements for displaying video information. This conflict currently takes the form of a debate over analog vs. digital technologies for providing video information.
- Television is serving a "real" market with advanced TV receivers available now. The computer industry has yet to get its act together. This scenario may give TV manufacturers a significant advantage when the two industries collide.

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## Preface

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*"The road is long, with many a winding turn  
that leads us to who knows where . . ."*

Lyrics from "He Ain't Heavy,  
He's My Brother," by The Hollies

---

Crisp, sharp pictures. Vibrant colors. Wide screens that put you on the fifty-yard-line at the Super Bowl. These are the promises of High Definition Television (HDTV) that have been shouted from the pages of the *Wall Street Journal*, *Business Week*, and *IEEE Spectrum* magazine and reverberated throughout Washington at the turn of the '90s. Touted as the ultimate fantasy of couch potatoes and the savior of the U.S. electronics industry, HDTV is a phenomenon that seems to offer something for everyone. Everyone who is (or believes he or she is) a stakeholder in the great HDTV debate claims to have the "right" view of HDTV's importance – or lack of its importance – and the definitive approach for its implementation.

This paper attempts to separate the hype from the reality, to provide some clues as to which stakeholders have got what it takes to play in the HDTV game, and to convey some insight into how HDTV may develop. It draws its observations and conclusions from the series of appendices following the paper itself.

The appendices include a brief primer on HDTV technology, a characterization of the Supplier Industry Stakeholders, and a discussion of the User Stakeholders. At the end of each stakeholder appendix is an "industry scorecard" summarizing the industry's prospects in HDTV. These industry scorecards are summarized and analyzed in the two figures presented in chapter 4 of this paper.

Each appendix is a stand-alone characterization of its subject. Some readers may wish to read selected appendices first to better familiarize themselves with the technology or the stakeholders before tackling the paper itself.

This paper reflects the state of events and data as of August 1990 when it was finished and distributed for external review. Since that time (during the review process), some significant changes in industry and technology have occurred.

Appendix I serves to capture these changes and their strategic importance so that the reader will be updated to events as of January 1991 and alerted to the speed at which fundamental changes are taking place.

## CHAPTER ONE

### INTRODUCTION

Everyone has heard the story of the six blind men who, by touching the individual parts of an elephant – the ears, legs, trunk, tail, and so on – attempt to determine what animal it was. The six men come up with six different answers, depending on which part of the elephant they encountered. So it seems to be with high definition television (HDTV) today. HDTV can be a slightly or significantly different animal depending on who describes it – broadcasters, cable TV operators, advertisers, computer industry folks, or TV set manufacturers.

In fact, it is often not clear even what is meant by HDTV since it is also lumped together with similar acronyms like ATV (advanced television), IDTV (improved definition television), and EDTV (enhanced definition television). While it might be nice to suggest that this paper will clarify HDTV to everyone's satisfaction, with the diverse – and sometimes shifting – perceptions of the would-be stakeholders and the unknowns in the technology itself, it seems foolish to crawl out on that limb today.

Instead, this paper evaluates the phenomenon of high definition television, not by defining what it is – the definition varies according to which "blind man" one talks to – but by what it can do to, and for, the stakeholders described here. After reading this paper, readers can then decide for themselves whether HDTV is an elephant, a mouse, or something in between.

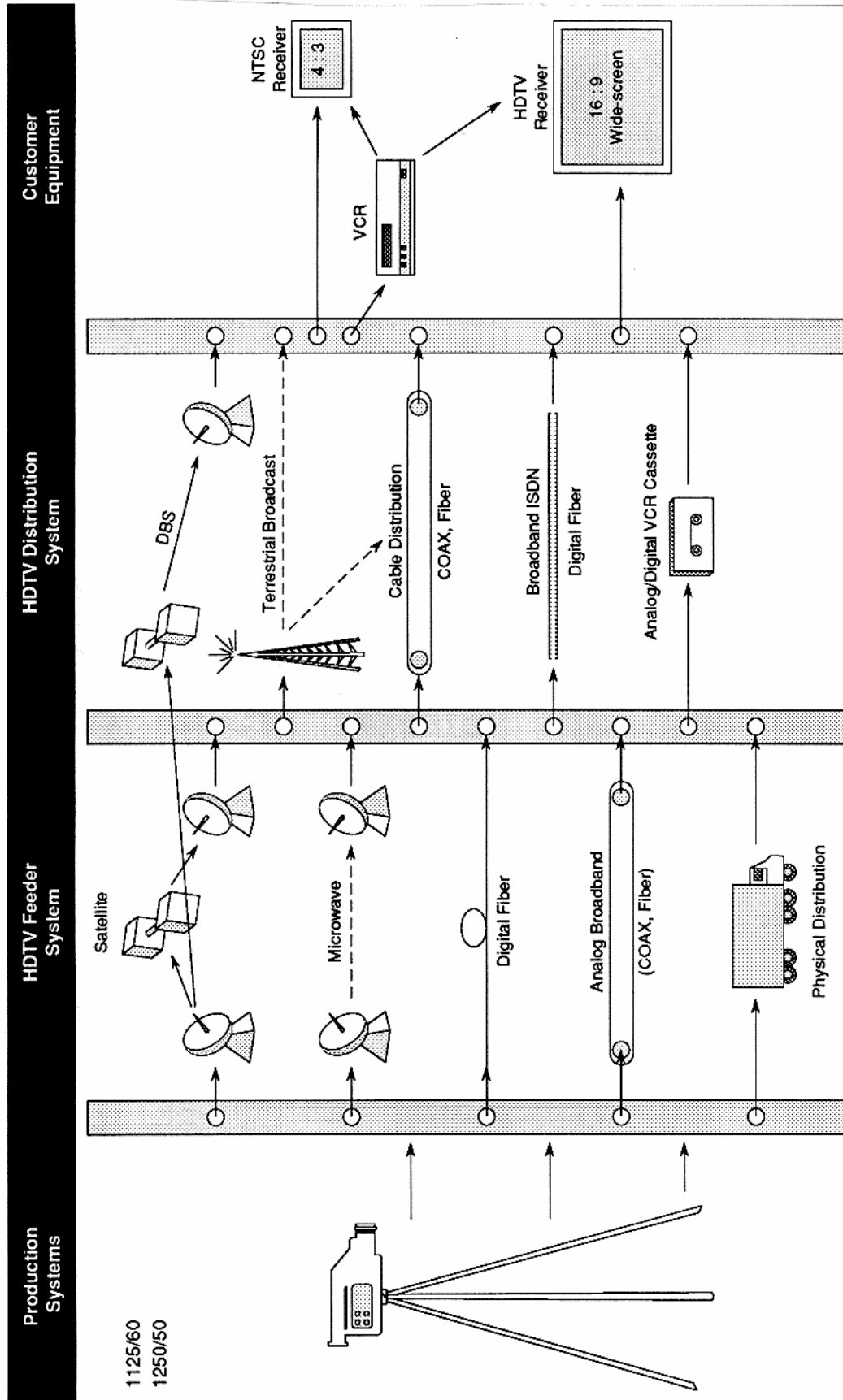
To accomplish this, we take somewhat of a grass-roots approach to high definition television by examining the would-be stakeholders in HDTV who may have something to gain or lose. In the long run, this approach may be more valuable than trying to nail down exactly what HDTV is today because the evolution of HDTV – in its various manifestations – will most likely be determined by the actions and perceptions of the stakeholders.

In its purest form, HDTV will provide video with the picture quality of 35mm film displayed in a wide-screen format and CD-quality sound. Figure 1-1 illustrates, in simplified form, the various components of a high definition television system.

HDTV looks and sounds simple enough, but its manifestations are very complex. First, HDTV broadcast signals take up five times the radio spectrum of the forty-year-old NTSC analog system uses today. Squeezing the 30 MHz HDTV signal into the FCC's 6 MHz requirement will be no small task. Second, since the roughly 180 million television sets in the country today won't be able to receive an HDTV signal, the FCC decided that the broadcasting scheme for HDTV which is adopted must not render those 150 million sets obsolete. Third, virtually no television programming in high definition is available today, although the costs are not prohibitive and the technology currently exists to convert 35mm film to an HDTV format. So even if we had the right TV sets and broadcasters could broadcast HDTV signals, there wouldn't be much to see.

On the more positive side, HDTV allows more information to be displayed on a screen. This has applicability beyond plain old television in military, commercial, and educational uses of HDTV's technology which - for the most part - don't need to wait for broadcasting or television standards to be settled. Some of these applications for HDTV do, however, need advances in areas such as fiber optics, flat-panel displays, and computing technology before they can become widely useful.

So, while HDTV offers potential benefits in improved video systems for both entertainment and non-entertainment areas, it has required some significant changes in the production, transmission, and display systems - some of which are done today - and will require additional modifications to these video systems to become more useful in the future.



Source: Adapted from Gary J. Handler, "High Definition Television," Bell Communications Research, testimony submitted before the House Subcommittee on Telecommunications and Finance, as contained in *Public Policy Implications of Advanced Television Systems: A Staff Report*, Committee Print 101-E, March 1989, p. 90. Diagram: © 1991 President and Fellows of Harvard College. Program on Information Resources Policy.

**Figure 1-1**  
**HDTV Delivery Options**

## CHAPTER TWO

### STAKEHOLDER ANALYSIS

In order for widespread HDTV to happen, the changes in production, transmission, and display systems mentioned above will have to be available at about the same time. These events are in the hands of several players or stakeholders. Since the transmission issues are the most visible, let's tackle them first.

The most obvious stakeholders in HDTV transmission are those who provide television today – the television broadcasters and cable TV industry.

#### 2.1 Television Broadcasters

HDTV presents a difficult problem for the television broadcasters technically, economically, and competitively. On the technical front, they must fit the HDTV signal within the current channel bandwidth allocated by the FCC, while at the same time continue to provide the current NTSC signal to those who do not choose – or cannot afford – an HDTV receiver. Several simulcast systems are being tested from which the FCC will choose one that best fits the "public interest." A system is not expected to be finalized until 1993 or 1994.

No matter which HDTV system is selected, television stations will incur significant expenses in upgrading their studios and transmitters to accommodate the new signals – in addition to having to maintain the current transmission system for as long as a critical mass of NTSC receivers exists. This could cost the industry several billion dollars and may be financially impossible for small and medium-sized stations. Moreover, because the FCC declined to set HDTV standards for cable TV or satellite transmission, the potential exists for the broadcasters to be left behind if these stakeholders implement systems much sooner than the broadcasters.

As a way to forestall a potentially massive investment -- and to remain competitive with alternative viewing choices -- the broadcast industry may be secretly cheering for the television manufacturer's less expensive enhancements to the NTSC signal, which would improve picture quality but fall significantly short of real high definition. Unfortunately for the broadcast industry, the FCC has declined to pick an enhanced definition standard -- if at all -- until the HDTV standard is finalized.

The competitive and economic implications of HDTV don't come at a particularly good time for the broadcast industry. Although broadcasters still dominate prime-time audiences, the cable networks and videocassette rentals have seriously eroded their market share. Cable television also has provided advertisers with alternatives to network advertising, causing the network revenues to remain flat for several years. In addition, due to limits on providing their own programming imposed by federal regulations, the networks are subject to the whims and escalating program costs of Hollywood studios -- their main source of television programs. Because broadcasters are faced with these financial and competitive pressures within the industry today, their enthusiasm for HDTV -- with its big costs and disruption of the embedded technology -- seems lukewarm at best.

## 2.2 Cable Television Industry

The cable television industry would seem to have an edge on the broadcasters in providing HDTV for a number of reasons. First, the FCC will not be looking over their shoulder and picking a transmission system for them. Second, the industry's embedded coaxial cable is already a wide bandwidth medium that is capable of carrying HDTV signals without jumping through the technological hoops facing broadcasters. Third, the cable industry is highly integrated, with the major cable players having substantial interests in cable systems, cable networks, and their own production studios -- thereby controlling the production and distribution portions of conventional and, potentially, high



definition television systems. Finally, the cable industry has a substantial retail presence with more than 60 percent of the households subscribing to cable services and almost 80 percent of all households passed by cable lines.

Alas, things are not quite so easy for the cable industry, either. Because the bulk of the programming watched by the average cable viewer comes from the networks, cable operators have elected to be compatible with the eventual broadcast HDTV standard. Therefore - except for the possibility of pay-per-view programming such as sporting events and movies - it is unlikely they will charge ahead with an HDTV system that denies subscribers access to "Cosby" or "America's Funniest Home Videos." Cable operators would also have to make some modifications in the cable headends to accommodate new HDTV satellite or terrestrial signals as well as develop a scheme for compressing the signal through the cable; however, this investment is not the same order of magnitude as the broadcasters'.

The cable industry also has problems in its own backyard now. The merger and acquisition frenzy that has occurred over the last five years has left the industry highly leveraged and, although the industry's cash flow easily can meet its debt obligations, it may be difficult to find the financing to upgrade the embedded technology to accommodate HDTV. It may also be time to "pay the piper" for the industry's dramatic revenue growth since its rates were deregulated in 1987. Subscriber concerns over degraded service and rapidly escalating cable rates have Washington contemplating re-regulation of the industry - with a real probability of actually doing it. It may be that, for the next few years, the industry could be busy investing in their current operations to keep subscribers and regulators happy - and worrying about HDTV sometime in the future.

Like the broadcasters, the cable folks have wondered whether there is money to be made in HDTV. They are not convinced that advertisers would pay a premium for commercials that are shown in high definition and, without an incremental source of revenue, the cable industry is leery of

making a substantial investment in just "better pictures." The cable industry uses the word "evolutionary" a lot to describe HDTV and seems content to let it take its course without doing much prodding.

### 2.3 Direct Broadcast Satellite Operators

Increasingly visible players in the transmission portion of HDTV systems are the direct broadcast satellite (DBS) operators. Like transmission by the cable industry, satellite transmission of HDTV requires no further FCC approval, and the spectrum allocated to DBS has sufficient bandwidth to transmit the HDTV signal relatively uncompressed. An advantage that DBS has over cable, however, is that once the satellite is launched no additional investment is needed to make it "HDTV-ready."

These stakeholders are less obvious because none exist in 1990 – even though in 1982, the FCC licensed eight operators to provide service. All of the satellite dishes sprouting up on people's lawns and housetops – as well as on the roofs of bars and motels – are for low-powered satellite reception of the same programming that cable subscribers receive and at about the same rates.

A big reason why DBS has not taken off has been the enormous cost to both the satellite operators and the consumer. In the last eight years, tens of millions of dollars have been invested in the high-powered Ku-band satellites by big players such as Comsat and GE without ever launching a single satellite. Satellite operators have been unsuccessful in convincing broadcast and cable networks to buy transponder capacity on high-powered "birds" when the lower-powered C-band satellites are adequate for conventional television. Consumers who have had to pay big bucks – up to \$2500 for the large three-meter dish – for all the channels that are now available for \$20 a month over cable are also reluctant to abandon their investment.

This may all be changing, however. In a seemingly never-ending quest to integrate horizontally, a group of the largest cable multiple system operators - the K Prime Partners - has announced plans to buy transponder space on an existing medium-powered GE satellite. This group apparently plans to offer pay-per-view and eventually perhaps HDTV programming. Another consortium - with deep pockets and interests in cable systems, broadcasting, motion pictures and entertainment programming - also recently announced plans to invest \$1 billion in a true high-powered DBS service (dubbed Sky Cable) offering 108 channels.

This group expects that small one-square-foot dishes - which cost about \$300 and mount on the side of a house - will be available from consumer electronics stores by the time the service is ready in three years. Like the K Prime Partners, Sky Cable will broadcast in NTSC but expects to offer HDTV when high definition programming and televisions become available. DBS could end up being a real sleeper in the transmission of HDTV if these ventures have the staying power and funds to persevere.

#### 2.4 Telecommunications Industry

From the obvious to less obvious, we now come to the more obscure stakeholders who see themselves in the transmission of HDTV - the telecommunications industry. This group includes those predominantly in the voice transmission business today - telcos or local exchange companies (LECs) like the Regional Bell Operating Companies (RBOCs), the interexchange companies like AT&T (IXCs), and private fiber networks like Williams Telecommunications.

This group of stakeholders has little experience in television except to the extent they act as long haul conduits for television signals today. Some of the independent telcos like Centel do own and operate cable systems outside of their telephone service areas, and others, including the RBOCs, do build and operate cable systems to a limited

extent on behalf of the franchised cable operators - although they are not involved in the program content portion of the enterprise.

The RBOCs particularly are taking advantage of the current uproar over cable TV's service and rate problems and have positioned themselves as "white knights" capable of bringing competition to the cable TV market. To gain experience in the video transmission arena, the RBOCs have acquired interests in cable television systems in Europe and the Far East, and one RBOC is seeking a majority interest in a cable system in the Chicago area. Local exchange companies see the provision of cable television services as a logical extension of their move to provide voice, data, and video services over broadband networks and view HDTV, in particular, as a way to perhaps justify bringing optical fibers directly to homes.

What appears to be at the heart of these stakeholders' entry into HDTV is their conviction that the wide bandwidth of optical fiber is a natural transmission medium for not only voice services but also HDTV video services - even in an analog format. In the long term, the additional benefit of fiber is its ability to fully exploit HDTV's digital format. Fiber, with its unlimited bandwidth and freedom from interference, does indeed seem to be an ideal transmission medium for HDTV. However, the cost of providing fiber directly to consumers just for voice services is three times that of current copper wire - an expense that state and federal regulators are reluctant to allow LECs to charge ratepayers. Enter HDTV, which along with the slew of information services promised by the cable industry but as yet undelivered, provides a platform for telco revenues.

To back up this claim, the telecommunications industry is committing vast resources to the broadband delivery of video services. Many LECs are conducting residential trials delivering video services over broadband fiber networks. AT&T is working with Zenith both on fiber transmission systems and a video chip set. Bellcore is conducting a digital-switched fiber trial with the broadcast networks as an alternative to terrestrial-based transmission. Several private

fiber-based network providers are involved in the Bellcore trial providing long distance transport and are also working with cable companies to provide similar capabilities.

Despite the technical and financial resources available to them, the LECs have substantial political and regulatory impediments preventing them from jumping directly into video services and HDTV. By virtue of the Cable Act of 1984 and FCC regulations, they are prohibited from providing cable services; the Bell System consent decree limits the RBOCs' involvement in information services, which probably includes video services; and current rate regulations at the state and federal level make it difficult to expend the \$250-\$300 billion needed to bring fiber to the home. While AT&T and the other long haul networks are unencumbered by these restrictions, neither do they have the access of the LECs to the 90 million households in the nation. They are, however, in a position to provide the "wholesale" or wide area transmission portion of HDTV for both entertainment and commercial users.

This group of stakeholders may be in position to provide an important piece of the HDTV transmission puzzle - bandwidth. Moreover, if the telecommunications industry turns out to be right, and digital transmission of HDTV proves to be the most efficacious way of bringing this technology to the consumer, these players could become the dominant delivery providers of HDTV. Of course, that assumes the enormous economic costs of "fiber-ing-up" the country and the political obstacles can be overcome. That could take a very long time.

## 2.5 Hollywood Studios

Assuming that HDTV programs can be transmitted by one or more of the delivery stakeholders, let's turn now to the group that is most likely to provide those programs - the Hollywood studios. Hollywood controls over 70 percent of the programs seen on television by either owning the rights to programs shown as re-runs or supplying original programming for broadcast and cable networks. The remaining programs are created by

the networks and cable companies themselves, but Hollywood, with its vast film and TV program libraries, remains the dominant provider.

Like the cable industry, the Hollywood movie industry is highly concentrated and vertically integrated, with seven motion picture studios dominating the industry and having various interests in broadcasting, cable TV, and theater chains. Perhaps most important for HDTV, Hollywood virtually controls the release of films on videocassettes. Despite periodic cries of "wolf" from the Motion Picture Association of America that new video technologies such as VCRs and cable television are eating into their markets, consumer demand for filmed entertainment has doubled to \$27 billion in the last five years. Even movie theater revenues - long projected by Hollywood to be dying - exceeded \$5 billion in 1989. The biggest problem movie studios seem to have is juggling the revenue flow among their distribution channels - theaters, pay-per-view, video rentals and pay television - to keep them all happy.

Of the stakeholders discussed so far, HDTV is available and being used only by Hollywood today. HDTV studio equipment, including cameras, video tape recorders, and editing systems, is available from a variety of predominantly Japanese companies. However, this equipment is bulky, power-hungry, and extremely costly, thereby limiting its use. Nonetheless, Hollywood is using HDTV production technology for post-production, movie editing, and special effects work; and some smaller studios have even produced movies and television programs in HDTV. However, Hollywood lives in a 35mm world - the original high definition medium - and, except for limited production work, it is unlikely HDTV will supplant film. In fact, one of the few criticisms of HDTV is made by movie producers, who complain that HDTV is too clear, showing details like dust on the set and make-up on the actors.

What may upset the 35mm apple cart for the movie industry, however, is the international appetite for Hollywood's movies and television programs. Over 40 percent of the movie industry's revenues come from license fees for television shows and movies overseas. One reason for

the increase in foreign ownership of movie studios - such as Rupert Murdoch and Sony - is to gain access to the thousands of films and tapes in Hollywood's libraries. As Europe and Japan move much more quickly than the U.S. to high definition television, Hollywood may feel increased pressure to provide both original programming and the programs already "in the can" in an HDTV format.

In fact, there are some who believe that Sony's acquisition of Columbia and Matsushita's purchase of MCA are long-term strategies to convert these movie libraries to HDTV as the software base for a new generation of Sony and Panasonic HDTV televisions, VCRs, optical discs, and studio production equipment.

If true, Sony will have a hard time convincing the nation's video rental outlets. It is unlikely that either consumers or video stores will easily abandon their accumulated personal inventories of NTSC-formatted video tapes unless the new HDTV systems are backward compatible. Even then, some video store operators may be reluctant to stock multiple formats of the same film at the current price of \$60 per tape. The slow acceptance of Super VHS today may be instructive for HDTV tomorrow.

Nonetheless, in addition to the productivity benefits of using HDTV in a production capacity, the fact that there may be money to be made from converting programs to HDTV for pay-per-view and international distribution may make Hollywood a leading stakeholder in HDTV.

## **2.6 Television Equipment Manufacturers**

The group that seems most likely to make money from HDTV's implementation, particularly in the consumer market, is the television equipment manufacturers. In fact, some cynics in the cable and broadcast industry believe that the television equipment manufacturers are the ones who are really driving HDTV so that they can sell more TVs. These manufacturers are working diligently in promoting an HDTV

transmission standard to which they can build their receivers. Several manufacturers have even joined with elements of the broadcast industry in advocating enhanced definition (EDTV) standards, which would provide some improvements to the NTSC standard; however, new televisions would be required to see these improvements.

Just to make sure that all of their bases are covered, TV equipment manufacturers are also introducing improved definition sets (IDTV) utilizing digital signal processing techniques that are designed to improve the quality of the current broadcast signals. Just think, a consumer might have to buy three new televisions in the next ten years or so just to migrate along the path to HDTV. Sounds like a money-maker to me.

Before the TV equipment manufacturers start counting all their money, however, they will have to wait for display technology to catch up. HDTV is best seen on large, wide-screen displays, and the current cathode ray tube (CRT) technology is limited to a 40" screen because of its weight and bulk. For consumers to get a real "home theater" experience, the development of flat panel displays that can hang on a wall is needed but is still several years away. Until then, TV equipment manufacturers will be trying to squeeze the most out of CRT technology and TV projection systems, which can handle the screen size but remain too large for the average living room.

All in all, the TV equipment manufacturers are in a good position to seed the high definition consumer market with a progression of IDTVs, EDTVs, and ultimately HDTVs. These televisions may be beyond the reach of the average viewer; each of these TVs has a projected initial cost in excess of \$2000. The manufacturers may not be too concerned about waiting for the HDTV price/performance curve to come down, since they still must wait for the FCC to decide upon an HDTV standard - which may not come until 1993.

On the other hand, the TV equipment manufacturers do not necessarily have to wait for the U.S. market in order to gain HDTV experience. With



the exception of Zenith, the remaining television manufacturers are either European or Japanese. As a result, these manufacturers would be able to test the HDTV receiver market in countries where HDTV is projected to be available first. However, the lure of replacing - perhaps twice - the 180 million televisions currently in U.S. households is probably too strong for the industry to ignore for long.

## 2.7 Computer Industry

The final industry stakeholder left to discuss is the computer industry. It is included in the following discussion of HDTV user stakeholders (see chapter 3) for their adaptation of HDTV technology for personal computer and workstation applications, but the computer industry is also included here - almost at their insistence - as sort of technology stakeholders. While some in the computer industry intimate that eventually home computers can be used as televisions, the main thrust of their interest in HDTV today seems to be in its impact on the semiconductors, displays, and optical storage devices technologies it shares with the television industry.

In addition, as guardian of the "digital way" of doing things, the computer industry believes that HDTV is inherently a digitally-based technology, and that the broadcast/consumer-oriented analog approach to HDTV fails to maximize its advantages. Of particular concern to the computer stakeholders is that decisions made about HDTV transmission standards for the benefit of analog-oriented consumer television will preclude compatibility with digital-oriented personal computers and workstations. While this situation, in fact, exists today, the computer industry believes that the current discussions over HDTV standards present an opportunity to prevent incompatibility in the future.

The retort of the consumer television camp is that video is inherently analog (a proven, time-honored technology), while digital television, although admittedly superior in theory, is as far from reality as a nationwide broadband network. Time will eventually tell

but, like the telecommunications stakeholders, the computer folks could in fact become much more important to HDTV as digital technology becomes adapted to video systems.

## CHAPTER THREE

### HDTV USER STAKEHOLDERS

As mentioned earlier in chapter 2, the programming, transmission, and display technologies for HDTV must all come together at about the same time to provide a consumer-based entertainment system. The same is not necessarily true for HDTV applications in the commercial world. Thus, while the battle rages over terrestrial broadcast standards, fiber to the home, and market penetration levels required for HDTV, a growing number of what marketing theorists call "early adopters" are implementing HDTV in some fashion now. Using bits and pieces of available HDTV production, transmission, and display equipment, these users are producing new applications, saving money with new processes, or boosting productivity by enhancing existing processes.

#### 3.1 Current HDTV Applications

Here, we will describe only briefly some of the areas where HDTV applications are either in advanced stages of development, in immediate anticipation of becoming real, or are in actual use today. For more details, the reader is encouraged to see appendix H, "HDTV in the Commercial World."

##### 3.1.1 Military and Space Operations

- ▶ The Air Force plans to replace its 35mm cameras with HDTV video for aerial reconnaissance to eliminate film-processing time and delays caused by shipping data on film.
- ▶ HDTV technology is being developed for cockpit displays in aircraft for weapons and sensor systems.
- ▶ The Defense Mapping agency uses an HDTV display for development and editing its digital maps.
- ▶ Scott Air Force Base has installed an HDTV display at its command center for tracking aircraft on maneuvers.
- ▶ Aircraft simulators using HDTV technology are under development to provide realistic conditions for pilot combat training.

- ▶ NASA has installed a fiber optic network for launch control and lift-off evaluation of shuttle launches.

### 3.1.2 Medical Systems

- ▶ The Texas Children's Hospital has tested and is considering implementation of remote diagnostic centers with HDTV studio equipment and connected over a fiber network to the hospital in Houston. Physicians will be able to "see" and evaluate patients for diagnosis as well as receive radiological images and pathology slides.
- ▶ A similar system for "telepathology" is being set up in the greater Washington, D.C., area to connect pathology labs with doctors in outlying areas.
- ▶ Surgical procedures that require high resolution and color fidelity are being videotaped in high definition for medical conferences and medical education seminars.

### 3.1.3 Education and Public Information

- ▶ The St. Louis Zoo has a continuous showing of LandSat videos as if taken from a space station using a high definition video disc. HDTV was used because of the durability of the disc over film and the high resolution needed to display the LandSat images.
- ▶ The Gifu Prefecture Museum of Art in Japan displays still images of fine art from around the world on two 60" displays and one 110" display. HDTV is used because the exhibit offers an interactive video feature allowing patrons to call up information and other art from a computer.
- ▶ The National Arts Center in Canada is planning HDTV broadcasts of special exhibits and lectures from Ottawa to other parts of Canada to extend Canada's cultural heritage around the country.

### 3.1.4 Computer Applications

- ▶ The Ford Design Center has six high resolution graphics systems with HDTV monitors being used to sketch and modify automobile designs. The wider aspect ratio of the HDTV screen and resolution fit such CAD and engineering applications particularly well.
- ▶ Symbolics Inc., a small, Massachusetts-based computer workstation company, has introduced a high definition graphics system for use in producing special effects and animation for commercial and business television productions.

- ▶ Multimedia workstations which integrate text, graphics, data and video – allowing integrated customized presentations to be developed – has been introduced by Apple and others. Although these early systems are not high definition, Apple, IBM and others are developing compression/decompression schemes in anticipation of incorporating HDTV in the future.
- ▶ Display technology, special video chips and higher density optical discs will still be required for full implementation of HDTV features.

### 3.1.5 Business Communications

- ▶ Mast Industries, procurement arm of fashion retailer The Limited, successfully conducted an HDTV video conference with suppliers in Hong Kong. The high resolution and color fidelity allowed buyers in Andover, Mass., to select fabrics and designs on the spot.

### 3.1.6 Advertising and Printing/Publishing

- ▶ HDTV systems have been used to produce magazine covers for *Esquire* and *Time*. Large-scale images for advertising billboards and posters have been developed for Dr. Pepper and *Sports Illustrated*. The photo background for the local CBS station in New York was developed in HDTV and made into a 9' x 27' print. The ability to manipulate images and produce high resolution enlargements were the reasons for using high definition systems.
- ▶ The new Fiat Dedra was introduced in Europe using a high definition video. HDTV was chosen over film because of the ease of editing and playback; it was chosen over conventional television production systems because of the quality of the image.

### 3.1.7 Public Entertainment

- ▶ A chain of HDTV video theaters in northern Florida is being opened in 1990, featuring a dinner club and wide-screen theater to show movies, sporting events, rock concerts, and cultural events in high definition. An HDTV production studio will be connected to the theaters over a fiber optic network; it will also be available for business uses such as video conferencing as well as special events like fashion shows and new product introductions – all in high definition.
- ▶ In December 1989, an HDTV satellite broadcast of the Leonard/Duran fight was beamed to seven sites in the U.S. and Canada.

These HDTV users are important to note for two reasons. First, they have found solid, justifiable reasons for using HDTV technology now. All or some of the benefits of high definition technology – high video resolution, color fidelity, flexibility in image manipulation, durability of the medium, wide aspect ratio, sharpness and clarity on large screens – have been integrated to produce new or improved products or services giving these users some sort of competitive edge in their respective fields. None of these applications is dependent on the controversy over terrestrial broadcast, fiber to the home, or television receiver formats.

Second, the role of early adopters of new HDTV technologies may be an important piece of HDTV's evolution to a consumer-oriented system. Despite its high cost, these users all seem to possess the financial strength not only to justify HDTV today but also to ride out the price/performance curve for the next generation of equipment. The diversity of the user stakeholders may, perhaps, ensure a wide exposure of the technology as more people see and work with the various HDTV systems, thereby raising its visibility to the next generation of sophisticated users. And finally, just maybe, as HDTV enhances the visual experience of people in the workplace, taverns, hotels, libraries, museums, and hospitals, these people may demand the same high level of video from the network and cable programs that they watch at night.

## CHAPTER FOUR

### STAKEHOLDER ANALYSIS

One purpose of this paper is to provide a way of looking at the stakeholders to determine if they have what it takes to participate in HDTV. Based on the preceding chapters and the analysis in the appendices that follow, an HDTV Stakeholder Chart was developed to provide a simplified method of evaluating each stakeholder's HDTV prospects.

At the conclusion of each appendix for the Industry Supplier and User Stakeholders, a "scorecard" summarizes the prospects of the individual stakeholder in HDTV. These scorecards are consolidated here in the Stakeholder Chart below (see Figure 4-1). The chart plots the stakeholder against a list of "ingredients" needed for success in HDTV. The scale - ranging from a low of 0 to a high of 9 - indicates the degree to which an individual stakeholder either possesses or has access to a specific ingredient. These ingredients are derived from the scorecards.

It should be noted that not every stakeholder may need all of the ingredients to successfully use or implement HDTV. There are some which could thrive in pieces of the business - some of them huge.

Some ingredients may also be more important than others. For example, if there is money to be made or saved, or a substantial productivity benefit to be gained, that possibility may override a particular stakeholder's deficiencies in retail market presence or a lack of regulatory finesse.

The chart as completed (see Figure 4-1) is the author's analysis of the data presented here and in the appendices. The reader is welcomed - indeed encouraged - to fill in the spaces according to his or her own interpretation of the analysis of the stakeholders and HDTV. A blank chart (Figure 4-3) is located at the end of this chapter for this purpose.

STAKE- HOLDERS	INGREDIENTS NEEDED TO SUCCEED IN HDTV								
	Program Origination	Wholesale Market Presence	Retail Market Presence	Technology Migration Path	Deep Pockets	Regulatory Finesse	\$ To Be Made	\$ To Be Saved	Productivity Benefit
Hollywood	9	6	8	7	7	5	7	4	8
Broadcasters	5	2	9	3	5	6	2	2	4
Cable TV	7	4	7	5	5	4	5	2	4
IXCs, Fiber Cos, Satellite Cos	NA	9	5	7	7	7	8	2	3
DBS	4	7	2	8	7	9	8	3	3
Local Telcos	NA	6	7	4	8	5	7	3	3
Television Manufacturers	NA	NA	9	7	7	6	9	2	4
Computer Manufacturers	NA	NA	NA	7	7	NA	7	5	5
Medical	NA	NA	NA	8	3	NA	NA	7	8
Government: Defense, NASA	NA	NA	NA	8	9	NA	NA	7	8
Advertising/ Publishing	NA	NA	NA	7	6	NA	5	7	8
Education, Public Institutions	NA	NA	NA	8	4	NA	2	6	8
CAD/CAM	NA	NA	NA	7	8	NA	2	7	8
Business Communications	NA	NA	NA	8	8	NA	4	7	8

Scale: 0 - 9 Low - High

Figure 4-1

Stakeholders Chart 1  
Who's Got What: Success Factors in HDTV

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#### 4.1 Evaluating and Comparing Stakeholders

Once the reader has determined a value for each ingredient, he or she can use the chart to first profile each of the stakeholders and then compare them.

For example, it could be deduced from the chart that the broadcast industry, despite having the strongest presence in the consumer market [Retail Market Presence = 9], faces a difficult task in implementing HDTV because of its expense and significant technical challenges to overcome [Technology Migration Path = 3]. Moreover, it appears there is little prospect of HDTV generating significant revenues [\$ To Be Made = 2] or providing significant cost savings or productivity benefits [\$ To Be Saved = 2; Productivity Benefit = 4] - in the short term. One conclusion, therefore, may be that it is in the best interests of the broadcast industry to move as slowly as possible toward HDTV.

Of course, competitive pressures may force the broadcast industry to respond faster if others are in a better position to implement HDTV more quickly. Based on the chart, the cable TV folks are in a decent position to do their own HDTV programming [Program Origination = 7], have penetrated the consumer TV entertainment market to a high degree [Retail Market Presence = 7], and have a slightly easier task in implementing the technology [Technology Migration Path = 5] than do the broadcasters. If the cable industry is not too financially strapped from its "merger mania" activities [Deep Pockets = 5] and has the skills to overcome the re-regulation pressure from Washington [Regulatory Finesse = 4], it could be in a position to implement HDTV before the broadcasters.

By comparing stakeholders' strengths and weaknesses, the chart can also help explain recent - and perhaps future - joint ventures and alliances among stakeholders. For example, the cable TV and DBS operators seem to offer each other compensating strengths where each is respectively weak. The cable industry's strong programming position [Program Origination = 7] and consumer presence [Retail Market Presence

- 7] compensate for DBS' deficiencies in these areas [Program Origination = 4; Retail Market Presence = 2].

Conversely, the DBS operators' easier path to HDTV delivery [Technology Migration Path = 8] and strength in overcoming regulatory impediments [Regulatory Finesse = 9] may atone for cable TV's shortcomings in these areas [Technology Migration Path = 5; Regulatory Finesse = 4]. These reasons may have prompted the players in both Sky Cable and the K Prime Partners to join forces; other such alliances may be formed in the future.

User stakeholders, too, can use the comparative values of the chart to determine where to "shop" for emerging HDTV technology for their respective needs.

Individual business communications users - seeing potential for cost savings [\$ To Be Saved = 7] and productivity gains [Productivity Benefits = 8] by utilizing high definition video-conferencing - might use the chart to determine which of the industry supplier stakeholders is in a position to offer such services. Such a search might lead them to the IXC's, fiber companies, and satellite operators which appear to be strong in the categories needed to provide high definition video-conferencing [Wholesale Market Presence = 9; Technology Migration Path = 7; Deep Pockets = 7; \$ To Be Made = 8].

Similarly, advertising/publishing and public institution users - in an identical position to utilize HDTV in their respective applications to save money or increase productivity [\$ To Be Saved = 7; Productivity Benefit = 8] - may be able to use the chart to determine which of the industry stakeholders offer systems, or parts of systems, meeting their requirements.

#### 4.2 Tracing the Effects of HDTV-related Developments on Stakeholders

In addition to using the chart to evaluate and compare stakeholders based on today's assumptions, one can also use it to trace the effect of new HDTV-related developments on the stakeholders. Suppose, for example, that the automotive and fashion advertisers decide that they are willing to pay more for their commercials to be shown in high definition. A new chart can be drawn to reflect this change and determine its impact on various stakeholders (see **Figure 4-2**).

Based on new values prompted by this assumption, the increased potential for broadcasters to gain new revenues [ $\$ \text{ To Be Made} = 8$ ] may energize the industry to implement HDTV faster. The cable TV industry likewise will be in a position to capture new advertising revenues – in addition to the existing revenue potential from pay-per-view [ $\$ \text{ To Be Made} = 7$ ]. The cable folks might well accelerate their plans for implementing HDTV as well.

The direct broadcast satellite operators – already in a strong position – may be surprise winners if advertisers become enamored with HDTV's potential to reach targeted consumers. The DBS people – despite the fact that they have low consumer TV penetration [Retail Market Presence = 2] – can target a high demographic advertising audience. Thus, DBS not only would be in a good position to capture new advertiser dollars [ $\$ \text{ To Be Made} = 8$ ], but also, because it has an easier technology path [Technology Migration Path = 9] and fewer regulatory hurdles [Regulatory Finesse = 9], could be well-positioned to gain market share in consumer-oriented HDTV with advertisers paying the tab.

Other assumptions can be made – with corresponding new values plugged in for the stakeholders – to create other scenarios as well. For example, the chart may prove useful in showing how a rapid implementation of digital broadband networks would affect the various stakeholders. Conversely, it could show the effect on the "digital" stakeholders if terrestrial broadcast standards were implemented sooner than expected. Scenarios about the success of IDTV or EDTV on the

STAKE- HOLDERS	INGREDIENTS NEEDED TO SUCCEED IN HDTV								
	Program Origination	Wholesale Market Presence	Retail Market Presence	Technology Migration Path	Deep Pockets	Regulatory Finesse	\$ To Be Made	\$ To Be Saved	Productivity Benefit
Hollywood	9	6	8	7	7	5	7	4	8
Broadcasters	5	2	9	3	5	6	8	2	4
Cable TV	7	4	7	5	5	4	7	2	4
IXCs, Fiber Cos, Satellite Cos	NA	9	5	7	7	7	8	2	3
DBS	4	7	2	8	7	9	8	3	3
Local Telcos	NA	6	7	4	8	5	7	3	3
Television Manufacturers	NA	NA	9	7	7	6	9	2	4
Computer Manufacturers	NA	NA	NA	7	7	NA	7	5	5
Medical	NA	NA	NA	8	3	NA	NA	7	8
Government: Defense, NASA	NA	NA	NA	8	9	NA	NA	7	8
Advertising/ Publishing	NA	NA	NA	7	6	NA	5	7	8
Education, Public Institutions	NA	NA	NA	8	4	NA	2	6	8
CAD/CAM	NA	NA	NA	7	8	NA	2	7	8
Business Communications	NA	NA	NA	8	8	NA	4	7	8

Scale: 0 - 9  
Low - High

Figure 4-2

Stakeholders Chart 2  
Who's Got What: If Advertisers Endorse HDTV

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progress or retarding of "real" HDTV can be drawn from the chart's information. The chart seems to address almost any question or assumption a reader may wish to try on it.

STAKE- HOLDERS	INGREDIENTS NEEDED TO SUCCEED IN HDTV								
	Program Origination	Wholesale Market Presence	Retail Market Presence	Technology Migration Path	Deep Pockets	Regulatory Finesse	\$ To Be Made	\$ To Be Saved	Productivity Benefit
Hollywood									
Broadcasters									
Cable TV									
IXCs, Fiber Cos, Satellite Cos									
DBS									
Local Telcos									
Television Manufacturers									
Computer Manufacturers									
Medical									
Government: Defense, NASA									
Advertising/ Publishing									
Education, Public Institutions									
CAD/CAM									
Business Communications									

Scale: 0 - 9 Low - High

Figure 4-3

HDTV Stakeholders: Who's Got What

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## CHAPTER FIVE

### HDTV: HOW CLEAR IS THE PICTURE?

The HDTV phenomenon continues to be defined by the ebb and flow of its would-be stakeholders' shifting perceptions. In fact, there is no clear picture of HDTV today since there is little consistency or agreement among stakeholders. Considering how divergent the stakeholders' perceptions of HDTV are, prospects for a much clearer picture in the near future appear dim.

At best, what we have is a stack of tiles for a mosaic that have not been arranged into a discernible pattern. Or, to use our Elephant and Blind Men metaphor, we may have a tail, some ears, a nose, and legs but do not yet know how these parts are connected – or even if all the parts are yet available – to form any kind of animal.

Therefore, the best way to understand HDTV is to understand the stakeholders. By this we do not mean to accept at face value individual stakeholder's public assertions regarding HDTV. What we have attempted to do here is to provide insight into stakeholders – both their perceptions and the reality – and the necessary tools to use these insights for evaluating HDTV as it evolves over time.

For example, faced with an apparent lack of financial incentives as well as some substantial technical hurdles, cable television and broadcasters are not yet in a position to drive HDTV – perhaps accounting for their lukewarm reaction. On the other hand, the potential financial rewards for DBS, Telcos, and the IXC/Fiber Companies stakeholders may put them in a position to fill the gap left by the yet undefined terrestrial delivery systems. DBS and the IXCs/Fiber suppliers are already running with the early adopters. The Telcos, however, probably still will have to wait for a more favorable regulatory climate to be in a position to deliver any video services directly to the home. They are pushing for that climate change in 1990.

Hollywood and the TV manufacturers seem to be in a favorable position to make money from HDTV, or one of its manifestations, and DBS now appears to be a viable dark horse in delivering HDTV to consumers in the foreseeable future. Intuitively, the computer industry seems to be an HDTV stakeholder, but its vision of a transition from analog to digital TV is as yet too unclear or too far in the future to be sharply articulated. On the other hand, computer manufacturers and software developers have been quick to adopt HDTV's visual enhancements for PC and workstation applications.

In fact, non-consumer users of HDTV, as early adopters of this new technology, seem to be in a position to drive HDTV more than the industry suppliers. Where cost and productivity benefits can be realized, high definition technologies appear to be thriving. If widespread and successful, these users can be an important driver for consumer-oriented HDTV.

The HDTV "beast" will not be better described until further events unfold. Yet to be determined is how the interdependence among the production, delivery, and display aspects of HDTV will drive the stakeholders. Still unknown is whether individual stakeholders will abandon their parochialism and develop alliances that would fill the gaps in their respective "ingredients" portfolios. There are indications that some stakeholders - cable TV, DBS, and the Telcos - are pursuing such strategies, but it is unclear what impact this would have on HDTV's evolution overall.

In addition, the impact of public policy decisions, the HDTV strategies of other countries, and individual companies' marketing and technology strategies - all in the future or beyond the scope of this paper - are equally unclear and may play important roles in shaping HDTV's future. The tools described here may assist in providing insight into each of these events as it unfolds.



With such additional insight, industry stakeholders may be able to predict what the competition is planning, or user stakeholders could be in a position to determine where the next applications of HDTV technology will come from. Public policy makers may be able to separate rhetoric from reality by better understanding the business or technology issues behind stakeholder's public positions. Eventually, we all may discover what kind of beast HDTV really is - an elephant, an ostrich, or maybe just another "mouse that roared."

## APPENDIX A

### HDTV TECHNOLOGY: A VERY BRIEF PRIMER

As this entire paper is about high definition television technology, this appendix is modest by design and meant to provide an overview of the technology. Subsequent appendices deal in more detail with HDTV and all of its other technical ramifications including broadcasting standards, aspect ratios, scanning alternatives, and display technology in the context of those stakeholders most affected.

The FCC definition of HDTV is simple and does not imply one particular set of technical standards over another:

Within the category of "ATV" [Advanced Television] we include any system that results in improved television audio and video quality. . . . HDTV generally refers to systems that provide quality approaching 35mm film, whereas EDTV refers to systems that perform better than NTSC but not on a par with 35mm film.\*

What this definition implies is that HDTV systems enhance the value of the video and audio aspects of

- Video Entertainment with theater-quality images, larger screen size, improved color and detail
- Video Information presentation with improved color and detail and enhanced multimedia capabilities
- Video Information manipulation with increased media flexibility and interactive video capabilities
- Video-based Productivity enhancements that can be used in normal business operations such as video-conferencing, computer-aided-design, training and education, and studio production processes for advertising and video programming.

In order to realize these benefits, however, changes are required -- often with some controversy among the stakeholders -- in video

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\*See *Advanced Television Systems, Tentative Decision and Further Notice of Inquiry*, MM Docket 87-268, 3 FCC rcd 6520 (1988), 41.

production, delivery, and display to accommodate HDTV. What these changes are, and where the discussion of them can be found in this paper are listed below:

- **Video production equipment improvements** for the creation of the programming for entertainment, software for commercial applications, editing capabilities for production, post-production, and special effects tasks. (For a discussion of these issues, see appendix F, "Hollywood and the Film Industry"; and appendix H, "HDTV in the Commercial World.")
- **Video delivery improvements or enhancements** in terrestrial broadcasting, satellite transmission, broadband networks, video tape players, and video-disks. (For a discussion of these issues, see these Industry Stakeholder sections: appendix B, "The Broadcast Industry"; appendix C, "The Cable TV Industry"; appendix D, "Direct Broadcast Satellite"; appendix E, "The Telecommunications Industry"; and appendix G, "TVs, PCs, and the Analog/Digital Wars.")
- **Video reception equipment improvements or enhancements** in televisions, personal computers, computer workstations, and video displays. (For a discussion of these issues, see appendix G, "TVs, PCs, and the Analog/Digital Wars"; and appendix H, "HDTV in the Commercial World.")

Certain stakeholders in HDTV are advocating interim steps to improve the picture quality of television broadcasts. These interim steps are listed below:

- **Improved Definition Television (IDTV):** TV receivers utilize digital signal processing and other techniques to improve the current NTSC broadcast signal.
- **Enhanced Definition Television (EDTV):** The NTSC broadcast signal itself is enhanced requiring modifications both at the transmitter as well as the receiver end.

IDTV and EDTV are discussed in appendix B, "The Broadcast Industry" and appendix G, "TVs, PCs, and the Analog/Digital Wars."

There is one other controversy that HDTV technology has spawned which deserves some discussion. This is an almost theological debate between those who view HDTV as a traditional analog video system and those who see HDTV as the beginning of digital television. This discussion is described in appendix G, "TVs, PCs, and the Analog/Digital Wars."

## APPENDIX B

### THE BROADCAST INDUSTRY: BETWEEN A ROCK AND A HARD PLACE

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*Regulatory decisions -- or inaction -- which put broadcasters at a competitive disadvantage to other media, in terms of quality or the timing of ATV service, will seriously jeopardize not only the ability of the industry to provide state-of-the-art picture quality to its vast audience, but the very viability of free over-the-air local television.*

Statement of National Association of  
Broadcasters to House Subcommittee on  
Telecommunications and Finance of the Committee  
on Energy and Commerce, 1 February 1989, 5.

*There's not much economic incentive for broadcasters to push HDTV, since it could cost as much as \$38 million to equip TV stations for HDTV, and advertisers aren't likely to pay more for HDTV commercials.*

John Abel, executive vice president, National  
Association of Broadcasters, *Communications  
Daily*, 25 September 1989, 6.

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What happened in these nine short months that made high definition television (HDTV) services go from an issue of survival for the broadcasting industry to one where the costs of providing the service would cause the industry to voluntarily take a back seat in a new television technology? Part of the answer very well may be the cost estimates referred to above for implementing HDTV services. But this appendix explores the possibility that additional forces within the industry, competitive and financial, may also have contributed to the 180 degree turn the National Association of Broadcasters (NAB) has taken regarding HDTV.

## In the Beginning

From the flicking black-and-white images of a cavorting "Uncle Miltie" on a 6-inch screen in 1949 to the colorful hype of Super Bowl XXIV on a 52-inch monitor, the broadcasting industry has pioneered television technology and provided the viewing public with its primary source of television programming. The industry been so successful that in 1990 we keep one or more of our 180 million sets on more than seven hours each day.<sup>1</sup> In fact, 98 percent of the 90 million households in the U.S. today have a TV; the broadcasting industry has achieved a degree of "universal service" surpassing even the telephone industry, which boasts a modest 92 percent penetration of households.<sup>2</sup>

The broadcast TV industry includes those who provide our everyday over-the-air (or terrestrial) TV programming: the major networks (NBC, CBS, ABC); the networks' local affiliates; the affiliated production studios, which provide some of the programming; the independent local broadcasters; and public broadcasting stations. Broadcast television programming is considered to be "free TV" because we, as viewers, do not directly pay for the pleasure of seeing first-run programs of "Wise Guy," "Who's the Boss," or the "Winds of War."

Instead, the industry's predominant source of revenue comes from advertising dollars, estimated at almost \$25 billion in 1989,<sup>3</sup> spent by those sponsors seeking a mass media outlet (known as commercials) for advertising their products.<sup>4</sup> The cost to a network advertiser for an average 30-second spot during a network's prime-time schedule was more than \$120,000 in 1987, and the annual granddaddy of all commercial spots, the Super Bowl, cost advertisers \$700,000 in 1990.<sup>5</sup> In contrast, 30-second spots from local affiliates range from \$6500 in Chicago to \$150 in Glendive, Montana.<sup>6</sup>

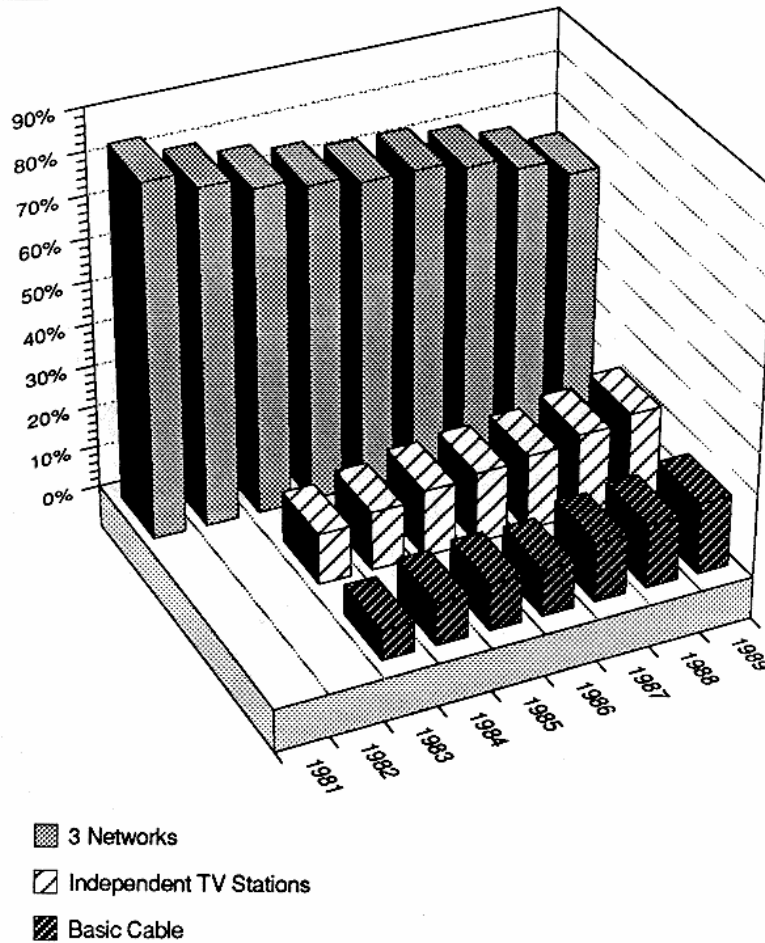
From the days of Uncle Miltie, the networks have dominated television viewership, enabling them to dictate advertising rates to sponsors. In 1970 the networks still commanded a 93 percent share of the viewing audience.<sup>7</sup> Independent stations were outnumbered 3:1 by the networks'

affiliates (only 25 percent of the 590 stations were not affiliated with a network)<sup>8</sup> and offered little in alternative programming – depending almost totally on network reruns and locally produced shows such as "Dialing for Dollars," "Community Auditions," and local news. Cable television served less than 8 percent of the households in 1970; it existed almost solely as a means to improve the viewer's reception of the networks' programs in rural areas that were not served by a local TV station or that suffered from interference with the terrestrial broadcast.<sup>9</sup>

### Trouble in Paradise?

After years of apparently having things their own way, the stakeholders in the broadcasting industry seem to be undergoing seismic competitive changes both from within and without. The networks particularly are affected by the emergence of competitive viewing alternatives and increased options for advertisers. The networks' share of the prime-time audience has eroded over the last decade from approximately 90 percent to about 68 percent in the most recently completed television season – an aggregate decline of 24 percent (see Figure B-1).<sup>10</sup>

In contrast, cable TV and independent stations have posted significant inroads in the audience share over the last five years; they now have 15 percent and 20 percent of the viewing audience, respectively (see Figure B-1).<sup>11</sup> In fact, ABC, CBS, and NBC hit rock bottom last summer when they recorded an all-time low of 55 percent audience share.<sup>12</sup> The networks traditionally drop 10 to 12 points in the summer when reruns fill the airways,<sup>13</sup> but never have they dropped so low. In an attempt to reassure television advertisers, both CBS and NBC downplayed the event. Bob Niles, vice-president of research for NBC, stated in *Broadcasting* that the networks "have not lost reach, they have lost frequency." Mike Eisenberg, CBS vice-president of Audience Measurement, commented that "[i]n one simple shot, the broadcast networks can deliver 100% of the country."<sup>14</sup>



Source: Data from Prudential-Bache Securities, Inc., *Broadcast Television Industry Report*, May 19, 1989, Tables 4, 5, 6.  
 Graph: © 1991 President and Fellows of Harvard College. Program on Information Resources Policy.

**Figure B-1**

**Percent Share of Prime Time Viewing:  
 Three Networks, Basic Cable, and Independents  
 (1981 - 1989)**

Because the networks' advertising revenue (as well as that of cable and independents) is tied directly to the audience share they can deliver, television advertisers look closely at their mix of television delivery options. Due to the decreasing audience the networks have delivered over the past five years, television network advertising has showed virtually no growth since 1984.<sup>15</sup> In fact, the major national advertisers are finding ways to "by-pass" the networks by using combinations of local stations that meet their audience target

requirements. Usually, these arrangements are substantially less expensive than paying the network advertising rates.

Procter & Gamble (P&G), the largest network advertiser, invested \$10 million in 1987 in a package of local and national spots involving six independent stations and Superstation WTBS. P&G estimated that it would be able to reach 65 percent of the nation's households at a cost 15 percent below the network rates. Moreover, using WTBS gave P&G access to cable households where network viewership is much lower than average, at only 53 percent.<sup>16</sup>

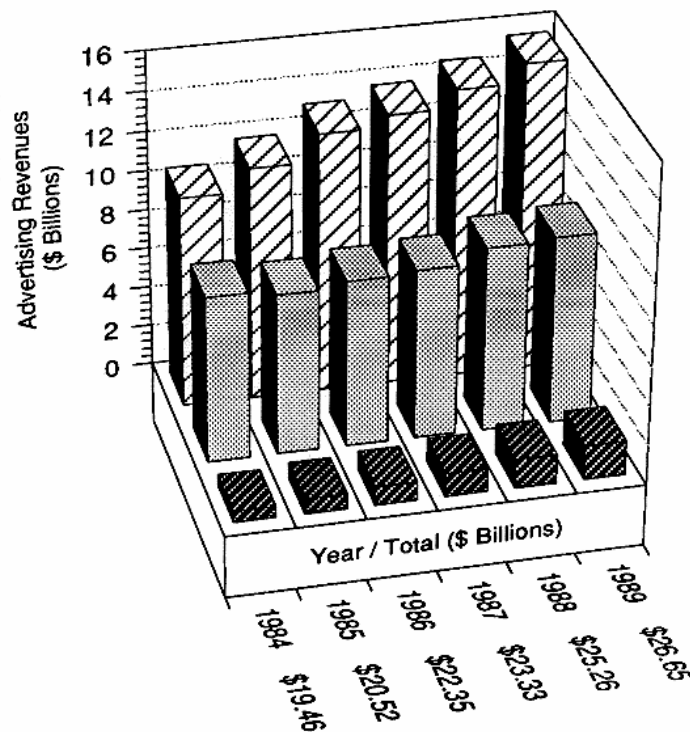
Other advertisers seem to be following P&G's example: network advertising accounted for 44 percent of total TV advertising (broadcasting only) in 1984 but dropped to only 38.8 percent in 1988. Figure B-2 shows the distribution of TV advertising expenditures and the gains made by the independents, local stations, and cable industry for the past five years.

Television advertisers may not be convinced by the assurances of NBC and CBS that they can still deliver the necessary audience. According to Jon Mandel, vice-president and associate media director for Grey Advertising

All the networks do during the summer is air busted pilots. The American public is not stupid. Network thinking is, "Why should I do original programming in June when the HUT [homes using television] levels are down?" It's about the same kind of thinking Detroit used to have about competing against the Japanese in the automotive markets.<sup>17</sup>

Based on the attitude of advertising executives like Mandel, the P&G "by-pass" experience, and the flat advertising revenue growth over the past five years, it is difficult to find a silver lining for the networks in such threatening clouds. However, the networks and the industry somehow seem to have found one. An industry study by Wilkofsky Gruen Associates for Blair TV predicts the industry will enjoy high growth rates well into the 1990s. Moreover, the network share of ad





- ▨ Local and Independent TV Ad Revenues
- ▨ Network Ad Revenues
- ▨ Cable TV Ad Revenues

Source: Data from Prudential-Bache Securities, Inc., *Broadcast Television Industry Report*, May 19, 1989, Tables 7, 9.  
 Graph: © 1991 President and Fellows of Harvard College. Program on Information Resources Policy.

**Figure B-2**

**Network Advertising Revenues Show Little Growth:  
 Independents, Local Stations, and Cable Ad Revenues  
 Make Impressive Gains  
 (1984 - 1989)**

revenues is projected to almost double to \$16 billion by 1995.<sup>18</sup> Hope springs eternal in the breast of the broadcasters.

Programming costs are a further worry in the broadcasting industry, particularly for the networks. The cost of producing prime-time programs for the networks has tripled from 1976 to 1987. The cost of programming can range from \$40,000 to \$100,000 for half-hour game shows

and talk shows. Prime-time one-hour shows averaged more than \$840,000 in 1987, and it is not unusual for some prime-time programs to exceed \$1 million for a single one-hour episode.<sup>19</sup> Almost 70 percent of a network's expenses are for the license and rights fees for television programming. In 1987, the three networks spent more than \$3.5 billion on programming, three-fourths of which represents the rights to programming by outside suppliers; the remaining one-fourth of programming costs is for shows produced in-house by the network.<sup>20</sup>

A 1983 Justice Department-imposed consent decree prevents the networks from producing or owning the rights to more than 16 percent (5 of the 22 hours) of weekly prime-time programming.<sup>21</sup> As a result, the networks must buy the majority of their programming from outside suppliers - independent production studios or major Hollywood producers. Under such a restriction the networks have had little leverage over the annual 10 percent increase in programming costs, although better control and additional competition among producers has dropped the rate closer to 5-6 percent.<sup>22</sup> FCC regulations prevent the networks from owning a financial interest in the prime-time programming that they show - that is produced by others - or from operating as a syndicator of television shows, whether they are produced in-house or not. These regulations, known as the "fin/syn rules," keep the networks from sharing in the ongoing success of profitable shows such as "The Cosby Show," which recently sold for an estimated \$500 million in syndication.<sup>23</sup>

The independent stations likewise have experienced a dramatic rise in programming costs as each station tries to differentiate itself from the others by its programming. The independents are subject to the same increasing costs for original programming as the networks. Moreover, the bidding war for "off-network" syndicated programs, commonly known as "reruns" and a staple in the independent stations' programming diet, has caused independents' programming costs to double from 1980 to 1987; one source expects the costs to double again by the end of 1990.<sup>24</sup>

It should be noted that the rise of the "fourth network," Fox Broadcasting, has contributed significantly to the competitive struggle

within the broadcasting industry. Under the FCC definition, Fox does not qualify as a national network (ala CBS, ABC, and NBC) because it provides its affiliates with less than fifteen hours of national programming per week; therefor, Fox is not subjected to the FCC rules governing the networks. Nonetheless, with stations owned in six major markets, access to the movie library of Twentieth Century Fox, and aggressive prime-time programming, the Fox network has drained audience share and advertising dollars from the major networks. During the 1989 summer disaster for ABC, NBC, and CBS, Fox gathered an 11 percent prime-time share of the audience.<sup>25</sup> Audience ratings on Saturday and Sunday nights are at break-even levels, and the network was in the black during the first half of 1989.<sup>26</sup> Coupled with the deep pockets of Rupert Murdoch's worldwide media empire, News Corporation, the Fox Network appears to be becoming a big player in the industry.

All of this seems to indicate that the broadcasting industry, once the dominant purveyor of television programming for the public, is undergoing a period of tremendous turmoil. Intense competition for audience share and advertising dollars comes from the outside as well as within the industry. The cost of programming continues to rise as more players compete for the creative talents of the Hollywood entertainment studios. Television advertising dollars rates are being forced downward as television advertisers leverage the greater number of television delivery options at their disposal. ABC, NBC, and CBS particularly seem to be caught in the squeeze from all sides.

These events, by no means, are meant to imply that the broadcast industry is going the way of the dinosaur. An industry that is generating \$25 billion in revenues and has an audience share of more than 80 percent (network and independent combined) is not yet ready for the La Brea Tar Pits. Some of the investment community and other industry followers see the networks' audience share stabilizing at about 65 percent in the next few years. Additionally, there are opportunities for new revenue from syndication and better control over programming costs if government restrictions are eased.<sup>27</sup>

## HDTV Technology and the Broadcasters

The broadcast industry faces a technological conundrum: how to fit twenty-five pounds of HDTV sausage into a five-pound casing of bandwidth. The FCC, to protect the embedded \$80 billion consumer investment in NTSC television receivers<sup>28</sup> and the spectrum already allocated to military, mobile radio, and satellite users, has decreed that any new HDTV system must fit within the existing 6 MHz bandwidth already assigned to terrestrial broadcast.<sup>29</sup> Therefore, the broadcasters must find a way to compress the HDTV signal for 1100 lines (originally configured by the Japanese MUSE system requiring five times the NTSC bandwidth) into a single channel.

Of the HDTV transmission systems being evaluated by the Advanced Television Test Center, most will require additional channel capacity within the current broadcast spectrum; enhanced NTSC system (not true high definition) can operate within current channel allocations. Therefore, according to John Abel of NAB, the broadcast HDTV system will require additional spectrum for each individual station.<sup>30</sup> In addition to potentially requiring a re-shuffling of channel assignments,<sup>31</sup> a simulcast or augmentation system will in all probability force the networks, their local affiliates, and independent stations to upgrade their studio and transmission systems to accommodate both NTSC and HDTV signals.

The interim report from the Advisory Committee on Advanced Television Systems (ATS) estimates the costs to equip a station for HDTV services. Bob Ross, director of broadcast operation for Group W's WJZ-TV in Baltimore and the leader of the subcommittee of ATS which developed the report, in a paper presented to the NAB Engineering Conference concluded that "there is no inexpensive path to an ATV system. The first in the market will pay a premium."<sup>32</sup> The bottom line of the report is that it would cost \$38 million to build an HDTV station today, compared to \$14 million to build an NTSC station from scratch.<sup>33</sup> Even if new transmission towers or microwave relays are not required, it would cost an additional \$1-2 million per year in operating costs.<sup>34</sup> Although this

differential does not seem large, the simulcast and/or augmentation HDTV system standard would require stations to maintain and operate both HDTV and NTSC facilities.

Is this such a big deal? In addition to John Abel, whose comments began this discussion, others in the industry seem to think so. Karl Ranwanz, vice president of Engineering and Operations at WNEV-TV Boston, at an HDTV conference in Washington commented: "Some TV stations are having trouble just surviving in the current NTSC world. In an era when station revenues are growing at 3-8% per year and some are finding revenues actually decreasing, it may be impossible for many to pay for HDTV upgrades."<sup>35</sup> Howard Miller, vice president of Operations and Engineering at PBS, was more concerned that the estimates of \$38 million are "causing a lot of public stations to wonder if they'll be around in a couple of years."<sup>36</sup>

The Advisory Committee report clearly states these figures are "worst case" estimates based on currently nontestable assumptions. However, even if overstated by an order of magnitude, the investment by the more than 1000 local stations alone will cost the industry billions of dollars. Perhaps this is why some in the industry are looking for a two-phase approach to HDTV. Phase one would employ enhanced definition television (EDTV), or improved NTSC, in the short term to gage consumer receptivity; phase two would move to the simulcast system when the market and receivers are ready.

Obviously, broadcasters and stations will not be rushing out tomorrow to build HDTV facilities. These costs can be expected to come down if HDTV becomes accepted by the consumer and demand for the HDTV equipment increases. However, these capital costs, plus the costs for operating a new (or worse yet, dual) broadcasting system, could very well prevent many small or medium-sized stations from participating in HDTV at all.

**And in the End**

Consider again the two quotes from the National Association of Broadcasters that introduced this section. They reflect the turmoil within the industry and its approach to advanced television services: competition and investment. The turbulent financial and market conditions in the industry will be a significant factor in how the industry perceives the advent of high definition television systems. Consequently, participation in HDTV becomes an issue of polarity. It may be that the early delivery of a broadcast or terrestrial-based HDTV becomes a survival issue for the broadcast industry, or it could become a non-issue if the networks continue to struggle and cannot find the additional investment required for new HDTV services.

If one were to make a scorecard of the broadcast industry's capabilities in preparation for their foray into HDTV, it might look something like the following.

### Broadcast Industry Scorecard

#### Video Marketplace Issues

Market Presence	HIGH	...X.....	LOW
Industry Growth	HIGH	.....X.....	LOW
Competition in Market	HIGH	...X.....	LOW
Depth of Pockets	HIGH	.....X.....	LOW

#### Political/Regulatory Issues

Political Impediments	HIGH	...X.....	LOW
Political Support	HIGH	.....X.....	LOW
Political Strength	HIGH	.....X.....	LOW
Political Strength of Competitors	HIGH	.....X.....	LOW

#### HDTV Technology Issues

Complexity for Industry	HIGH	...X.....	LOW
Cost of Participating	HIGH	...X.....	LOW
Cost of Implementing	HIGH	..X.....	LOW
Timing of Implementation	SHORT TERM	.....X.....	LONG TERM

#### Importance of HDTV to Stakeholder

SURVIVAL	CRITICAL	IMPORTANT	OPPORTUNITY	INCIDENTAL	WHO CARES
....X.....					.....X.....

## NOTES

1. *NTIA Telecom 2000: Charting the Course for a New Century*, NTIA Special Publication 88-21, July 1988, 483.
2. *Ibid.*, 486.
3. Prudential-Bache Securities, Inc., *Broadcast Television Industry Report*, 19 May 1989, Table 7 (hereinafter, *Prudential-Bache Report*). [NEXIS]
4. Public Television stations are viewer-supported; they rely not on advertising revenues for operations but on corporate and individual contributions.
5. *NTIA Telecom 2000*, 486.
6. *Ibid.*, 506.
7. *Ibid.*, 492-93.
8. *Ibid.*, 492.
9. *Ibid.*, 542.
10. *Prudential-Bache Report*, Table 4. The report notes that the Writers Guild strike in 1988 and the change to "people-meters" in 1987-88 might distort the results for the last two measurement periods. The report suggests that 50 percent of the loss of share is real and that the rest is a result of the writers' strike and change of methodology, although it is impossible to quantify.
11. *Ibid.*, Tables 5, 6.
12. "Networks Hit Summer Doldrums," *Broadcasting* 117, no. 8 (21 August 1989).
13. *Ibid.*
14. *Ibid.*
15. *Prudential-Bache Report*.
16. *NTIA Telecom 2000*, 493-94, 510.
17. *Broadcasting*, "Networks Hit Summer Doldrums."
18. "Television 1995: 'Free TV' Promotion Unveiled at NAB," *Communications Daily* 9, no. 84 (2 May 1989).
19. *NTIA Telecom 2000*, 484.
20. *Prudential-Bache Report*.



21. Ibid.
22. Ibid.
23. Ibid.
24. *NTIA Telecom 2000*, 498.
25. *Broadcasting*, "Networks Hit Summer Doldrums."
26. Drexel Burnham Lambert Incorporated, *Entertainment and Media Conference of January 11-14 at Laguna Niguel, Calif.: Highlights*, 31 January 1989, "The News Corporation Limited." [NEXIS]
27. Ibid.; see also *Prudential-Bache Report*. Both companies see revenue gains for the industry for the next three years of between 5-7 percent.
28. *NTIA Telecom 2000*, 502.
29. *In the Matter of Advanced Television Systems and Their Impact on the Existing Television Broadcast Service, Tentative Decision and Further Notice of Inquiry*, MM Docket 87-268, 3 FCC rcd 6520 (1988), 41 (hereinafter, *FCC ATV Decision*).
30. John Abel, *Testimony of John Abel, Executive Vice President, National Association of Broadcasters before Senate Commerce Committee, Subcommittee on Science, Technology and Space on High Definition Television*, 16 May 1989, at 2pm.  
See also Alex D. Felker, "Broadcast HDTV Standards and Spectrum Tradeoffs," paper presented at the 17th Annual Telecommunications Policy Research Conference, Arlington, Virginia, 3 October 1989.
31. The FCC seems willing to abandon, or at least modify, the so-called "UHF taboos" which require adequate spacing between channels so as to prevent interference from adjacent stations at the viewer's receiver. Advances in the last decade in receiver and transmission technologies seem to have decreased the requirement for such wide spacing, thus allowing the interval spectrum to be used for such things as augmented or simulcast ATV signals. See *FCC ATV Decision*, 41.
32. "State of the Art Technology: Special Report," *Broadcasting* 117, no. 17 (23 October 1989).
33. "Existence Threatened: Full HDTV Conversion Could Cost \$38 Million Per TV Station," *Communications Daily* 9, no. 174 (9 September 1989).
34. Ibid.
35. Ibid.
36. Ibid.

## APPENDIX C

### THE CABLE TELEVISION INDUSTRY

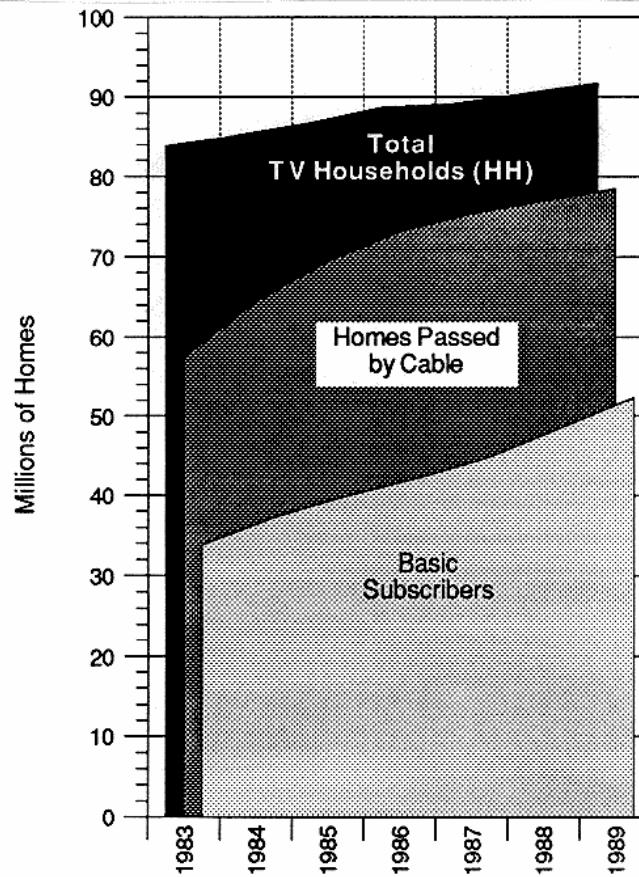
Like one of its founding fathers, Ted Turner of Turner Broadcasting, the cable TV industry has evolved into a brash, ubiquitous, and influential set of stakeholders which, in the last ten years, has changed the television landscape for the viewing public. Beginning solely as a means to improve the television reception of mostly rural viewers, cable TV today offers a diverse array of 24-hour programming on an estimated 180 cable services<sup>1</sup> – from Women's Beach Volleyball Championships in Hawaii on ESPN, to ballet on the Arts & Entertainment Network, to around-the-clock global news coverage on CNN.

The cable industry comprises three segments, which are often blurred by consolidation and integration:

- **Franchised Cable Operators.** These operators (such as TCI, Viacom, and Cablevision) install and operate the cable system itself. They are the ones to whom users pay their monthly subscription fee.
- **Cable Networks.** These networks (superstations such as WTBS and WOR, as well as USA, Nickelodeon, and ESPN among others) are advertiser supported, provide programming, and are usually included in the "basic" service from the local cable operators.
- **Pay or Premium Service Providers.** These service providers (such as HBO, Showtime, or the Movie Channel) supply movies or original programming for which subscribers pay an additional monthly fee.

#### Like a Shooting Star

The growth of the industry, particularly from 1985 to 1990, has been somewhat meteoric. After somewhat sluggish growth in the early seventies,<sup>2</sup> the industry now has 50 million subscribers, and almost two-thirds of the households capable of receiving cable services (households passed) subscribe to them (see Figure C-1).<sup>3</sup> Much of this growth is attributed to advances in satellite transmission technology and the proliferation of new cable programming networks.<sup>4</sup> Since the Cable TV Act of 1984 deregulated rates in the industry, the revenue



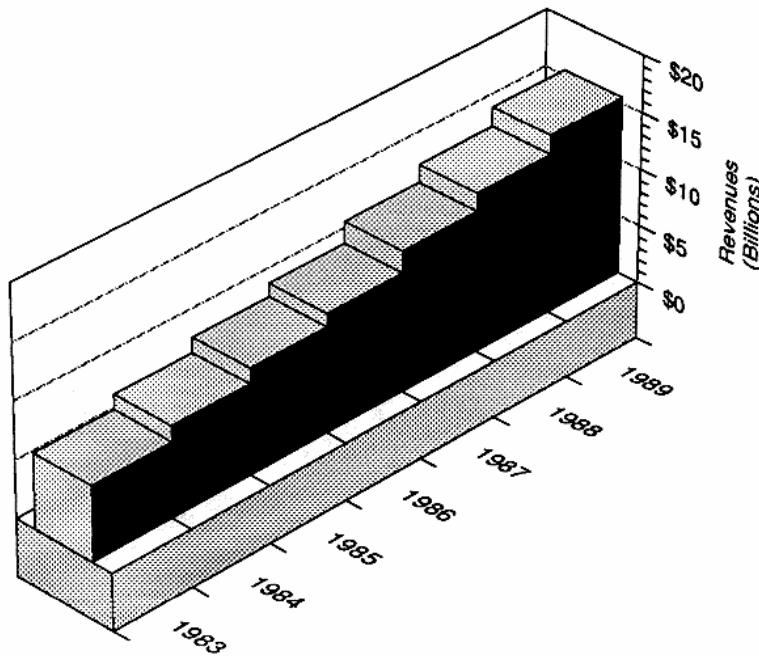
Source: Data from Prudential-Bache Securities, Inc., *Cable Television Industry Report*, May 24, 1989, Table 3.  
 Graph: © 1991 President and Fellows of Harvard College. Program on Information Resources Policy.

**Figure C-1**

**Rapid Growth in Homes Passed by Cable  
 Fueled Subscriber Growth  
 (millions)**

gains of the industry have been equally impressive (see **Figure C-2**).<sup>5</sup> Cable is now a \$15 billion a year industry (see **Figure C-3**). The average household spends more than \$30 a month for cable's basic and pay services – almost double that for local telephone service.<sup>6</sup>

The industry and some of the investment community are equally enthusiastic about the future of cable TV. Some estimate that by 1994,



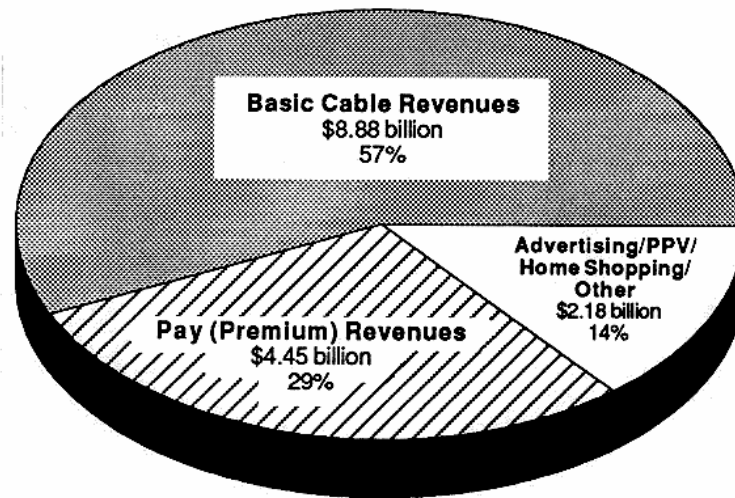
Source: Data from Prudential-Bache Securities, Inc., *Cable Television Industry Report*, May 24, 1989, Table 4.  
 Graph: © 1991 President and Fellows of Harvard College. Program on Information Resources Policy.

Figure C-2

**Cable Industry Revenues  
 Have Posted Impressive Gains  
 (1983 - 1989)**

the cable industry will reach \$25 billion in revenues and that 90 percent of U.S. households will be passed by cable, of which 65-75 percent will be subscribers (see Figure C-4).<sup>7</sup> Revenues from advertising (predicted to increase from \$350 million in 1988 to \$1 billion in 1993) and pay-per-view services (predicted to increase from \$210 million in 1988 to \$1 billion in 1993) are expected to become more important sources of revenue as the subscriber population becomes saturated in the mid-1990s (see Figure C-5).<sup>8</sup>

A further indication of the cable TV industry's success is in the perceived value of the cable systems to buyers in the past few years. Recent purchases of cable systems in 1989 by Tele-Communications, Inc.



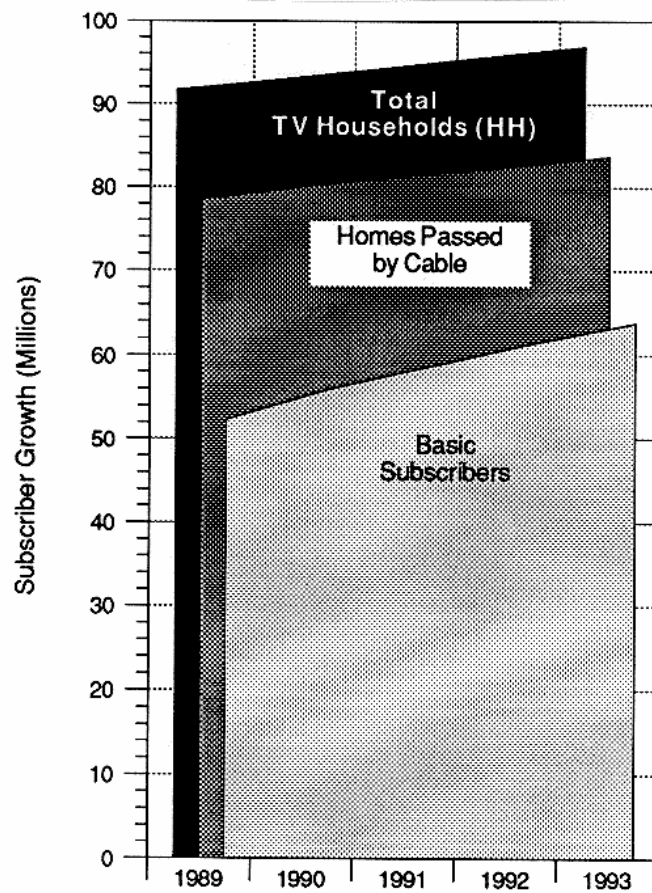
Source: Data from Prudential-Bache Securities, Inc., *Cable Television Industry Report*, May 24, 1989, Table 4.  
 Graph: © 1991 President and Fellows of Harvard College. Program on Information Resources Policy.

Figure C-3

1989 Sources of Cable Revenues  
 (\$ billions)

(TCI), the nation's largest multiple-system operator (MSO), cost between \$2200 and \$2500 per subscriber – almost three times the per-subscriber price of just six years ago.<sup>9</sup> One side benefit to the cable operator of this increased valuation per subscriber is that the cost of adding new subscribers has dropped substantially. TCI estimates that it is now economically efficient to wire some areas with densities as low as 15 homes/mile, as compared to 60 homes/mile a few years ago.<sup>10</sup>

Cable TV has one other prominent attribute – the horizontal concentration and vertical integration of the industry. Horizontal concentration is the share of subscribers accounted for by the largest MSOs. The merger and acquisition frenzy of the last four years has created a situation where the top five MSOs have almost 50 percent of



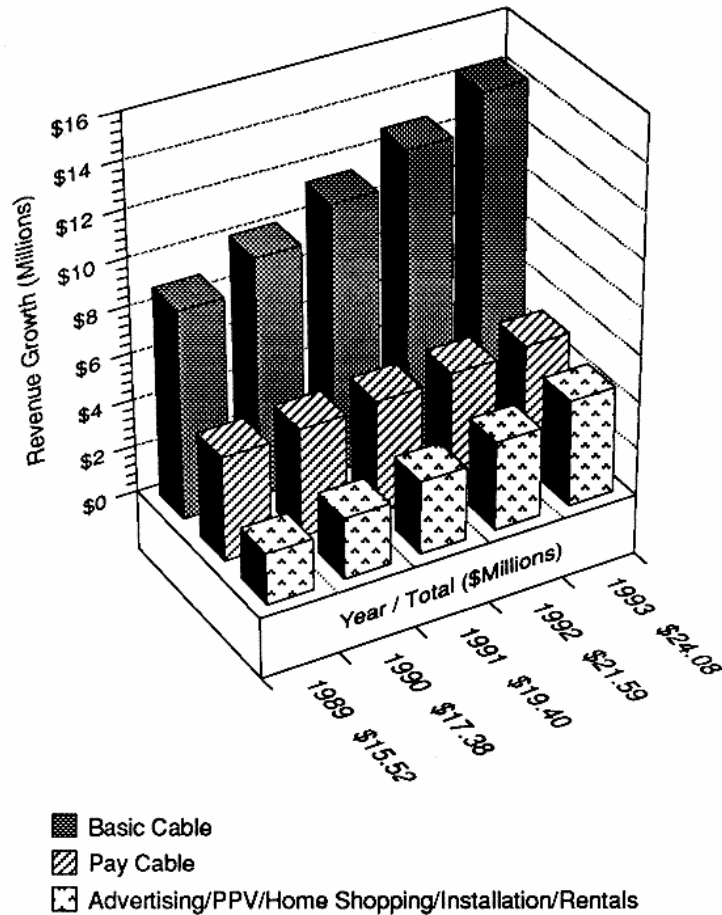
Source: Data from Prudential-Bache Securities, Inc., *Cable Television Industry Report*, May 24, 1989, Table 3.  
 Graph: © 1991 President and Fellows of Harvard College. Program on Information Resources Policy.

**Figure C-4**

**Optimism for Future Cable Subscriber  
and Revenue Growth  
(1989 - 1993)**

the subscribers (see Table C-1).<sup>11</sup> By itself, TCI has almost 20 percent of the total cable TV subscribers.

Vertical integration refers to MSO ownership of cable programming by having an interest in any or all of the following: cable networks, movie/film libraries, or program entertainment studios. Table C-2 shows



Source: Data from Prudential-Bache Securities, Inc., *Cable Television Industry Report*, May 24, 1989, Table 4.  
 Graph: © 1991 President and Fellows of Harvard College. Program on Information Resources Policy.

**Figure C-5**

**Future Cable Revenue Sources  
(1989 - 1993)**

the extent of the program holdings of three of the largest cable system operators or MSOs.

The rich may be getting even richer. According to an article in *Communications Daily*, TCI is rumored to be the front-runner in the bidding for MGM/UA studios and to have just completed a deal for 50 percent of Viacom's Showtime pay movie channel.<sup>12</sup>

Table C-1

**"Top Ten" MSOs  
(April 1988)**

<b>Top 5 MSOs</b>	<b>Number of Subscribers</b> (Total Subscribers 44,700,000 = 100%)
1. Tele-Communications, Inc. (TCI)	10,756,265
50% of Storer Cable Communications	735,500
	11,491,765
2. American Television & Communications	4,540,000
3. Continental Cablevision	2,332,219
4. Comcast Cable Communications	1,354,150
50% of Storer Cable Communications	735,500
	2,089,650
5. Cox Cable Communications	1,438,057
<b>Subtotal 1-5</b> (48.98% of all subscribers)	21,819,691
<b>Top 6-10 MSOs</b>	
6. Warner Cable Communications	1,424,364
7. Newhouse Broadcasting	1,074,799
8. Viacom Cable	1,068,400
9. Cablevision Systems	1,035,429
10. Jones Intercable	990,041
<b>Subtotal 6-10</b> (12.51% of all subscribers)	5,593,033
<b>Total Top 10</b> (61.49% of all subscribers)	27,484,724

Source: House Committee on Energy and Commerce, *Cable Television: Hearings before the Subcommittee on Telecommunications and Finance*, 100th Cong., 2d Sess., March 30 and May 11, 1988, p. 403.

The MSOs and the cable networks are also increasing their programming budgets to produce their own original programs in order to become less dependent on Hollywood and broadcast programming products. According to



Table C-2

**Equity Interests of Cable TV System Owners  
in Other Cable Program Services**

<b>Owners</b>	<b>Other Services</b>	<b>Ownership (percent)</b>
<b>Tele-Communications, Inc. (TCI)</b>	American Movie Classics	50.0%
	Black Entertainment Television	16.5
	Event-TeleVision (pay-per-view)	10.0
	Cable Value Network	11.3
	Discovery Channel	10.0
	The PreView Channel	unspecified
	The Fashion Channel	unspecified
	Pirates on Cable and other sports services	
	Turner Broadcasting (WTBS, CNN, Headline News)*	35.0
<b>Viacom International/ Viacom Cable</b>	Showtime	100.0
	The Movie Channel	100.0
	Viewers Choice I&II (pay-per-view)	100.0
	MTV	100.0
	VH-1	100.0
	Nickelodeon	100.0
	Nick-at-Night	100.0
	Lifetime	33.0
	Cable Value Network	2.4
<b>Time, Inc./ATC Cable Systems**</b>	HBO	100.0
	Cinemax	100.0
	Festival	100.0
	Black Entertainment Network	16.5
	Cable Value Network	8.7
	The PreView Channel	unspecified
	The Fashion Channel	unspecified

\* TCI along with 18 other MSOs and private investors own 35 percent of Turner Broadcasting.

\*\* Time, Inc. owns 82 percent of ATC Cable Systems.

Source: U.S. Department of Commerce, *NTIA TELECOM 2000: Charting the Course for a New Century*, NTIA Special Publication 88-21, October 1989, p. 556.

TNT Executive Vice President Scott Sassa: "The important issue for cable in the 1990s is to not only create its own programming, but to get the best people to do quality programming."<sup>13</sup>

To that end, Turner Broadcasting has signed agreements with Steven Speilberg's Amblin Entertainment to produce at least six original movies by top playwrights. TNT's New Showcase Theater will air once a month starting in 1991, and feature one "name star" plus a repertory company. Because the project will use a repertory company and shoot the films consecutively, TNT can produce these movies at a cost much lower than outside studios and has budgeted only \$3 to \$4 million per film.<sup>14</sup>

#### **What Price Success?**

All in all, the cable TV industry has been an impressive success, particularly in the last five years. But as often happens in a competitive world, success usually comes at the expense of someone else.

The broadcast television industry, upset with its shrinking share of the viewing audience and advertising revenues lost to cable television, views the cable TV industry as monopolists. At a hearing before the Senate Communications Subcommittee in June 1989, Eddie Fritts, president of the National Association of Broadcasters, testified that "broadcasting is at a disadvantage to cable because of its greater regulatory burden. And since it is unlikely that broadcasting is going to be deregulated, cable should be regulated. Congress may also wish to consider restrictions on cable ownership."<sup>15</sup>

Hollywood program studios are concerned about the vertical integration of the cable industry into television programming and its control over the level and kind of programming distributed to subscribers. Their dismay is expressed through the strident testimony of Jack Valenti, president of the Motion Picture Association of America (MPAA), before the House Subcommittee on Telecommunications and Finance in May 1988:

[I]s it in the public interest that only one corporation, only one company control all the television material that flows into the cable homes of a community? Is it in the public interest that a single corporate authority not only owns the cable system and has a virtual lock on all the channels and wields the power over what programs are shown, and not shown, but now takes an increasing ownership stake in the programs they exhibit?<sup>16</sup>

Paradoxically, or perhaps not, Valenti expressed almost identical rage at the prospect of the big three networks (ABC, NBC, CBS) being allowed to produce more of their own programming. As reported in *Broadcasting*, Valenti, testifying in June 1989 at the same hearing as Fritts of NAB, proclaimed: "Despite the audience erosion, the three networks remain dominant forces in prime-time programming with total mastery over what gets shown and what does not. If you strip away this one leveling force, it's all over"<sup>17</sup> [emphasis added]. Apparently, there are barbarians at every gate to Hollywood.

As noted earlier, the Cable Television Act of 1984 freed the industry from rate regulation, effective in 1987. The cable operators were quick to react to new pricing freedom — they raised basic cable rates by an average of 30 percent between January 1987 and December 1988.<sup>18</sup> A Government Accounting Office (GAO) report on cable rate increases submitted to the House Subcommittee on Telecommunications and Finance also reported that 17.6 percent of cable subscribers incurred rate increases of more than 50 percent, and more than one in four subscribers incurred an increase of more than 40 percent.<sup>19</sup> The average monthly subscriber now pays more than \$30 per month for basic and pay cable services, although the number of channels available as part of the basic package increased from 27 to 32.<sup>20</sup>

The dramatic rise in cable TV rates (see Table C-3), coupled with a flood of service complaints by subscribers, cities, and municipalities,<sup>21</sup> has caught the attention of Congress. As the testimony above suggests, both the House and Senate have held (and promise to hold more) hearings on the structure of the cable industry,

Table C-3

**Basic Cable TV Rates  
Show Dramatic Increase Since 1984**

Cable System	Year		Increase (percent)
	1984	1988	
Manhattan	\$9.75	\$14.95	53
New Jersey	\$8.24	\$12.77	35
Los Angeles	\$9.30	\$16.54	44

Source: Data from Geraldine Fabrikant, "In Cable TV, A Free Rein Raises Prices," *New York Times*, Sunday, December 11, 1988, sec. 1.

and six separate bills have been introduced to modify the Cable Television Act to curtail the alleged monopolistic practices of the industry.<sup>22</sup>

The Federal Communications Commission (FCC), in a currently pending proceeding, has already tentatively concluded that the cable TV/telephone cross-ownership restrictions should be removed to allow telephone companies to provide cable transmission services.<sup>23</sup> In December 1989 the FCC issued a Notice of Inquiry to determine the extent of competition in the cable TV and video distribution marketplace to determine if re-regulation of the cable industry is appropriate or new competition in the form of the broadcast networks or telephone companies should be allowed.<sup>24</sup>

As if the cable industry didn't have enough trouble with outsiders, the industry also seems to be becoming cannibalistic. In a bizarre twist, Viacom, the sixteenth-largest MSO with substantial programming services, filed suit for \$2.4 billion in May 1989 against Time, Inc. and its subsidiaries, HBO, ATC, and Manhattan Cable. Sounding much like the NAB or the MPAA by alleging monopolistic practices, Viacom's complaint is that Time is preventing the carriage of Viacom's Showtime and The

Movie Channel in competition with Time's HBO and Cinemax.<sup>25</sup> Talk about strange bedfellows. There appears to be more than enough heat in the system - and no shortage of witnesses to come forward to bear testimony - for the possibility that some oversight of the cable industry may not be far off.

#### The Cable Industry and HDTV

The cable television industry is in a somewhat better position than the terrestrial broadcasters in its ability to technically implement a system for HDTV delivery. According to NTIA, the major issue for the cable industry is the establishment of a transmission system that is compatible with the current NTSC system with which cable channels are also configured.<sup>26</sup> The bandwidth of coaxial cable used in the industry is more than sufficient to handle an HDTV standard that exceeds the current 6 MHz bandwidth for NTSC transmission. In fact, the cable industry has tested transmission of the NHK Muse system at 8.1 MHz by combining channels.<sup>27</sup>

The problem for cable operators comes if the HDTV broadcast standard requires *additional* channel spectrum, thereby forcing the cable operator to reconfigure channel allocations. The FCC Advisory Committee has endorsed a simulcast transmission system for HDTV. The simulcast approach to terrestrial broadcast of HDTV would force cable operators either to drop NTSC programs for HDTV ones on existing channels or to expand channel capacity so that an NTSC program can be broadcast on one channel and the same program broadcast in HDTV on a separate one.<sup>28</sup>

Such a result could have a significant cost impact on the cable operators. Cable TV Labs' Vice President Craig Tanner believes that "cable operators are worried because if all the networks and many independent stations add simulcast NTSC, we may need to move pretty quickly to add 8 or 10 channels to already-crowded cable systems, and that would require major system upgrades."<sup>29</sup> This would require significant modifications to the cable "headends" (where the video and

audio signals are received, processed, and prepared for transmission to subscribers) as well as the interface equipment (or converter/decoders) in the subscriber's home.<sup>30</sup>

With all of their other public relations problems over poor service and increased rates, the cable industry is sensitive to avoiding problems with their subscribers. At the June 1989 17th Annual International Television Symposium in Montreux, Switzerland, Walt Ciciora, vice president of technology for American Television and Communications (ATC), a division of Time, Inc., acknowledged this issue:

The toughest decision the cable industry will have to make is how high quality a system to install. Subscribers do not like to see their bills increase. We must do this [implement HDTV] in a way that provides both video quality and is cost effective.<sup>31</sup>

Part of that concern over costs to the subscriber stems from the new converter boxes that must be installed in the subscriber's home to receive the HDTV signal. According to estimates from the FCC Advisory Committee on Advanced Television Service, the cost of an addressable converter/decoder for HDTV can be three times the cost for a comparable NTSC converter.<sup>32</sup> Particularly in the early stages, when only one or two channels are transmitting HDTV programs, subscribers may balk at paying three times more for renting the converter box for only one or two HDTV programs a month.

Nonetheless, the cable industry seems to recognize the competitive importance of HDTV in relation to the broadcast and film industries. As Ciciora stated in Montreux, "[b]y the time HDTV becomes a viable product, cable will serve 80% of all U.S. homes. Therefore, it is *crucial* for the cable industry to find ways to compete with broadcasters and the VCR"<sup>33</sup> [emphasis added]. To ensure the industry's viability in the development of HDTV, the Cable TV Labs - the industry research consortium - has provided \$2 million for the HDTV transmission development and testing work being conducted by the Advanced Television Test Center.<sup>34</sup> The Cable TV Lab is also pursuing development of fiber

optic HDTV transmission and investing in systems to prevent copying of pay-per-view programming.<sup>35</sup>

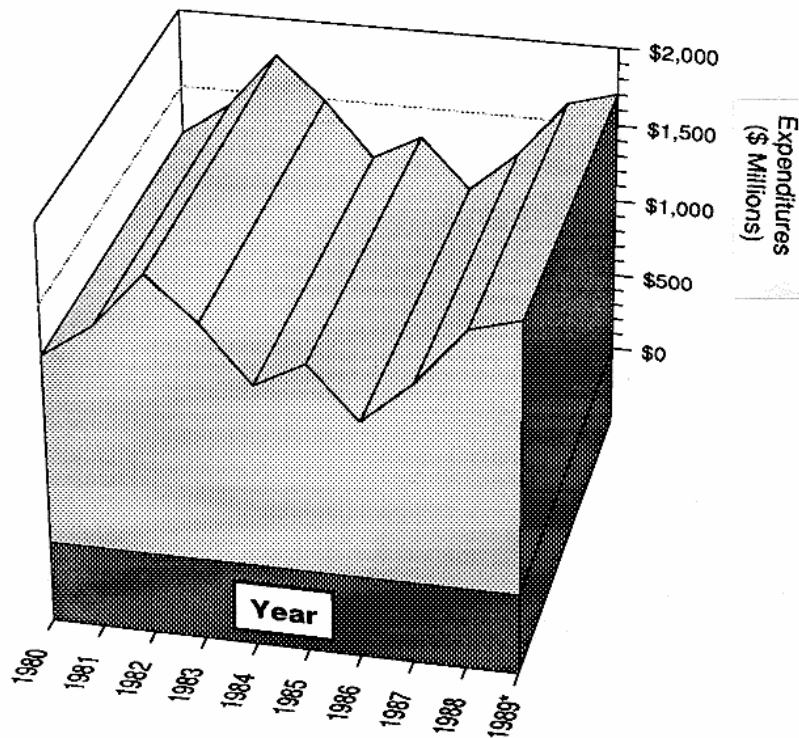
The work conducted on pay-per-view is particularly important to the industry because it gives the cable operators flexibility in providing HDTV programming. Cable operators could test the market for HDTV by providing pay-per-view HDTV movies on the premium channels – directly transmitted by satellite – without making the heavy initial investment in modifying their cable systems for terrestrial reception.<sup>36</sup> This is a luxury that the broadcasters do not have at their disposal, according to Ciciora.<sup>37</sup>

In potentially having to upgrade their systems, the cable folks might very well find themselves in a financial bind. The cable industry has spent in excess of \$12 billion over the last ten years in construction expenditures to reach the 50 million subscribers they have today (see Figure C-6).<sup>38</sup> Thus, the industry has a relatively young cable network in place – but with a considerable embedded investment. The cable industry is expected to turn to other issues, or, as expressed by the investment firm A.G. Edwards & Sons

[T]he easy subscriber growth from wiring the nation is now behind the industry. With the dramatic decrease in capital expenditures now that construction of cable systems is virtually complete, operators are expected to increase their marketing budgets. *However, the development of quality cable programming is expected to offer the greatest leverage to help operators attract subscribers.*<sup>39</sup> [Emphasis added]

As noted earlier the industry is following – or has anticipated – this sage advice.

In addition to construction expenditures, marketing expenses, and programming costs, the industry is also carrying a significant interest load from its feeding frenzy in the merger and acquisition seas. The value of the mergers and acquisitions in the cable industry over the last two years is estimated at roughly \$27 billion.<sup>40</sup> Since the vast



\*1989 is an estimate.

Source: Data from Research & Policy Analysis Department, National Cable Television Association, Washington, D.C., *Cable Television Developments*, vol. 13, no. 51, August 1989, p. 6.  
 Graph: © 1991 President and Fellows of Harvard College. Program on Information Resources Policy.

**Figure C-6**

**Cable TV Construction Expenditures  
(1980 - 1989)**

majority of these mergers and acquisitions were financed by debt, the industry is carrying a sizable debt load. The following examples illustrate this situation. Adelphia Communications, the twentieth-largest MSO, currently is carrying \$1.05 billion in debt and, according to a Drexel Burnham industry report, cash flow is just now exceeding cash interest this year.<sup>41</sup> Comcast Corporation, the fourth-largest MSO, is carrying a debt load of \$1.2 billion.<sup>42</sup> Finally, Tele-Communications, Inc. (TCI), the largest MSO, was carrying a whopping \$6 billion in debt as of January 1989.<sup>43</sup>



None of these cases is exceptional in the industry and in no way should it be assumed that the MSOs cannot meet their debt obligations. The subscriber base throws off an enormous amount of cash which can easily handle the interest on the debt. According to the Drexel Burnham analysis

Improved basic rate structures and increased penetration of homes passed are producing further cash flow margin expansion. . . . With compound annual cash flow growth in a range of 12-15 percent, net asset values should compound more rapidly as excess cash flow is deployed to reduce debt.<sup>44</sup>

The point of all of this is to raise the question, Where will financing come from to upgrade recently constructed cable facilities to accommodate HDTV? With relatively young cable systems essentially in place, and new subscriber revenues being channeled into reducing debt and increasing expenditures for marketing and programming, cable operators may not want to make a major commitment to HDTV implementation requiring substantial investment in upgrading facilities. Wall Street might not be as favorably disposed to finance new cable TV ventures as they have in the past.

Fred Seegal, an investment banker at Shearson, Lehman, recently offered this observation in the *New York Times*: "[Cable] companies cannot sell deals that depend on high growth in cash flow to meet minimum debt service. The market is simply too skeptical. Buyers can only borrow three-quarters of the debt load they routinely expect."<sup>45</sup> The re-regulation debate in Congress and the FCC also may be a factor in obtaining financing. According to Steven Rattner, an investment banker at Lazard Freres & Co.

Another factor discouraging lenders is the uncertainty of forecasting cash flow projections at a time when re-regulation could limit cash flow. If the Government were to set guidelines for cable rate increases, they could reduce the cash flow available to make debt payments.<sup>46</sup>

**Another Fine Mess**

The cable television industry has achieved enviable success in the 1980s. It is in a strong market position and has proven that its players can compete with broadcast television for audience share, advertising revenues, and programming. However, its very success -- created by moving into programming, consolidating systems, and increasing revenues through rate increases -- has drawn increasingly negative attention (and in some cases the ire) of competitors, subscribers, investors and, worst of all, federal, state, and local governments.

These issues alone would seem to be enough to occupy the cable industry for several years to come. But coupled with potentially expensive system upgrades for HDTV and the uncertainty over HDTV transmission standards, the industry will have to determine the importance of HDTV to its future. Indications suggest that it can afford to proceed at the same pace as the broadcast industry without losing any competitive ground. On the other hand, the opportunity for the cable industry to provide HDTV ahead of the broadcast industry might prove irresistible if it can be done with a minimum of expense and a maximum of visibility -- which seems possible only if they can avoid, or minimize, the political and public relations mess they are in now.

The Cable TV Industry scorecard follows.

## Cable TV Industry Scorecard

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**Video Marketplace Issues**

Market Presence	HIGH	...X.....	LOW
Industry Growth	HIGH	.....X.....	LOW
Competition in Market	HIGH	...X.....	LOW
Depth of Pockets	HIGH	.....X.....	LOW

**Political/Regulatory Issues**

Political Impediments	HIGH	.X.....	LOW
Political Support	HIGH	.....X.....	LOW
Political Strength	HIGH	.....X.....	LOW
Political Strength of Competitors	HIGH	..X.....	LOW

**HDTV Technology Issues**

Complexity for Industry	HIGH	.....X.....	LOW
Cost of Participating	HIGH	..?.....?.....	LOW
Cost of Implementing	HIGH	..?.....?.....	LOW
Timing of Implementation	SHORT TERM	.....X.....	LONG TERM

**Importance of HDTV to Stakeholder**

SURVIVAL	CRITICAL	IMPORTANT	OPPORTUNITY	INCIDENTAL	WHO CARES
.....	.....	.....X.....	.....	.....	.....

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## NOTES

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## APPENDIX D

### DIRECT BROADCAST SATELLITE (DBS): AWAKENING AT LAST?

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*Many have written off the likelihood of high powered Ku-band DBS systems as a pipe dream. But such systems are counting down to scheduled launch dates. When those systems are operational in the next decade, we will see the transformation of our market from rural to suburban and urban; from 10 to 12 foot parabolic antennas to one foot square flat plate or parabolic antennas; from \$2500 C-band systems to \$500 (or less) Ku-band systems; and from 2 million households to perhaps 40 or 50 million households.*

Mark C. Ellison, vice president, Satellite Broadcasting and Communications Association; Report of the Satellite Broadcasting & Communications Association of America, to the Subcommittee on Telecommunications and Finance of the Committee on Energy and Commerce, U.S. House of Representatives, March 1989, 9-10.

*I've had a long history of familiarity with DBS and its successes, but mostly its failures. A version of DBS has caught on in the United States with about 2 million C-band receivers [antennas] in backyards. But that's merely a fallout and an outgrowth of tremendous programming that is being delivered to the cable industry and the broadcast industry. So, it's a secondary market, not a primary market. [Emphasis added]*

Sidney Topol, founder and chairman of the board, Scientific-Atlanta Corporation; Comments at the Federal Computer Conference General Session, Washington, D.C., 23 October 1989, as reported in *Federal News Service*, 23 October 1989, 4.

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In 1982, the FCC established the regulatory policies for Direct Broadcast Satellite (DBS) and approved eight applications for transmission of DBS. Today, there is still no provider of high-powered, Ku-band satellite television programming in the U.S.<sup>1</sup> As the two

opposing views above suggest, there is a mixture of optimism and resignation among members of the industry as to the future of DBS as a transmission medium for television programs directly to the home.

Direct Broadcast Satellites are high-powered (Ku-band) communications satellites that transmit television program-signals directly to earth stations located on home premises. Satellite broadcasting in general is typically distinguished by the power of the satellite: *high-power* Ku-band satellites (true DBS) at about 200 watts per transponder, *medium-power* Ku-band satellites at about 20-60 watts, and *low-power* C-band satellites at less than 20 watts.<sup>2</sup>

A more important distinction among satellites – from the viewer's perspective – is the size of the antenna or satellite dish required to receive the signals from the three types of satellites. High-power satellites can deliver television to two-foot, or less, dishes; medium-power satellites can reach one-meter antennas; and low-power satellites require antennas with a 10- to 12-foot diameter.<sup>3</sup> According to Harry Jessel and Peter Lambert of *Broadcasting* magazine, "one of the axioms of the business is the smaller the antennas, the larger the potential market. Put it another way, the larger the antenna, the fewer the people willing to install it."<sup>4</sup>

To the average homeowners in the mid-1980s, the possibility of picking up dozens of programs directly off of C-band satellites – free of charge – seems to be well worth the \$2000 for the 12-foot antenna perched on the roof of their suburban and rural homes. In my neighborhood in southern New Hampshire, it meant that the rabid New York Giants' fan down the street could see his beloved Giants play anytime and anywhere without the inconvenience of subscribing to the Sports Channel for \$20 per month. Many people are apparently lured by the possibility of seeing HBO and ESPN without paying for them because the number of home satellite dish owners now numbers 2.2 million.<sup>5</sup>

Unfortunately for my neighbor and the others – as well as for the industry – the cable networks were less than pleased that their



unscrambled programming, intended for cable headends for re-distribution to paying subscribers, was being seen free of charge.<sup>6</sup> This "piracy" practice continued until January 1986 when HBO began scrambling its signal; other programmers quickly followed suit.<sup>7</sup> Sales of low-power earth stations dropped sharply as earth station dealers could no longer promise consumers free access to programming.<sup>8</sup>

Today, programmers offer their programs for a fee through a descrambler. However, industry sources claim that the incidence of piracy is still very high because dish owners have learned to "hot wire" the descramblers and obtain programming they are not authorized to receive. Although 1.1 million VC-II descramblers have been shipped since 1986, only 485,000 subscribers are authorized to receive programming.<sup>9</sup> Thus, some 600,000 dish owners are still getting a free ride by pirating signals directly from the satellites.

Although the industry is seeking to gain control over the piracy problem with new scramblers that are more difficult to alter and aggressive enforcement of "anti-piracy" copyright laws, the industry at best remains an ancillary market for distribution of television programming.<sup>10</sup> With only 2.2 million of almost 90 million television households receiving programming from low-power earth stations, the home satellite television market today seems to be viable only as a niche for homes without access to cable.

While low-power C-band satellite television distribution has at least an ancillary market, true DBS - delivered by Ku-band satellites to 2-foot-square antennas mounted easily on the side of a house - has yet to get off the ground, so to speak. Satellite Television Corporation, the broadcasting subsidiary of Comsat, moved aggressively into DBS in the early 1980s by purchasing two Ku-band satellites from General Electric to provide pay programming to home viewers. When STC could not get commitments from programming partners, it bowed out of the market in 1984 and lost both its \$100 million investment as well as ownership of the satellites, which reverted back to GE.<sup>11</sup>

Crimson Satellite, a partnership of HBO and GE Americom, and United Satellite Communications both tried to offer DBS services but failed when costs proved too high and growth too slow to sustain services.<sup>12</sup> United Satellite's efforts ceased in 1985, and Crimson is seeking buyers for its satellite that was constructed for DBS.<sup>13</sup> Another potential player is Tele-Communications Inc. (TCI), the nation's largest cable operator. Through its Netlink subsidiary, TCI is a major force in low-power satellite broadcasting packaging and sales of cable programming to backyard dish owners.<sup>14</sup> Through newly-acquired Tempo Enterprises, TCI could offer DBS an applicant. John Sie, vice president of TCI, maintains that medium- or high-power satellites "offer no clear advantage over the low-power birds. DBS is a high-risk business with an uncertain market."<sup>15</sup>

#### Turning the Corner: HDTV and DBS

The times may be changing for the DBS believers in the 1990s, and HDTV may be a contributing factor. Dominion Video Satellite claims that later in 1990 it will have in operation a DBS system that offers three channels of programming to 2-foot dishes. Dominion plans to offer a mixture of family entertainment, educational, and religious programming (for which it has apparently signed on some 90 televangelists).<sup>16</sup> In contrast to its assertion a year ago, TCI - and a group of eight other multiple system operators (MSO) called the K Prime Partners - seemed to find a way to share the risk and find an advantage in medium-power satellites. In February 1990, the K Prime Partners signed a \$100 million lease for ten transponders on an existing GE American Communications medium-power satellite.<sup>17</sup> The group plans to offer a 10-channel service that offers pay-per-view (PPV) as well as some "Superstation" channels. Eventually, the partners envision offering high definition television programming.<sup>18</sup>

Another partnership - with deep pockets and existing interests in cable systems, satellite communications, broadcasting, motion pictures, and programming - also seems to believe that DBS can now be a profitable

and less risky venture. On 21 February 1990, General Motors' Hughes Communications, Rupert Murdoch's News Corporation, GE's NBC, and Cablevision Systems announced their plan to invest nearly \$1 billion to launch a new DBS service with as many as 108 channels.<sup>19</sup> The new service - called Sky Cable - would be delivered by a Hughes high-power Ku-band satellite, allowing consumers to receive programming on a napkin-sized dish that could be installed easily on a rooftop or windowsill. The group expects the dish to retail for about \$300 at consumer electronics stores, but the monthly cost for receiving the programming has not yet been determined.<sup>20</sup>

According to Murdoch, Sky Cable will need between 3-4 million subscribers to break even, but "the market for Sky Cable is almost limitless, and advertisers are expected to pay premium dollar to reach a small, yet select, audience." Sky Cable may be a low-risk way to establish the value of HDTV for advertisers as well. Sky Cable is expected to deliver standard NTSC video signals and digital-quality audio initially, but it will be ready to transmit high definition television signals when the time comes.<sup>21</sup>

A potential turn-around for DBS in the nineties is further indicated by the recent funding commitment Hubbard Broadcasting received from Nationwide Communications.<sup>22</sup> Hubbard Broadcasting first applied for a DBS license in 1982 and, although it has yet to launch a DBS service, has maintained that the "infrastructure for DBS - that is the manufacture and distribution of low-cost reception equipment - is falling into place."<sup>23</sup> With the interest Nationwide Communications has in broadcasting as well as the "deep pockets" of its insurance division backing the company, Hubbard expects to launch a Ku-band satellite in December 1992.<sup>24</sup>

According to Hubbard, HDTV is integral to the company's DBS plans:

We plan to offer from the beginning two channels of some form of high definition television. We don't need to worry about EDTV [enhanced definition television] because we have the technical facilities to broadcast full high definition television. The Japanese are planning consumer service in late '92 or early '93. That equipment should be just as applicable to the U.S. market as it is to the Japanese market."<sup>25</sup>

Public pay-per-view broadcasting of special events has already put direct broadcast satellites in the vanguard of providing HDTV to the public. Public pay-per-view (PPV) programming - also called "closed circuit" television - has provided special sporting events, particularly boxing, to theaters for several years. On 7 December 1989, the Sugar Ray Leonard/Roberto Duran fight in Los Vegas was transmitted in high definition by way of a Hughes satellite to closed-circuit viewing sites in New York, Miami, Toronto, and Los Angeles.<sup>26</sup> According to Jacqueline Cook of Telesat, Canada, who was responsible for the broadcast at the Toronto site, "the demonstration reinforced Telesat's impression that there may well be a near term market for such networked sporting to electronic cinema and similar venues."<sup>27</sup>

Sidney Topol of Scientific-Atlanta also sees promise in public PPV for satellites:

There is clearly a market for satellite delivered high definition television to bars, theaters, and hotels. Scientific-Atlanta is already delivering a system using its own form of MAC - B-MAC - to deliver high definition television to about six or seven theaters in Canada.<sup>28</sup>

Thus, while the DBS operators might have to wait for the price of VSATs to come down in order to provide service directly to homes, they may be early players in the HDTV sandbox by way of public PPV. [The phenomenon of "electronic cinemas" or "video theater" is discussed in more detail in appendix H, "HDTV in the Commercial World."]

These recent events in DBS seem to confirm what some industry observers see as HDTV giving a boost to the DBS industry. NTIA, in its *Telecom 2000 Report*, saw HDTV as a means to "jump start" a DBS system in the U.S. similar to the efforts for providing HDTV over DBS in Japan and Europe.<sup>29</sup> The Satellite Broadcasting and Communications Association asserts

Projections are for expansion from the current level of two million homes equipped for C-band direct broadcast reception to twenty to thirty million homes during the next decade. . . . Thus, DBS will rapidly become an effective and wide-spread form of distribution for high definition television (HDTV) and other advanced television technologies at both C-band and Ku-band.<sup>30</sup>

From an HDTV-technology standpoint, satellite delivery of HDTV does seem to have a lot going for it. DBS has been allocated more than enough spectrum for HDTV transmission in the 12.2-12.7 GHz range and, as the FCC points out in its *ATV Notice of Inquiry*, "DBS may be used *today* for conventional and *ATV broadcast services*"<sup>31</sup> [emphasis added]. Moreover, the FCC is not inclined to reallocate the DBS spectrum for the benefit of terrestrial broadcast of HDTV because it is "reluctant to disturb the nascent DBS service because of its potential to provide multichannel television to rural and under-served areas."<sup>32</sup> Unlike most of the other HDTV delivery stakeholders, DBS seems to be in the enviable position of having both the FCC and technology on its side.

Because of its wide bandwidth, satellite transmission of HDTV can accommodate multiple terrestrial standards and would not have to wait for the FCC to determine which of the competing systems will be the U.S. standard. Satellite operators such as AT&T, GE Americom, and Hughes are offering their assurances that satellites will be HDTV-ready, no matter which standard(s) are adopted by the programmers. In the words of Walter Braun, vice president of operations at GE Americom, "[t]he position for satellite operators has to be to make the birds compatible with everything."<sup>33</sup> Therefore, the GE birds will have flexible

bandwidths. GE Americom has already performed HDTV transmission tests on advanced TV in conjunction with the David Sarnoff Research Center.<sup>34</sup>

#### A Late Wake-up Call?

Things may be turning around for the DBS operators in the 1990s. Although it remains to be seen if K Prime or Sky Cable can really make money in direct broadcast satellite delivery of programming, the recent partnerships among major media giants, the flow of investment dollars, and the improvement in VSAT technology pushing dish costs down are all positive signs that DBS to the home may at last become a reality. The DBS industry also is blessed with the support of regulatory bodies and a transmission technology that is more easily – and relatively inexpensively – adaptable to the high definition bandwidth requirements than some of the other players'. With public pay-per-view services such as video-theaters and an attractive set of subscribers, DBS could become an HDTV experimental playground for advertisers and program developers, giving both DBS and HDTV a significant boost. That would make my neighbor even happier – then he'd only have to worry about the New York Giants' defensive line.

The DBS scorecard follows.

## DBS Industry Scorecard

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**Video Marketplace Issues**

Market Presence	HIGH	.....X.....	LOW
Industry Growth	HIGH	.....X.....	LOW
Competition in Market	HIGH	..X.....	LOW
Depth of Pockets	HIGH	.....X.....	LOW

**Political/Regulatory Issues**

Political Impediments	HIGH	.....X.....	LOW
Political Support	HIGH	.....X.....	LOW
Political Strength	HIGH	.....X.....	LOW
Political Strength of Competitors	HIGH	....X.....	LOW

**HDTV Technology Issues**

Complexity for Industry	HIGH	.....X.....	LOW
Cost of Participating	HIGH	.....X.....	LOW
Cost of Implementing	HIGH	.....X.....	LOW
Timing of Implementation	SHORT TERM	.....X.....	LONG TERM

**Importance of HDTV to Stakeholder**

SURVIVAL	CRITICAL	IMPORTANT	OPPORTUNITY	INCIDENTAL	WHO CARES
.....X>	.....	<X.....	.....	.....	.....

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## APPENDIX E

### THE TELECOMMUNICATIONS INDUSTRY: AN HDTV LONG SHOT?

If you feel in a particularly impish mood someday, and happen to be in Washington, D.C., at a big cocktail party, simply ask, Why shouldn't the telephone companies be allowed to provide video programming? At that point, stand well back and prepare yourself to be assaulted by the following typical retorts.

#### I'll Tell You Why Not

- **National Cable Television Association**

*"For the telcos to keep their telephone monopolies, but at the same time be freed to enter the cable business within their telephone service areas, would be an invitation to predatory behavior not seen in this country since the days of the robber barons."*<sup>1</sup>

- **Continental Cablevision**

*"[T]o suggest that telco entry would promote greater competition is sheer nonsense. Rather, we would see a cable industry dominated by the Bell Operating Companies."*<sup>2</sup>

- **NTIA**

*"Telephone companies should not be allowed to provide video programming because of possible anti-competitive conduct by them."*<sup>3</sup>

- **National Association of Broadcasters**

*"[We] will only support telephone company entry into television if they stay out of the programming content business and if they are prohibited from owning existing cable systems."*<sup>4</sup>

- **Tele-Communications, Inc.**

*"[The nationwide integrated fiber network] is an alluring 21st century Holy Grail but it would never be cost effective because carrying voice, data, and video would require too many technical and operational compromises."*<sup>5</sup>

Oh Yeah? Well, Here's Why

- Ameritech

*"Telephone companies could provide high definition television as well as voice and data over a fiber optic loop. The ability of the telephone company to transmit video programming cannot but improve the cost effectiveness of fiber."*<sup>6</sup>

- U.S. Conference of Mayors

*"Mayors consider telephone entry the answer to competition in cable and to building a fiber optics infrastructure."*<sup>7</sup>

- Federal Communications Commission

*"Thus we tentatively conclude that a policy of open entry by telephone companies into the cable marketplace, subject to safeguards, would better serve the public interest. We additionally conclude that construction by carriers of technologically advanced integrated broadband networks to be used to provide cable television and other service should constitute good cause for waiver under the existing statutory framework."*<sup>8</sup>

- Association of National Advertisers

*"Elimination of the telephone company/cable television cross-ownership ban can provide a real measure of competition and choice for viewers, advertisers and broadcasters alike."*<sup>9</sup>

Along with sex, religion, and politics, it might be wise to add the "telephone/television" issue to the list of forbidden topics for discussion at Washington parties.

Why is it that the telephone companies - with no public experience in production, operation, programming, transmission, or any other aspect of television - evoke such vehement opposition from cable TV, broadcasting, and NTIA? Conversely, how can the telephone companies, even with the support of the FCC, ANA, and the nation's mayors, enter a market in which they have no current capability to deliver video programming?

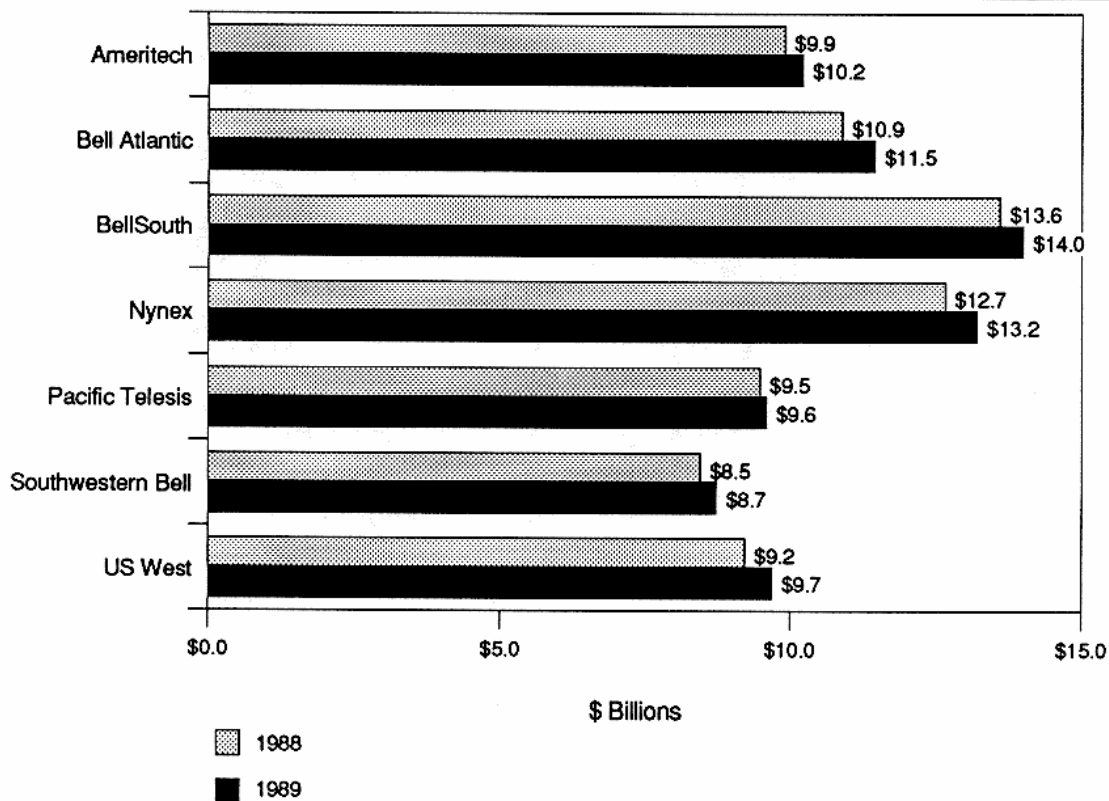
### Well Known, Well Financed, but on a Short Leash

Perhaps some of the concern of those who oppose telephone company entry into television markets derives from the industry's ability to leverage its formidable financial clout. Columbia University's Center for Telecommunications and Information Studies reports that the local and long distance telephone revenues for 1989 will top \$141.5 billion, and the business is now bigger than computers or aerospace.<sup>10</sup> With the increasing popularity of new services such as cellular phones, electronic data networks, and discounted long distance packages, total telephone usage is growing three times faster than the population, according to the Center.<sup>11</sup> Wall Street, too, seems to be enthusiastic about the prospects for the industry. Greg Sawers, a security analyst at the investment firm of Sanford C. Bernstein & Co., predicts that "telecommunications will be the best business of the next decade, period."<sup>12</sup>

The local exchange carrier (LEC) portion of the industry is dominated by the Regional Bell Operating Companies (RBOCs), which reported \$76.9 billion in 1989 revenues<sup>13</sup> (see Figure E-1), and GTE, which boasted revenues of \$12.5 billion from telephone operations in 1989.<sup>14</sup> Together, the RBOCs and GTE provide telephone service to approximately 90 percent of the 85 million households with telephone service, with some 1,200 smaller companies servicing the remainder.<sup>15</sup>

The long distance or interexchange companies (IXCs), including AT&T, MCI, US Sprint, and others, have estimated 1989 revenues of \$51.7 billion, with AT&T far outstripping the others (see Figure E-2).<sup>16</sup> The Gartner Group seems to join in Wall Street's optimism about the future of the industry, with 1994 revenue estimates of \$107 billion for the RBOCs and GTE and \$86 billion for the IXCs.<sup>17</sup>

Another concern to those who do not want the telephone industry in television may be the fact that the telephone companies have enormous visibility, with their telephone services in almost 93 percent of the households in the country.<sup>18</sup> This "universal telephone service" - with



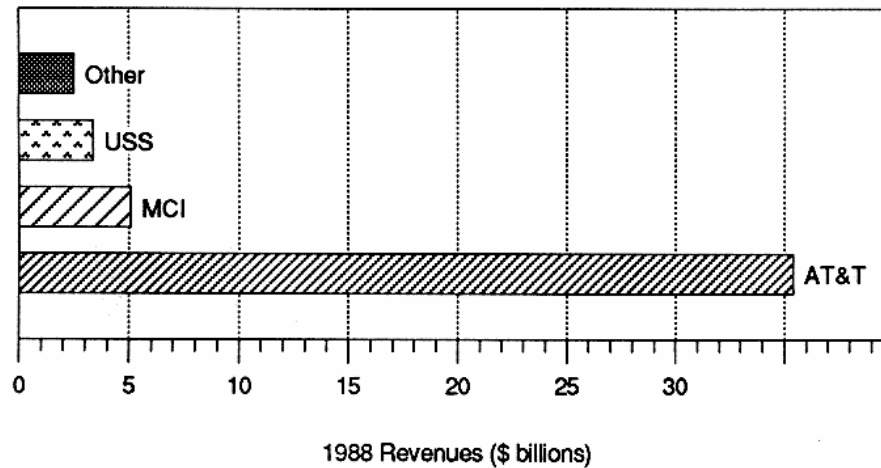
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**Figure E-1**

**1989 RBOC Revenues**

government "encouragement" and industry implementation and advertising – now ensures that each of us knows how to "reach out and touch someone" (AT&T), can identify "The one for you New England" (New England Telephone), and is aware of service so good that "You can hear a pin drop" (US Sprint).

As a personal observation, I know the individual company to gripe to when I can't – on the rare occasion – get a dial tone. On the other hand, if the HBO channel goes out for some reason, I am forced to swear at the "cable company" – whose name I don't even know since my wife pays the bills in our family. Even popular network TV shows seem to be



Source: Data from Gartner Group, Inc., *STS 1990 Scenario*, November 2, 1989, p. 36.  
 Graph: © 1991 President and Fellows of Harvard College, Program on Information Resources Policy.

Figure E-2

#### 1988 Interexchange Carrier Revenues

anonymous in their origin. I never say, "Let's watch the 'Cosby Show' on NBC," it's "Let's watch the 'Cosby Show' on Channel Four." I'm not sure whether or not my observations are "typical," but the pervasiveness of its services and advertising would seem to confer the members of the telecommunications industry with a high degree of "brand recognition" in the minds of the average consumer.

A third cause for alarm to potential competitors of telephone companies entering the television business arises from the industry's status – predominantly the LECs – as regulated monopoly providers of local exchange service. The list of LEC anticompetitive practices – which regulatory, judicial, and legislative dictate are supposed to control – envisioned by the cable television industry include the following: limiting access to the telephone poles and conduits necessary for cable to access residential areas, shifting costs from cable TV operations into the regulated rate base (cross-subsidization), and utilizing its monopoly power to increase profits from sales in the

unregulated (cable TV) market (discrimination).<sup>19</sup> In fact, it was this litany of possible anticompetitive activities that led to excluding the telephone industry from providing cable television in the 1984 Cable Television Act.<sup>20</sup>

### **The Attraction of Television**

The local exchange companies never have been particularly shy about experimenting in lines of business other than plain old telephone service (POTS). Since divestiture in 1984, the RBOCs have tried their hand at real estate, computer maintenance, directory publishing, leasing, computer stores, and paging. While some ventures have been successful and some have not, the trend continues to be to diversify and generate revenues from unregulated sources.

For example, in 1988, 18 percent of the revenue for all of the RBOCs came from unregulated sources, although some individual companies were more aggressive in moving into new areas.<sup>21</sup> Bell Atlantic in 1989 derived 31 percent of its revenues from non-regulated businesses, and according to Chief Financial Officer Philip Campbell, "By 1994, our objective is to have 60 percent of our revenues subject to incentive regulation and 40 percent of them unregulated."<sup>22</sup> BellSouth likewise expects 25 percent of its revenue to come from unregulated activities in 1991.<sup>23</sup>

The search by BellSouth and Bell Atlantic for unregulated sources of revenue are typical of the LECs and seems to be prompted by state utility commissions' reluctance to approve rate increases as well as ordering rate reductions and rebates.<sup>24</sup> Greg Sawers, Wall Street security analyst, estimates that in 1988 the RBOCs together earned \$500 million above their allowed rates of return, which had to be returned to customers in the form of rate reductions.<sup>25</sup> Sawers goes on to say, "in the absence of either a shift away from strict rate base regulation or a sharp increase in capital expenditures, earnings from the regulated telephone business have reached a plateau."<sup>26</sup> According to the Gartner

Group, "these actions, coupled with slow growth in POTS demand and continued ceilings on POTS earnings in many jurisdictions, are driving the [RBOCs] to seek new avenues for business expansion."<sup>27</sup>

One of those areas for expansion is the cable television business. It would seem to be a natural extension of the telephone companies' traditional network-like business, it is relatively unregulated, and there is money to be made (see appendix C, "The Cable Television Industry"). An investment report by A.G. Edwards & Sons on the cable television industry seems to sum it up best:

Contrasted with regulations in the telephone business, cable TV is a monopoly or quasi-monopoly with few regulations. For instance, cable operators can raise rates without approval from regulatory agencies. As such, cable TV represents a viable business extension for the regional "Bell" telephone companies who wish to grow out from under a regulated business. In addition, the Bell Companies may be interested in the potential economies that may develop from upgrading a system with fiber optic cable.<sup>28</sup>

The LECs are currently prohibited by the "cable TV cross-ownership" rules of the FCC and the 1984 Cable TV Act from owning cable television systems within their own local service area. Moreover, it is unclear whether or not the Modified Final Judgment -- the AT&T consent decree governing the non-telephone activities of the RBOCs -- allows the RBOCs to own cable systems in the U.S. even outside of their service areas.<sup>29</sup> However, with the problems the cable industry is having with Congress and a new FCC inquiry into competition in the cable TV marketplace, the time may be coming when telcos can fully participate in the video distribution market. In the meantime, the RBOCs and other LECs are working with or around the regulators in order to gain experience in cable television operations.

Centel currently owns and operates several cable systems -- but all outside of their telephone service areas.<sup>30</sup> GTE-California recently received a five-year experimental waiver of the cable TV cross-ownership



rules from the FCC, allowing it to lease half of the cable system they are building in Cerritos to the cable franchisee, Apollo Cablevision, and the other half to its own affiliate, GTE Service Corporation.<sup>31</sup> The purpose of the waiver and the GTE-California trial is for "comparative testing of coaxial cable, fiber optic and copper wire for carriage of voice, data, and video signals."<sup>32</sup> Even though it cannot have direct control over the programming, the FCC will allow GTE to "contract with a programming supplier to provide the programming, and it may have some input with that program supplier."<sup>33</sup> The RBOCs also have been building and leasing cable facilities to cable franchisees - such as C&P Telephone in Washington, D.C., and Pacific Bell in Palo Alto, Calif.<sup>34</sup>

Some RBOCs are buying into cable systems in Europe and the Far East. US West has been the most active, buying into existing cable interests in the UK and France, and as part of a consortium for a new system in Hong Kong.<sup>35</sup> A limited joint-partnership between Jones Intercable of Denver and Pacific Telesis International has been awarded a cable franchise in the UK, providing both telecommunications and cable services - permitted in the UK - to more than 380,000 homes.<sup>36</sup> Pacific Telesis also has two other franchises in the UK as part of a second partnership with Masada Corp. of Birmingham, Alabama, serving 140,000 homes.<sup>37</sup> Lest the intentions of the RBOCs are unclear, US West stated that the experience gained in the UK could "enhance our ability to serve the needs of cable companies" in US West's 14-state service area.<sup>38</sup>

Pacific Telesis went one step further when, in April 1989, it asked the Department of Justice to approve its proposed "conditional" 68 percent interest in Prime Cable of Chicago - serving 97,000 subscribers.<sup>39</sup> In April 1989, the Justice Department approved Pacific's request and set the stage for a ruling by Judge Greene when the formal waiver was made later that year.<sup>40</sup> As of this time, the Court has not yet made a decision on Pacific's request. If the request is granted, it would not be unreasonable to see the value of cable systems shoot up as other RBOCs look for a toehold in out-of-region cable markets.

## The "Delivery" Piece of the Puzzle

The telecommunications industry is looking beyond transport of video signals solely as a method of diversifying its revenue sources. Notwithstanding current legal obstacles, LECs eventually see themselves as the primary provider of voice, data and video services to businesses and consumers alike. As Raymond Smith, CEO of Bell Atlantic, puts it, "our first goal is very familiar to you, to become the premier communications, information, value-added network service company."<sup>41</sup>

The CEO of BellSouth, John Clendenin, expresses the vision in this manner:

The very idea of what constitutes information is changing. If it can be digitized, it can be transmitted. That includes photographs, movies, symphonies, books, financial or engineering data, and, of course, voice. *We can make the telephone line your entry gate to the information age.*<sup>42</sup> [Emphasis added]

As a further example of how LECs view themselves, David Nicol, vice-president of Corporate Planning for United Telecom, introduced his company at a presentation on October 1989 in this way: "We're a Kansas-based company that provides *global voice, data, and video services*"<sup>43</sup> [emphasis added].

If I were to whisper one word to Dustin Hoffman in *The Graduate* in 1990 instead of the 1960s, that one word would be "fiber." All right, two words - "optical fiber." With its huge bandwidth, easy maintenance, and immunity to interference, optical fiber is the LECs' key to tapping the riches of the information age services, particularly video services. (For further discussion of the role of fiber optics in providing video services, see appendix G, "TVs, PCs, and the Analog/Digital Wars.)

As Smith of Bell Atlantic explains

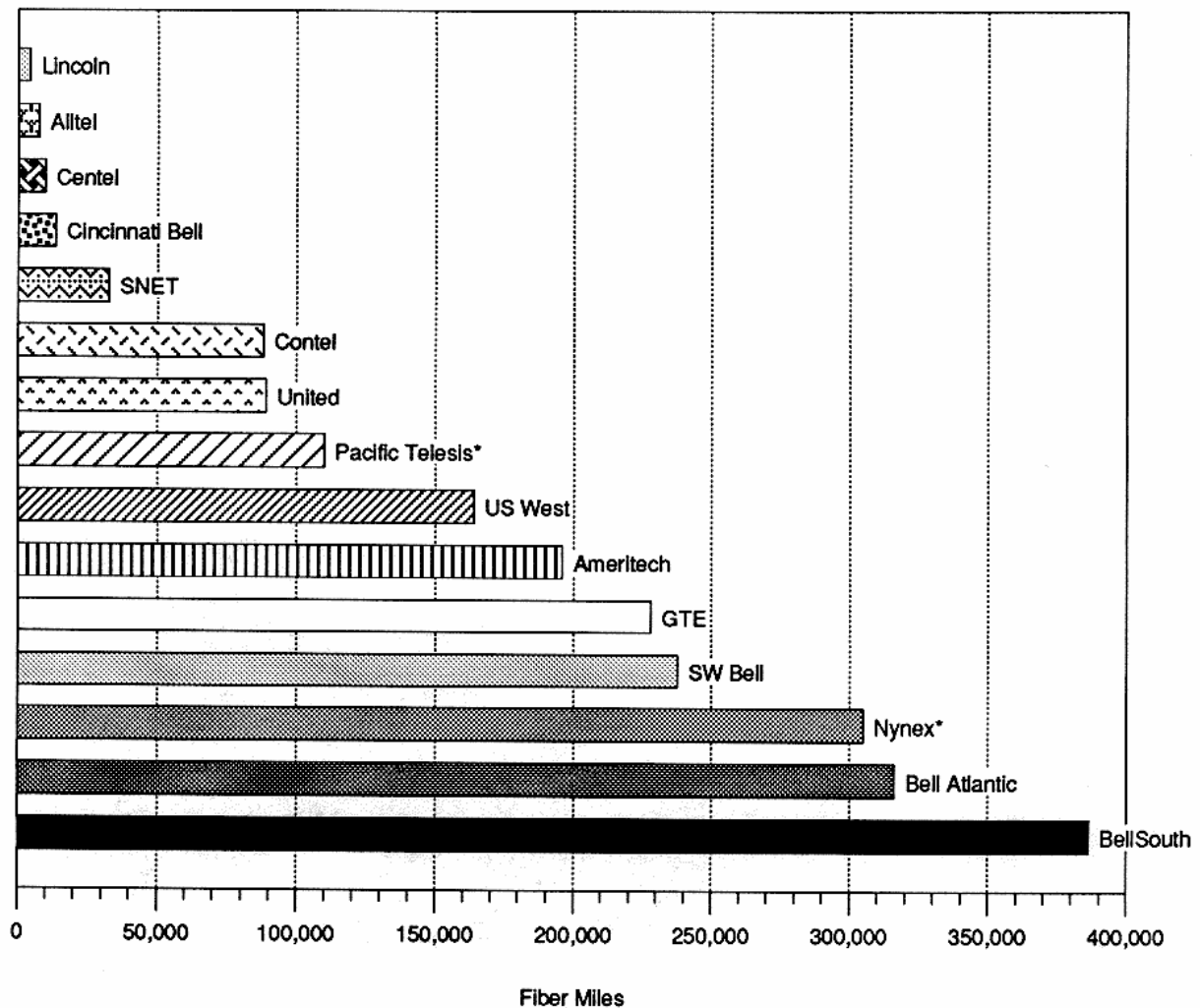
Another network opportunity lies in equipping our network to provide broadband services.... The size of the revenue opportunities in broadband services is truly huge. Our business plans identify potential revenues in the billions of dollars from such services as pay-per-view, video gateways, video transport for cable television programmers and electronic yellow pages.<sup>44</sup>

Nicol echoed this sentiment in his presentation on broadband networks: "[W]e must transition our Local Exchange networks from narrowband architectures to broadband. It's also absolutely clear that the key to this transition is fiber optics and digital technology."<sup>45</sup>

To support these new broadband services as well as the increasing demand for current digital data services, the telecommunications industry is going on what it calls a "high fiber diet." Bell Atlantic is installing fiber at the rate of 100,000 miles a year, and it is the test site for Northern Telecom's new fiber-electronic central office switch.<sup>46</sup> BellSouth's interoffice trunk network, which connects central offices, is now more than 97 percent fiber optic cable.<sup>47</sup> BellSouth also claims to have the world's first all-fiber central office, using fiber for both interoffice and feeder facilities (lines that go from the central office to a development or office park), also called "fiber to the curb."<sup>48</sup> Figure E-3 shows the fiber installed in the LEC networks through June 1989.<sup>49</sup>

The interexchange companies -- as well as private network providers -- likewise have been implementing fiber in their long distance networks (see Figure E-4).<sup>50</sup>

The high-capacity network requirements to support voice and data services have justified the use and cost of fiber for the industry's backbone network since the mid-1970s.<sup>51</sup> Providing fiber to the home, however, has yet to prove the same cost benefit. According to Paul Shumate of Bellcore, today it would cost about \$3000 per line to install a fiber link to the home, just for POTS -- "about twice the \$1500 widely



Note: For GTE, 227,971 is projected year end 1989.

\*Estimated by Telephony/Market Research

Source: Data from Information Gatekeepers, Inc., *Fiber Optics and Communications Newsletter* 12, no. 12, (December 1989), p. 13.

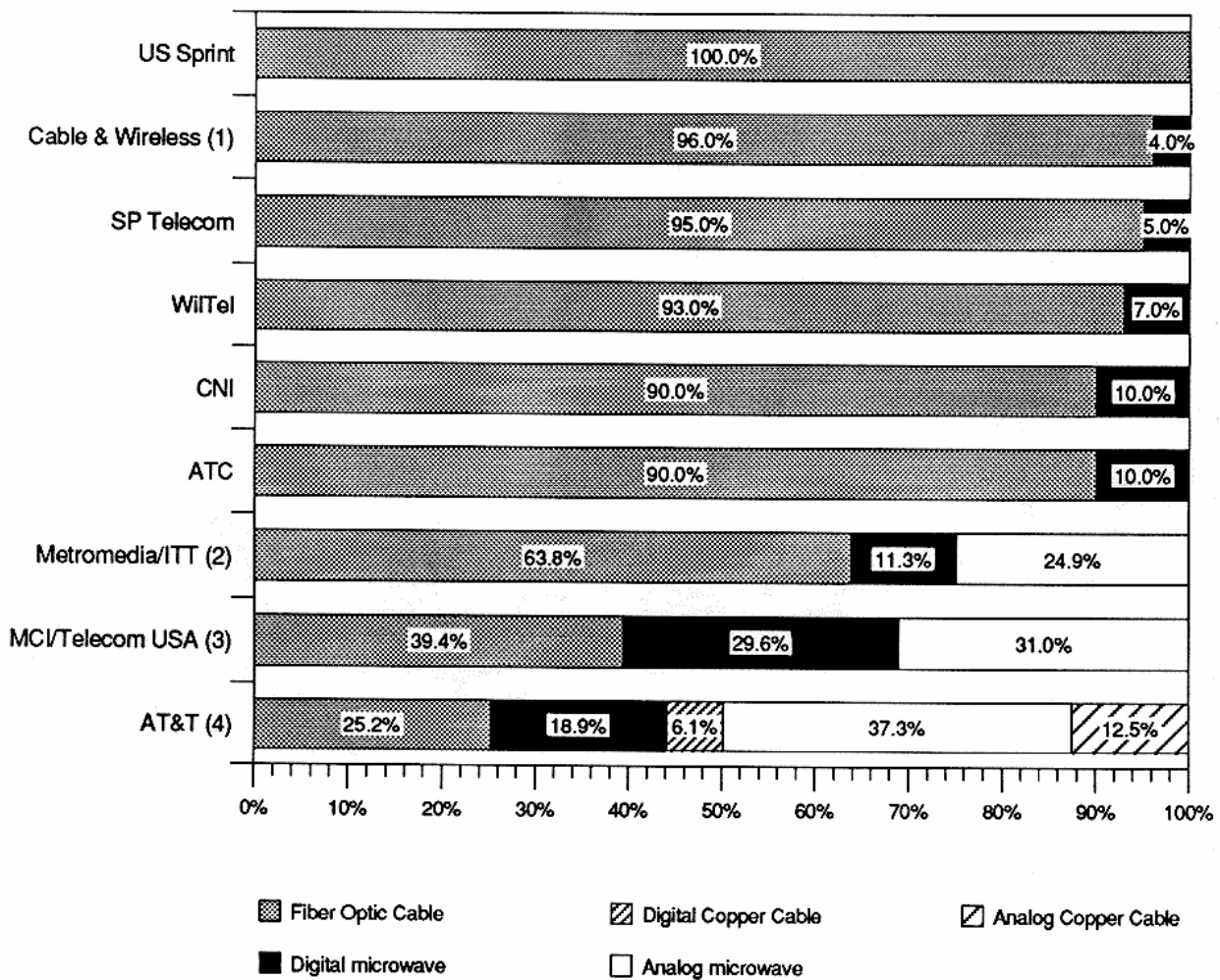
Original source of data: Telephony/Market Research.

Graph: © 1991 President and Fellows of Harvard College. Program on Information Resources Policy.

Figure E-3

### Fiber Optic Leaders (June 1989)

accepted for the objective in the industry." A true broadband capability – supporting voice, data, and video applications – is estimated to cost between \$5000 and \$10,000 per residence. Shumate



## Notes:

- (1) As of Oct., 1990, Cable & Wireless will replace some microwave facilities with fiber, bringing total fiber percentage up to 98%.
- (2) As of Jan., 1991, Metromedia/ITT's network will be 100% digital, with 80% fiber and 20% digital microwave.
- (3) With respect to MCI's recently announced upgrade. If MCI were to convert its analog microwave facilities to fiber optic and digital microwave on a 50% / 50% basis, MCI's total network composition would be 55% fiber and 45% digital microwave by year-end 1991.
- (4) Of AT&T's 62,000 miles of analog facilities, 45,000 are scheduled for total retirement over the next two years. All AT&T analog facilities presently carry less than 1% of all calls.

Source: TeleChoice, Inc., Montclair, N.J.

Figure E-4

## Fiber-Rich Long Distance Networks

compares this cost with that of providing copper wire (\$900 to \$1400) and cable television coaxial cable (\$600 to \$1000) to the home.<sup>52</sup> Bellcore estimates that the higher costs for these services to the home

come from the advanced electronic equipment required to decode the incoming signals, as well as the cost of the fiber.<sup>53</sup>

Shumate estimates that the cost of fiber could drop to \$1500 per line by the mid-1990s, making it competitive with the cost of providing new copper wire to the home. This would make fiber the local loop material of choice for new homes, shopping centers, and office parks in the next few years.<sup>54</sup> Providing an all-fiber network for both businesses and residences will not be cheap or immediate. According to Bellcore, the total construction costs for an all-fiber local access network installed between 1990 and 2025 would cost between \$200 and \$250 billion.<sup>55</sup>

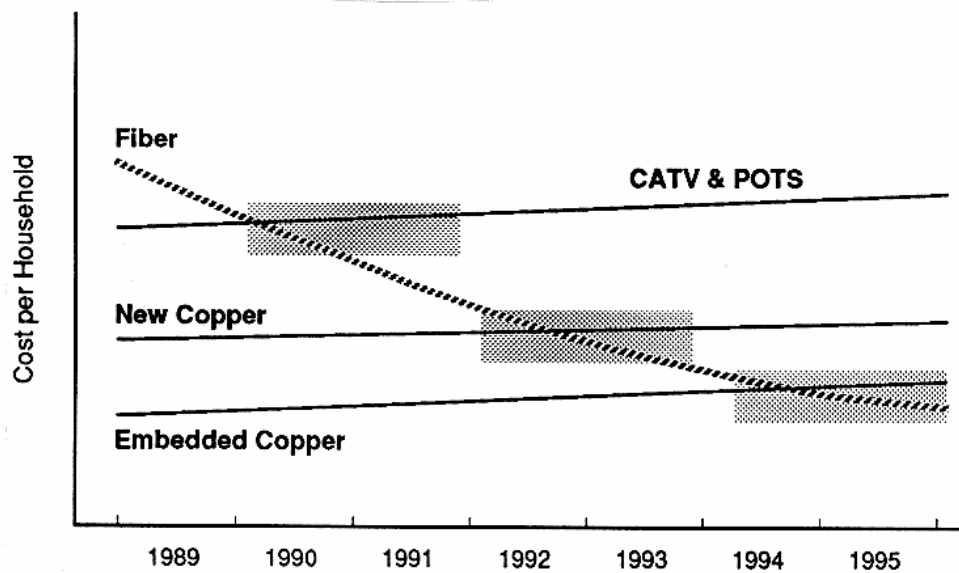
In his October 1989 presentation to the National Communications Forum, Nicol offered Figure E-5 to illustrate the time frame when the "cross-over" point justifies the cost of fiber to the home if the fiber replaces not only the copper for POTS but also coax for cable TV.<sup>56</sup>

Nicol's analysis reflects the thinking of the rest of the local exchange providers, as demonstrated by the quote from Ameritech beginning this section. Others have voiced similar conclusions, as reported in the *FCC Notice of Inquiry and Proposed Rulemaking on Cable Cross-Ownership*:

Centel contends that the future of wired video distribution is clear: it will be switched, digital and fiber.

The ability of the carrier to provide cable television service would undoubtedly promote and accelerate the development of broadband fiber facilities and the delivery of new broadband services to the customer, according to BellSouth.

GTE believes that the broadband market is now ready for development but that cable companies are not able to satisfy it because development of other services such as video-on-demand, meter reading, and utility load management requires investment capital which cable companies are unable to provide.<sup>57</sup>



Source: Adapted from D.J. Nicol, *Public Broadband Networks*, presentation to National Communications Forum, Chicago, IL, October 2, 1989, p. 13. Reprinted with permission.

**Figure E-5**

**Predicted Local Distribution Plant Costs  
(1989 - 1995)**

These companies, and others, are out to prove the feasibility of providing both POTS and broadband services over fiber by conducting a parade of residential trials across the country (see Table E-1).<sup>58</sup>

GTE's Cerritos, Calif., trial is the most ambitious, providing a wide range of video services over a switched broadband fiber architecture. Steven Walker, manager of the Systems Technology Lab for GTE, described the Cerritos trial at a 14 February 1990, HDTV Conference in Washington, D.C.:

The video capabilities include video-on-demand with 16 broadcast and 4 switched video channels available to the user. It includes full VCR control of the switched video allowing the user to pause, rewind, freeze and fast forward the program at his or her command. The system will support three televisions and one VCR which can be switched to any or all of the TVs.<sup>59</sup>

Table E-1

## Fiber to the Home Trials

Telephone Company	Location	Date of First Service	Number of Homes		Services
			initial	final	
Southern Bell Telephone & Telegraph Co., Atlanta, Ga.	Hunters Creek, Fla.	11/12/86	95	251	CATV transport
Southern Bell	Heathrow, Fla.	6/30/88	256	4000	POTS, ISDN, CATV transport
New Jersey Bell Telephone Co., Newark, N.J.	Princeton Gate, N.J.	8/9/88	51	104	POTS, data
Southwestern Bell Telephone Co., St. Louis, Mo.	Leawood, Kan.	10/27/88	64	134	POTS
South Central Bell Telephone Co., Birmingham, Ala.	Memphis, Tenn.	11/16/88	43	99	POTS
Contel Corp., Atlanta, Ga.	Ridgecrest, Calif.	12/28/88	100	400	POTS
Bell of Pennsylvania, Philadelphia	Perryopolis, Pa.	1st quarter, 1989	80	100	POTS, CATV transport
US West Communications, Engelwood, Colo.	Mendota Heights, Minn.	1st quarter, 1989	100	—	POTS
Contel	(town undetermined), N.Y.	2nd quarter, 1989	—	600	POTS
GTE Service Corp., Stamford, Conn.	Cerritos, Calif.	2nd quarter, 1989	—	5000	POTS, CATV and advanced broadband services transport
Southern Bell	Coco Plum, Fla.	2nd quarter, 1989	12	200	POTS
Southern Bell	Governors Island, N.C.	2nd quarter, 1989	4-8	49	POTS

The system vendor for the Hunters Creek, Fla., trial was AT&T Bell Laboratories; for the Heathrow, Fla., trial it was Northern Telecom Inc., Atlanta, Ga.; for the Perryopolis, Pa., trial it was Alcatel Network Systems, Raleigh, N.C.; for the Cerritos, Calif., trial there were three vendors: AT&T Network Systems, Morristown, N.J.; GTE Laboratories, Waltham, Mass.; and American Lightwave Systems Inc., Wallingford, Conn. For the other eight trials the vendor was AT&T Network Systems.

CATV = cable television

POTS = plain old telephone service

ISDN = integrated-services digital network

— = number undetermined

Source: Paul W. Shumate, "Optical Fibers Reach into Homes," *IEEE Spectrum* 26, no. 2 (February 1989), p. 47.  
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In addition to gauging the consumer reaction to the services, GTE is comparing copper and glass media by wiring some parts of the community with coax and copper and other parts with just fiber carrying both telephone and television.<sup>60</sup>



## HDTV and the Telecommunications Industry

The telecommunications industry acts as though it has the potential to be a significant player in HDTV. The industry envisions a fiber optic network with a bandwidth that will easily support the requirements of HDTV transmission. HDTV represents a level of "sex appeal" on the list of broadband services the telcos are planning which - at least on a superficial basis - makes a nice argument to the regulatory, legislative, and judicial bodies. The financial future of the industry appears to strong enough to make the necessary investments to prepare for HDTV. The fact that HDTV would be an additive line of business to telecommunications companies - and not a survival issue - allows the industry to let others with more at stake to take the initial risks and give the telcos the opportunity to learn from them.

In fact, time may be the biggest asset the industry has in preparing for HDTV. As Gary Handler, vice president of Network Planning for Bellcore, sees it, "the telcos are projecting a 5 percent home fiber penetration by 1996, 7 million homes, based on plain old telephone service." Citing the AEA and EIA projections of HDTV set penetration, he continues, "if this timeline is what we're waiting for, we'll have America fibered up."<sup>61</sup>

In the meantime, in addition to the fiber to the home trials, some industry members are engaging in HDTV transmission in non-consumer markets:

On August 4, 1988, Southwestern Bell transmitted the first live HDTV broadcast of a sporting event. The Cardinals-Phillies baseball game was carried over fiber to a 28-foot screen in the historic Fox Theater in St. Louis.<sup>62</sup>

BellSouth has signed an agreement with Club Theaters in Florida to link 14 theaters showing HDTV programming with optical fibers.<sup>63</sup>

BellSouth has also provided NASA with a closed circuit high definition transmission system using fiber optic technology to track and record space shuttle launchings.<sup>64</sup>

AT&T has also entered the HDTV arena with its agreement to work with Zenith on the development of high definition technologies. According to AT&T the companies will work together to develop "a total HDTV transmission system design, including the key element - a sophisticated HDTV receiver."<sup>65</sup>

Bellcore is conducting a field trial of a land-based fiber optic broadcast network in conjunction with ABC, CBS, NBC, PBS, and Fox. The broadcasters will test the use of terrestrial systems based on digital-switched fiber optic technology for delivering programming to affiliates. According to Robert Blackburn of Bellcore, "our ultimate goal is to provide the broadcasters and their affiliates an alternative or supplement to satellite transmission."<sup>66</sup> The eight-city trial will use the fiber networks of each of the RBOCs, and long distance service will be provided over the fiber facilities of five long-haul providers - none of which is a telephone company.<sup>67</sup>

The timing for HDTV may give local exchange companies and the industry the necessary breathing room to solve some thorny problems standing in the way of their providing HDTV. The RBOCs must overcome the MFJ restrictions keeping them from providing cable TV and the much-heralded broadband services they foresee. All of the LECs must have the cable TV cross-ownership restrictions removed, or at least modified, to allow them to provide video services. The implementation of some form of incentive-based rate regulation in more states would provide the LECs with financial incentives to deploy fiber more rapidly - as would permission to include it in their rate bases. If HDTV is at least five or six years away, it would appear that the industry has a reasonable amount of time to play with the technology and effect the necessary changes to prepare it for that day.

The Telecommunications scorecard follows.

# Telecommunications Industry Scorecard

## Video Marketplace Issues

Market Presence	HIGH	....X.....	LOW
Industry Growth	HIGH	.....X.....	LOW
Competition in Market	HIGH	..X.....	LOW
Depth of Pockets	HIGH	...X.....	LOW

## Political/Regulatory Issues

Political Impediments	HIGH	.X.....	LOW
Political Support	HIGH	.....X.....	LOW
Political Strength	HIGH	.....X.....	LOW
Political Strength of Competitors	HIGH	....X.....	LOW

## HDTV Technology Issues

Complexity for Industry	HIGH	.....X.....	LOW
Cost of Participating	HIGH	..X.....	LOW
Cost of Implementing	HIGH	..X.....	LOW
Timing of Implementation	SHORT TERM	.....X.....	LONG TERM

## Importance of HDTV to Stakeholder

SURVIVAL	CRITICAL	IMPORTANT	OPPORTUNITY	INCIDENTAL	WHO CARES
.....	.....	.....X.....	.....	.....	.....

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## APPENDIX F

### HOLLYWOOD AND THE FILM INDUSTRY

In testimony before Congress on 11 May 1988, Jack Valenti, president of the Motion Picture Association of America (MPAA), made the following observation:

No one industry, no single entity, no group of enterprises ought to be allowed, by special grants of Congressional privilege, to dominate the marketplace and unfairly contend with those who want to compete with them. The losers in that ungainly arrangement are consumers, always, everytime.<sup>1</sup>

Valenti was speaking about the cable television industry as a group of monopolists controlling the flow of programming into the consumers' homes. He could just as well have been talking about his own motion picture industry.

To give equal time to the cable television folks, the following is the National Cable Television Association's (NTA) assessment of the motion picture industry, as contained in the *NTIA Telecom 2000 Report* of October 1988:

That industry [the motion picture industry] controls over 92 percent of all theatrical film rentals, 68 percent of all videocassette sale's, over 50 percent of all prime time network programming, at least 45 percent of the syndicated broadcast program market, and 74 percent of pay cable service program payments, plus 14 percent of all theaters and at least 33 percent of the nation's television stations.<sup>2</sup>

Without passing judgment on the validity of NCTA's statistics, there is little doubt that the motion picture industry - or Hollywood - is a dominant, highly-integrated force in the entertainment business. The industry is composed of the major motion picture studios - Columbia, Disney, MCA, MGM/UA, News Corp. (20th Century Fox), Paramount, and Time/Warner - and a second tier of predominantly independent studios



like Orion, Image Films, Cinecom, Hemdale, Island Pictures, and King Road Entertainment.<sup>3</sup>

Despite periodic cries of "wolf" from the MPAA that their market would suffer, the development of new technologies such as video-cassettes, videodisks, and cable television have ultimately proven beneficial to Hollywood.<sup>4</sup> Consumer demand for filmed entertainment has more than doubled -- from \$13 billion in 1984 to \$27 billion in 1989.<sup>5</sup> The average U.S. household now spends \$300 per year on filmed entertainment compared to only \$60 ten years ago.<sup>6</sup> These new consumer viewing alternatives have not diminished the public's thirst for film; they only restructured the economics of the movie business. A studio's film rental (its portion of the box office) now makes up only 33 percent of that movie's total domestic revenue, as compared to a 75 percent share ten years ago. The ancillary markets for film (pay television, pay-per-view (PPV), and especially home video rentals) have now become the major revenue contributors, with videocassette rentals accounting for approximately 40 percent of domestic revenues.<sup>7</sup>

According to an October 1989 industry report by Bateman Eichler, a Wall Street investment firm:

Despite increased demand for filmed entertainment, consumers have substituted film-viewing experiences. Pay television and home video, for example, have siphoned viewers and ratings points from broadcast television. Network programming executives have been forced to cut back their licensing of feature films; movie revenues from broadcast television have fallen accordingly. Pay television [HBO, Showtime, The Movie Channel] has also experienced a slowdown in subscriber growth as a result of the explosion in VCR ownership and videocassette rentals. Theatrical exhibition, on the other hand, has managed to withstand consumer substitutions because the "big screen" experience and social desire to "go out to the movies" (particularly among teenagers) remains strong.<sup>8</sup>

In fact, the "big screen" experience remains so strong that box office revenues for 1989 exceeded \$5 billion.<sup>9</sup>

### Now Where's the Money Going to Come From?

One of the primary concerns for the major studios is the revenue tradeoffs among the consumers' viewing alternatives. Table F-1<sup>10</sup> shows an estimate of the different revenue contributions per viewing household for each of the various viewing alternatives.

**Table F-1**  
**Estimated Studio Revenues**  
**for Each Type of Movie Viewing**

Type of Movie Viewing	Average Retail Price Per Film	Studio Margin	Studio Revenue Per Household	Studio Revenue Per Viewer*
Theatrical	\$4.11	45%	Not applicable	\$1.85
Pay-per-view	\$4.00	45%	\$1.80	\$0.82
VCR rental	\$3.25	34%	\$1.10	\$0.50
Pay TV	\$0.60	25%	\$0.16	\$0.07

\*Assumes 2.2 members per household.

Source: Data from Bateman Eichler, Hill Richards, Inc., *Major Motion Picture Companies Industry Report*, October 23, 1989, Table 1.

Clearly, the movie studios would prefer that everybody go to the theater where they can get the highest amount of revenue per viewer by not having to share it with other distribution media. Since the viewing public doesn't do exactly what Hollywood wants, however, the next best thing is to have films distributed through PPV where the studios can get a higher percentage of the retail dollar (45 percent) than they can through videocassette rentals (34 percent) or pay television (25 percent).

Thus, transferring one dollar from videocassette rental to PPV would provide incremental revenue to the studios. It would seem logical that studios would encourage the development of PPV, even though the volume

of revenue from videocassette rental is substantial. Since PPV, however, is still in its infancy, Hollywood will have to tread carefully so it does not upset the video rental distribution channel in the meantime.

Perhaps to better control their lines of distribution and capture a higher percentage of the retail dollar, the major studios have been pursuing a strategy of forward integration. They have acquired interests in home video, theaters, and television stations as well as cable television stems.

- **MCA**, the owner of United Artists studios, has a 50 percent interest in Clineplex Odeon, the second largest theater chain in North America with more than 1,700 screens; 50 percent of USA cable network; and 100 percent of WOR, the Superstation out of New York.<sup>11</sup>
- **Columbia Pictures**, recently purchased by Sony (49 percent is still owned by Coca Cola), acquired Loews Theaters, with more than 800 screens in 180 locations.<sup>12</sup>
- **Warner**, recently acquired by Time Inc., has a 50 percent interest (with Paramount) in CineAmerica Theaters, with more than 500 screens. It has a minority interest in seven broadcast stations. Warner is the sixth-largest cable operator with more than 1.5 million subscribers and is the industry's largest worldwide home video provider. Warner also has an exclusive five-year deal with Disney to distribute Disney films overseas.<sup>13</sup>
- **Paramount**, owned by Gulf and Western, has a 50 percent interest in CineAmerica Theaters and a 50 percent interest in USA cable network. Paramount also has a \$500 million, five-year agreement to provide HBO with the first-run movies.<sup>14</sup>
- **Rupert Murdoch**, owner of Twentieth Century Fox, also has six major market television stations as well as interests in cable TV systems.<sup>15</sup> In addition, Murdoch is a partner in Sky Cable, a

recently-announced direct broadcast satellite venture that expects to broadcast directly to homes by the mid-1990s.<sup>16</sup>

In addition to these acquisitions, the major studios have two other things in common. First, it can hardly go unnoticed that there are some extremely deep-pocketed players in the motion picture industry – a valuable resource when it comes to making acquisitions or exploiting new technologies. Second, most of the studios – through their owners or affiliated companies – are part of very large multifaceted entertainment conglomerates. In almost all cases, there are combinations of book or magazine publishing, theme parks, recorded music and other entertainment interests, all of which are focused on the consumers' entertainment dollar.

#### **Exporting Roger Rabbit – Importing Rupert Murdoch**

An important source of revenue for Hollywood is the export of movies and television programs around the world. In 1989, U.S. programs accounted for up to 40 percent of the 125,000 hours of programming aired on television in the European Community.<sup>17</sup> Overall, Hollywood exported more than \$4.4 billion in movie and TV shows in 1988, accounting for about 40 percent of the industry's revenues.<sup>18</sup> Foreign producers don't seem able to compete with Hollywood's programming capabilities. According to Andy Birchall, director of British Satellite Broadcasting's Movie Channel, "the U.S. has the best infrastructure, the most well-known stars, and can afford to spend the most money to put together a first-rate product."<sup>19</sup> Even if Hollywood produces a second-rate movie, it often can recoup production expenses – and even make a profit – through the license fees for the movie's international release in both theatrical and videocassette formats.<sup>20</sup>

The amount of programming Hollywood has in its libraries – for international as well as domestic release (or re-release) – is truly astounding. Columbia Pictures has more than 2,700 feature films and 240 television series with more than 25,000 episodes.<sup>21</sup> [As an interesting

aside, Columbia, with its Tri-Star studio, also has the capacity to release 30 to 40 new films each year along with its syndicated TV programs like "Wheel of Fortune" and "Jeopardy."<sup>22</sup> MCA/Universal Studios has more than 2,200 movies and 12,500 television episodes.<sup>23</sup> Warner Communications has 1,500 films and more than 100 television program series.<sup>24</sup>

The vast amount of programming available and the thirst for it internationally may account for the surge in foreign acquisition of Hollywood's assets. British Satellite Broadcasting has committed more than \$850 million over five years to acquire 2500 American films and TV shows like "Murphy Brown" and "Night Court."<sup>25</sup> TVS Entertainment PLC, a television station in England, recently paid \$320 million for MTM Enterprises to get access to its television library, which includes episodes of "The Mary Tyler Moore Show" and "Hill Street Blues."<sup>26</sup> These are, of course, in addition to the better-known acquisitions of Columbia Pictures by Sony and 20th Century Fox by Rupert Murdoch.

## Hollywood and HDTV

### Film vs. HDTV

One of the major issues for Hollywood centers around the competing technologies of HDTV and 35mm film. As they have been for ages, current studio production programs are shot almost entirely in 35mm film. Hollywood production studios have substantial investments in 35mm cameras and production equipment, and 35mm technology is already considered to be "high definition." (After all, HDTV is touted as comparable to pictures "as good as 35mm film.") According to Hollywood producers, HDTV technology is not expected to replace film as the medium of choice for Hollywood productions.

Fern Field of Broadfield Productions, an independent film producer which produced *The Littlest Victims* in HDTV as a made-for-TV CBS movie, observed, "Hollywood is not immersed in HDTV technology. The sooner the argument [that video will replace film] is put to rest, the better it

will be for HDTV. HDTV is not going to replace film."<sup>27</sup> According to an article in the 26 June 1989 issue of *Broadcasting*, there is a near consensus among studio film executives that electronic production will have a role in future productions. Most of the shooting will continue to be done in film, but HDTV may often be used for post-production, especially when special effects are needed.<sup>28</sup> These executives also realize that someday HDTV will be the major form of distribution for their product, whether by VCR, cable, or broadcast TV, and they encourage the development of equipment that will interface well with HDTV.<sup>29</sup>

According to Joseph Flaherty, vice president of Engineering for CBS, while locally produced television programs are shot on videotape, "about 90% of network prime time entertainment is produced on 35mm film, and represents a substantial part of Hollywood's output. But about half of that film output is finished in NTSC tapes."<sup>30</sup> This "down conversion" from 35mm to NTSC standards is what currently separates the quality of film from television pictures and tends to create friction between the broadcasters and Hollywood. However, like the studio folks, Flaherty also sees the need for "future accommodation of HDTV production to satisfy the multiple distribution alternatives of videotape and broadcast television."<sup>31</sup>

Despite the caution of the major film studios, several smaller high definition studios currently are producing HDTV movies. At the American Film Institute Video Festival, 26-29 October 1989, over twenty high definition films were exhibited.<sup>32</sup> Rebo High Definition Studios has produced - in high definition - MTV's new nationally syndicated television series, "BUZZ," scheduled for release in April 1990.<sup>33</sup> Without going into the technical details, HDTV allows for a process called "blue screen matting," where special effects can be produced realistically and mixed with live action (ala *Roger Rabbit*). Most of these independent studios, however, are not in the mainstream of major movie production and specialize in production of print and video advertising, special effects, and post-production editing of film, where the use of high definition technology is most applicable today.

There are also artistic objections to using HDTV over 35mm film. The increased clarity and sharper contrast of HDTV is not necessarily a plus in Hollywood productions. Recently, a joint BBC/NHK/PBS production titled *The Ginger Tree* was shot in high definition. It is scheduled to air on PBS' Masterpiece Theater in the 1990-91 season - after being down-converted to NTSC broadcasting standards.<sup>34</sup> Timothy Ironside-Wood, the BBC producer, made the following comments on the super clarity of HDTV:

You can almost see too much. Background activity is distressingly clear, as are details such as dust on the set, rust on metal or heavy make-up designed to make actors look older than they are. And fading those details electronically is difficult.<sup>35</sup>

This clarity presents problems with production designers and make-up artists which had to achieve new levels of realism. As Ironside-Wood pointed out, "where in the past, you could get away with a fake brick wall, now you need a real brick wall."<sup>36</sup> Some film buffs apparently object to HDTV's hard-edged picture and increased depth of field (a plus, however, for viewers of sporting events). As Ironside-Wood put it, "they believe that film is the natural medium for shooting drama."<sup>37</sup>

There were also some technical drawbacks with HDTV for the cameraman as well. The bulkier HDTV cameras were difficult to maneuver and tied to generators with cumbersome cables.<sup>38</sup> The cameramen also found that a steadier hand is required to "shoot" HDTV because the increased clarity demands more precise focusing so that the picture does not blur or shake.<sup>39</sup> On the positive side, recording engineers apparently loved HDTV's ability to instantly play back a scene, and cameramen raved about the affinity of HDTV's wide-screen format for exterior scene shots.<sup>40</sup>

#### **HDTV and International Program Exchange**

Since it supplies much of the world with its movie and television programming - as well as receiving 40 percent of its revenue - the development of an international production standard for HDTV is a concern for Hollywood. According to James Hindman, deputy director of The American Film Institute

International program exchange is currently hampered by the existence of multiple broadcast formats (NTSC, PAL and SECAM). It is estimated that conversion of filmed programs into these broadcast formats today costs the industry or its customers over \$7,500,000 annually. Should advance television systems be developed in multiple formats, serious consequences could result for both the economic and creative spheres. The inevitable high cost of high definition television conversions, and additional costs related to distribution of multiple standards, would limit international program exchange while severely reducing the potential revenues from international markets. In addition, standard conversions would reduce the image quality of the programs, compromising the artistic integrity of the work."<sup>41</sup>

Currently, there is no agreement on an international HDTV production standard. Europe is promoting a 1250 line, 50 field per second interlaced standard (1250/50) - for both production and transmission - but with a bandwidth too wide for HDTV transmission over U.S. terrestrial lines.<sup>42</sup> [This is consistent with the European broadcast system today which is satellite-based and not subject to the same bandwidth limitations of terrestrial broadcast.] Japan is pushing a 1125 line at 60 fields per second (1125/60) transmission, and production standard and is supported by Canada as well.<sup>43</sup>

In the U.S., the Society of Motion Picture and Television Engineers (SMPTE) adopted Japan's 1125/60 as a production standard in 1987 but - because compatibility with the current NTSC transmission is required - a broadcast standard is still in development under the direction of the FCC.<sup>44</sup> There appears to be little hope of settling on one of the three world views in the short term, and compromise for a common image format (CIF) and a common data rate (CDR) will be discussed at the International Radio Consultative Committee (CCIR) in May 1990.<sup>45</sup> Meanwhile, Hollywood continues to use the 1125/60 standard for production (probably because 95 percent of the HDTV production equipment available today is made by Sony) and plans to convert to other formats when required.<sup>46</sup>



### HDTV, Pay-Per-View, and Videocassettes

Aside from HDTV's post-production and special effects usage, Hollywood may find HDTV's biggest benefit comes in the area of pay-per-view (PPV) and producing videocassettes. The transfer of film to videocassette for home viewing is a major source of irritation to most film makers today.<sup>47</sup> According to Allen Daviau, Steven Spielberg's cinematographer for *E.T.*, "one of the major missions of a cinematographer today is guiding the marriage of video and film technology."<sup>48</sup> Some directors, such as Steven Spielberg, Woody Allen, and Stanley Kubrick, reserve the right to withhold release of videocassette versions of their works unless the tapes meet their standards.<sup>49</sup> Their main objection to video is the degradation of picture quality: the wide-screen film format doesn't fit the nearly-square television screen without cropping or shrinking the picture. Distortions of color and losses of detail and contrast also reduce picture quality.<sup>50</sup>

HDTV technology - with its closer affinity to the qualities of film - may go a long way to resolving some problems of transferring film to videotape.<sup>51</sup> HDTV videocassettes could retain the color and detail of the original film, while HDTV's wider aspect ration would eliminate the problems caused by shrinking or cropping a film to fit a small screen. Aside from the artistic value of preserving the original film's integrity, the opportunity to re-release many of the thousands of films in the studios' libraries in an HDTV format could provide Hollywood with an incremental source of revenue.

Kodak recently announced a new telecine (industry jargon for a "converter"), which will transform conventional motion picture film into high definition video.<sup>52</sup> The HDTV telecine is expected to be available within two years. Such a device would seem to satisfy the artistic demands of film makers, while making a large body of HDTV "software" available to viewers. In the push-pull debate over HDTV receivers being needed before HDTV programs will be developed, the accessibility of Hollywood's film libraries may be a critical factor in the development of HDTV for consumers. Moreover, conversion of Hollywood's products to

HDTV formats would fit either the videocassette or the PPV distribution channels.

However, before the eyes of Hollywood's movie moguls grow too large with these prospects, some economics of PPV and the video rental business must be taken into account. The question of releasing movies on videocassette in multiple formats that are incompatible was addressed by Allan Caplan, CEO of Applause Video, at the 2nd Annual Conference and Exhibition on HDTV on 12-14 February 1990, Arlington, Va. Applause Video has twenty video stores in the greater Omaha area. According to Caplan, he buys 70 to 100 tapes of a top title movie like *Indiana Jones*, *The Last Crusade* for his stores. It cost him more than \$35,000 just for the VHS format alone, and he questions whether he can afford to stock multiple formats.<sup>53</sup> In fact, he doesn't stock any titles in the currently available Super VHS format, which is not backward-compatible to VHS VCRs, because his customers don't ask for it.<sup>54</sup>

Caplan also raised the question of consumers' investments in their own VHS video libraries being lost if new HDTV VCRs are not backward-compatible. Equally bad, he believes, is the problem of new titles being released only in HDTV formats not playable on VHS recorders.<sup>55</sup> Applause Video stores currently have an investment in more than 600,000 cassettes, and Caplan doesn't care for the prospect of either paying for all of them to be converted to HDTV or replacing his inventory with HDTV-formatted cassettes.<sup>56</sup>

He also raised an interesting point regarding PPV's impact on video rentals. His strategy is not to buy as many cassettes of a movie for rental if he knows it will be offered as PPV. Caplan also said that 93 percent of PPV users tape the movie they request. The effect of these two events, Caplan asserts, is that the studios receive less revenue from the video store, while the video store receives less rental revenue from the movie shown on PPV.<sup>57</sup> Interestingly, Caplan's strategy to keep his customers is to offer a special \$1 rental on PPV movies being shown in the Omaha area.<sup>58</sup> As a final note, Caplan said that without backward-compatible VCRs, it would take a 10 to 15 percent penetration

level of HDTV video systems in his area for him to stock HDTV videocassettes.<sup>59</sup>

## Conclusion

Hollywood would seem to have some things going for it in the great HDTV race. Movie studios, by virtue of being part of large diversified entertainment conglomerates, might well be able to get the financing required to convert their film and television program libraries to HDTV formats. That would seem to be a logical first step in exploring the potential for new revenues to be generated by HDTV.

The industry's strategy of forward integration allows a degree of control over the introduction of HDTV programs on a selective and relatively lower-risk basis than some of the other stakeholders. However, the studios would have to be somewhat careful in balancing the interests of theater operators, video store operators, the broadcast networks, and cable TV operators since they all compete for the same pool of consumer entertainment dollars.

Hollywood would also seem to benefit from the familiarity with HDTV technology being used in the production of film and video programs. Such experience may allow them to move up the learning curve in applying HDTV's benefits faster than others, while still accruing some productivity benefits in post-production and special effects work. Because of the heavy reliance on foreign revenue sources in Europe and Japan, Hollywood may have to move faster on HDTV if – as it seems likely – both Europe and Japan implement HDTV systems in their areas before the U.S.

The Hollywood HDTV scorecard follows.

# Film Industry Scorecard

## Video Marketplace Issues

Market Presence	HIGH	...X.....	LOW
Industry Growth	HIGH	.....X.....	LOW
Competition in Market	HIGH	...X.....	LOW
Depth of Pockets	HIGH	...X.....	LOW

## Political/Regulatory Issues

Political Impediments	HIGH	.....X.....	LOW
Political Support	HIGH	.....X.....	LOW
Political Strength	HIGH	..X.....	LOW
Political Strength of Competitors	HIGH	...X.....	LOW

## HDTV Technology Issues

Complexity for Industry	HIGH	.....X.....	LOW
Cost of Participating	HIGH	.....X.....	LOW
Cost of Implementing	HIGH	.....X.....	LOW
Timing of Implementation	SHORT TERM	.....X.....	LONG TERM

## Importance of HDTV to Stakeholder

SURVIVAL	CRITICAL	IMPORTANT	OPPORTUNITY	INCIDENTAL	WHO CARES
.....	X.....	.....	.....	.....	.....

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## APPENDIX G

### TVs, PCs AND THE ANALOG/DIGITAL WARS

Assuming - at some point in time - that there is something to watch or display in high definition and there is a means of delivering such high definition programs, some kind of receiver will be needed to view or use the promise of high definition technology. This section will deal with the receiver or display stakeholders in HDTV - the television and/or the computer. Additionally, since television and computers sit on opposite ends of the analogue-digital scale, the issues surrounding HDTV in an analogue or digital environment will be discussed here as well.

#### HDTV and Television Sets

*The television manufactures are driving HDTV; they are running out of things to sell. The big push to change the aspect ratio (the relationship of a TV screen's width to its height, currently 4:3) is their marketing strategy to generate new TV sales.<sup>1</sup>*

Edward Horowitz, senior vice president,  
Technology, Viacom International

There is little doubt that the market for televisions in this country is huge. It is estimated that approximately 180 million televisions are in 98 percent of U.S. households.<sup>2</sup> Table G-1 shows the industry's revenue from the sale of televisions and VCRs over the last five years. In 1990, the Electronic Industries Association (EIA) estimates that in the U.S. almost \$7.5 billion will be spent on color, black and white, and projection televisions, with another \$5.5 billion spent on VCRs.<sup>3</sup> In 1988, approximately 40 percent of televisions sold replaced older sets, and 50 percent were for additional sets in the home.<sup>4</sup>

Three companies accounted for about half of the 1988 TV sales in this country. These television manufacturing stakeholders consist of Thomson of France, which owns the GE and RCA brands; Philips of the Netherlands, which owns Magnavox, Philco, and Sylvania; and Zenith, the sole



Table G-1

**Sales of Televisions and VCRs  
(1985 - 1989)**

Year	Black & White TVs (\$ millions)	Color TVs (\$ millions)	Projection TVs (\$ millions)	VCRs (\$ millions)
1985	309	5562	488	4738
1986	328	6024	529	5258
1987	287	6271	527	5093
1988	200	6530	525	5055
1989	205	6670	534	5280

Source: Electronic Industries Association, *Consumer Electronics, HDTV and the Competitiveness of the U.S. Economy*, report submitted to Congressman Edward Markey, Chairman, House Telecommunications and Finance Subcommittee, February 1, 1989, p. 36.

U.S.-owned television manufacturer. The rest of the market is supplied predominantly by Japanese and Korean manufacturers such as Samsung, GoldStar, Sony, Toshiba, Hitachi, Mitsubishi, Sharp, and JVC.<sup>5</sup>

In many cases, firms such as Sony, Thomson, Philips, Sharp, and GoldStar also sell other consumer electronics products such as videocassette recorders and players, videodisc players, camcorders, personal computers, and audio systems. When one considers the overall equipment market for HDTV, it should be noted that Thomson, Sony, JVC, Philips, and perhaps some others as well also manufacture cameras, videotape recorders, monitors, and other equipment for the broadcast, film, and video production industries.

That these manufacturers are bullish on HDTV would be an understatement. Zenith is investing more than \$30 million in new flat tension mask tube technology to produce a high resolution color monitor. While the mask was developed for computers, the company plans to adapt the technology for its HDTV system.<sup>6</sup> Zenith has also entered into an

agreement with AT&T to produce a specialized chip set for HDTV sets.<sup>7</sup> Jerry Pearlman, CEO of Zenith, predicts that Zenith could offer HDTV sets for less than \$1000 within 3 to 5 years after their introduction.<sup>8</sup>

Matsushita is establishing an advanced TV research lab in Burlington, N.J. With an initial investment of \$7 million, the Panasonic Advanced TV-Video Lab will "research, develop and contribute to the standardization of a U.S. advanced television system that is compatible with the NTSC TV broadcast system."<sup>9</sup> Toshiba also plans an HDTV R&D center in Lebanon, Tenn.<sup>10</sup> Philips announced plans to build a \$100 million manufacturing facility in Michigan to produce color picture tubes and components for high definition televisions.<sup>11</sup>

#### **HDTV Broadcast Standards and TV Manufacturers**

To protect the public's investment in their 180 million NTSC televisions, the FCC has determined that an HDTV broadcast standard must be compatible with NTSC.<sup>12</sup> Moreover, because the radio spectrum is scarce and there are competing users for the spectrum - mobile land radio, satellite, paging, and government communications - the FCC has also concluded that any HDTV system must fit in the existing 6 MHz channel currently allocated for television.<sup>13</sup> To further conserve spectrum usage, in a ruling on 23 March 1990, the FCC decided that proposed HDTV systems must be based on a simulcast approach in which high definition programs are broadcast on channels separate from those for conventional NTSC programs.<sup>14</sup> Because television receivers must be designed to receive a specific terrestrial broadcast standard, TV manufacturers are working with the television networks and the FCC to determine a standard suitable to these parameters.

Where there were once twenty-one HDTV standards proposed, the FCC's parameters and consolidation of the participants has narrowed the competing proposals to seven.<sup>15</sup> On 25 January 1990, Philips dropped its augmentation approach to HDTV and joined with Thomson, NBC, and the Sarnoff Research Center to form the Advanced Television Research Consortium. This group will develop a widescreen NTSC-enhanced system

as well as a full high definition system based on simulcasting.<sup>16</sup> Table G-2 shows the proponents and their systems to be tested starting in 1991.

Table G-2

**HDTV Options:  
Proposed Methods and Proponents**

<b>The three proposed methods of broadcasting high-definition television and their main proponents. On 3/21/90 the FCC endorsed the "simulcast" method as the best way to broadcast HDTV.</b>	
<b>Simulcast</b>	<b>HDTV and regular TV would be broadcast on separate channels.</b> <ul style="list-style-type: none"> <li>■ Massachusetts Institute of Technology</li> <li>■ NHK</li> <li>■ Philips-Thomson-NBC-Sarnoff</li> <li>■ Zenith</li> </ul>
<b>Augmentation</b>	<b>HDTV and regular TV would be broadcast on the same channels. A second channel would transmit extra details for HDTV.</b> <ul style="list-style-type: none"> <li>■ New York Institute of Technology</li> </ul>
<b>Enhanced</b>	<b>HDTV and regular TV would be broadcast on one improved channel.</b> <ul style="list-style-type: none"> <li>■ Faroudja Laboratories</li> <li>■ NHK</li> <li>■ Philips-Thomson-NBC-Sarnoff</li> <li>■ Production Services, Inc.</li> </ul>

Source: Andrew Pollack, "Format Emerging for Advanced TV," *New York Times*, Friday, March 23, 1990, sec. D, p. 1, col. 3, Late Edition.

As might be expected, the Japanese manufacturers are supporting the NHK (Japanese Broadcasting Network) systems, and Thomson and Philips are supporting the Sarnoff ACTV I and ACTV II proposals. Zenith has been working on its simulcast system for over three years and probably can be considered the "sentimental favorite" of those interested in preserving the hope of a U.S.-based consumer electronics industry.

### Enhanced/Improved Definition Television (EDTV/IDTV)

*The primary competition to HDTV is NTSC improvements. For people who watch TV solely for information content, it isn't so important to see warts on the ends of noses.<sup>17</sup>*

Peter J. McCloskey, president, EIA

Enhanced definition television (EDTV) is a proposed interim step on the path to full high definition. It is based on improvements in transmission systems – proposed by Faroudja and Sarnoff – and receiver design. Faroudja's SuperNTSC system, which recently completed preliminary testing, features a combination of preprocessing at the transmitter end and postprocessing at the receiver to enhance the quality of the NTSC picture.<sup>18</sup> ACTV I (supported by NBC, Thomson, Philips, and Sarnoff Labs) proposes a widescreen system. In 1989, the SuperNTSC approach received major funding by a group of cable operators – Viacom, TCI, and Continental Cablevision – as well as ABC, Newhouse Broadcasting, and Westinghouse Broadcasting.<sup>19</sup> The broadcast and cable industries are particularly interested in this interim approach because it requires the fewest changes in transmission and delivery systems, while still improving the quality of NTSC pictures. Ed Horowitz of Viacom commented, "we figure we have to improve NTSC anyhow because that is the business we are in now."<sup>20</sup>

Whereas EDTV is based on improvements in both the transmission signal and the receiver, improved definition television (IDTV) is achieved entirely within the television itself. In addition to more advanced line and color filters to remove artifacts and enhance color rendition, the heart of IDTV receivers is in the use of semiconductor technology to create a field memory, which stores an entire field (one full transmitted screen) at a time. The picture is then enhanced before it is displayed on the screen. Progressive scanning then doubles the number of scan lines per field, producing a 30 to 40 percent improvement in picture quality over NTSC.<sup>21</sup> This improved resolution then allows for larger screens without the distraction of visible scan lines.

Manufacturers seem to believe that IDTV is intrinsically linked to HDTV. According to Brian Williams, director of Product Planning for NEC (which plans to introduce a 52" IDTV projection set early in 1990)

The technologies are really very similar. You've got to do the ID homework if you want to be a factor in HDTV. The receiver manufacturers will attempt to seed the market by putting hardware in place. That will be different than in the past, where it was a chicken-and-egg situation with software [programming].<sup>22</sup>

Philips has introduced both a 27" and 31" IDTV that use ten 256 Kb Drams to store the individual screens and also allow the picture to be frozen, stored, and later recalled. These computer-technology-enhanced IDTVs also can provide a picture-in-picture (PIP) feature, which shows a second or third station in a small box in the corner of the screen.<sup>23</sup> Such technology does not come cheaply, however. The 27" IDTV lists at \$2000, the 31" at \$2800. And Panasonic offers a 51" set that adapts the IDTV principle to projection television - for a mere \$5500.<sup>24</sup>

Taking one step closer to HDTV, Thomson is expected to introduce a 36" multi-standard television receiver, the Vistascope, in Europe in the fall of 1990; the Vistascope would be the first consumer television with the wide-screen 16:9 aspect ratio.<sup>25</sup> Zoom format control permits a full-screen image for either today's 4:3 broadcasting or the coming 16:9 wide-screen standard. The multi-standard feature allows the Vistascope to accept European broadcast signals from terrestrial or satellite sources as well as the North American NTSC signal. When the European high definition satellite standard (HD-MAC) is ready to be broadcast, a converter plug would allow the Vistascope to receive that signal also. Being the first on the block to get all of these features will cost about \$4800.<sup>26</sup>

In March 1990, at the same time it selected the simulcast standard for HDTV, the FCC seemed to deliver a setback to the EDTV proponents. The FCC decided it would not select a standard for EDTV "if at all until after an HDTV standard was authorized so as not to detract from development of full HDTV."<sup>27</sup> The FCC's decision affects the Faroudja

(SuperNTSC) and Sarnoff (ACTV I) systems but has no effect on developments of IDTV receivers, which use the existing NTSC signal. The ACTV I supporters tried to put the FCC's decision in a positive light. D. Joseph Donahue, senior vice president of Technology and Business Development for Thomson, said he felt confident that ACTV I would still win approval in 1993 because it would be less costly than HDTV. Michael Sherlock, NBC vice president of Operations, also said he feels confident that ACTV I will be ready the same time as HDTV, even though an HDTV standard will be selected first and an EDTV standard may not be selected at all.<sup>28</sup>

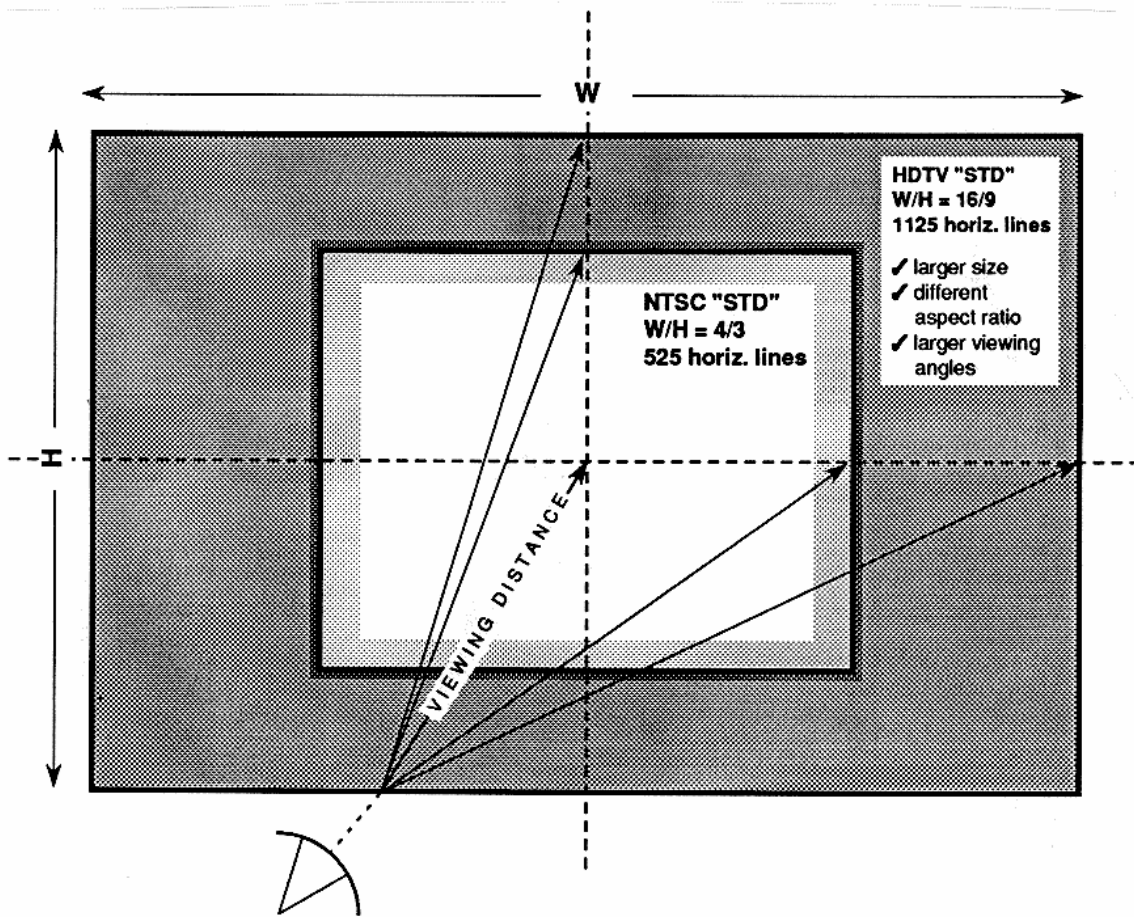
While it may not be "true HDTV," either EDTV or IDTV will provide improved quality pictures and large screens probably in the next few years and – considering the rapid integration of semiconductor technology into television receivers – consumers may even see warts on the nose of their local weatherman.

#### **The Dilemma of Displays**

The conventional wisdom in the TV set manufacturer world seems to be that HDTV will not make much of a difference to consumers on a 20" television. As John Abel, executive vice president of the National Association of Broadcasters, expressed it, "there is no demand for HDTV on 20" screens."<sup>29</sup>

James Hurd, president/CEO of Planar Systems (a manufacturer of electroluminescence (EL) flat panel displays), in a paper presented at the 2nd Annual Conference and Exhibition on High Definition Television, maintains that, "for maximum viewing benefit, the size and resolution of the HDTV display must be more than double that of today's typical NTSC display."<sup>30</sup> Figure G-1 illustrates this requirement.

Current direct view (CRT) technology seems to be limited by its depth and weight to a forty-inch diagonal screen. Matsushita's 40" CRT, in addition to costing over \$3000, has a depth of 25" and weighs over 170 pounds.<sup>31</sup> The Sony 42" television is 26" deep and weighs a whopping 230 pounds. The limitations of size and bulkiness of CRT televisions "will



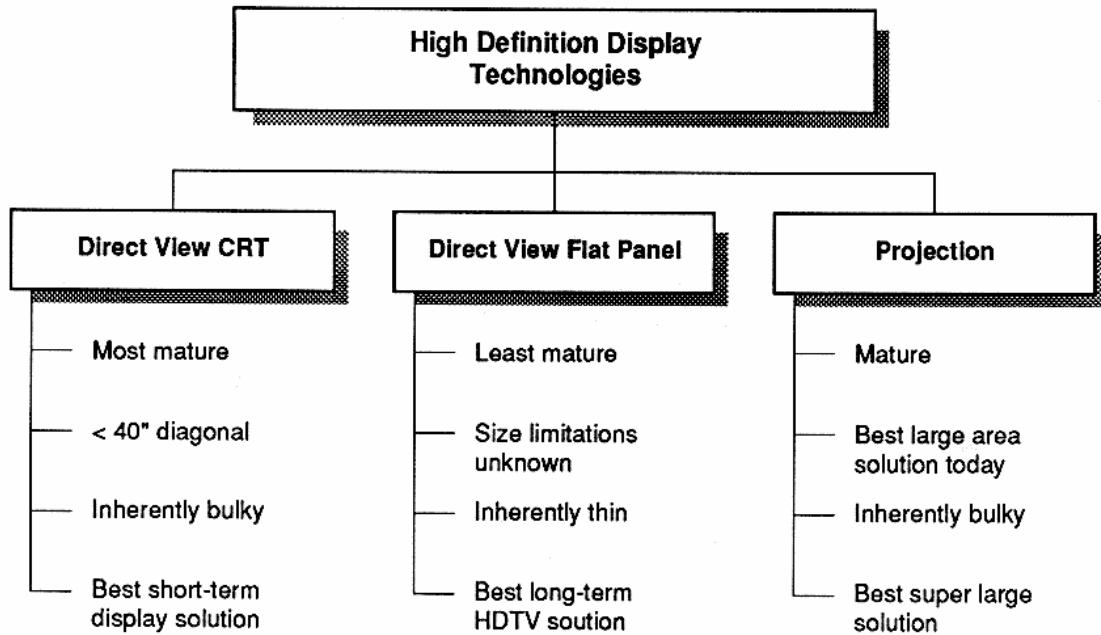
Source: Adapted from James M. Hurd, "The Critical Role of the Display for HDTV and More," paper presented at the Second Annual Conference and Exhibition on High Definition Television, *HDTV Newsletter & HDTV World Review*, Arlington, Va, February 12-14, 1990, p. 1. Copyright © 1990 Meckler.

Figure G-1

#### Screen Size: HDTV vs. NTSC

not be able to satisfy the large area HDTV requirement; however, because of its dominant position as the most mature technology, it will satisfy the need for high definition displays of less than 40" diagonal."<sup>32</sup>

As to the attributes of the competing high definition display technologies, Hurd presented a summary of CRT, direct view flat panel, and projection systems (see Figure G-2).



Source: Adapted from James M. Hurd, "The Critical Role of the Display for HDTV and More," paper presented at the Second Annual Conference and Exhibition on High Definition Television, *HDTV Newsletter & HDTV World Review*, Arlington, Va., February 12-14, 1990, p. 2. Copyright © 1990 Meckler.

**Figure G-2**

### **Characteristics of HDTV Display Technologies**

Roger Stewart, head of research at the David Sarnoff Center, maintains that large flat-screen displays are vital to HDTV, which requires a picture too large to be delivered by conventional systems (that is, picture tubes). Stewart goes on to say that "getting them [conventional displays] into the living room is a major challenge – a 35" tube is the limit of what will fit in a doorway."<sup>33</sup>

Stewart says that if one uses the traditional 8' viewing distance (the distance we sit from our televisions), today's monitor grade TV set with comb filtering and higher resolution tube makes 27" the ideal screen size. He goes on to explain that at an 8' viewing distance IDTV needs a 30" screen, EDTV a 45" display, and HDTV "needs a 75" display, 3-by-5-foot screen."<sup>34</sup> The HDTV display parameters that Sarnoff Labs



are shooting for are a 45" to 75" diagonal, less than 4" thick, and with a retail tag of less than \$500. The Sarnoff timetable calls for a CRT-tube HDTV set available within five years, but the flat panel, direct view, liquid crystal display (LCD) HDTV set is ten years away, although a projection version might be available within seven.<sup>35</sup>

Photonics has built a 60" flat panel projection display for the Air Force, but at \$100,000 per screen it is not practical for commercial use. Current use of flat panel displays is limited to small personal televisions - like the Watchman - and laptop or personal computers. The limitation in size for active matrix displays is about 14" and is imposed by semiconductor fabrication equipment.<sup>36</sup>

Based on the display and receiver technologies still needed at levels to support consumer televisions, the first HDTV sets will be bulky, expensive, and still not big enough to provide the average couch potato with the home theater experience that HDTV advocates promise.

#### **So Many Televisions and So Little Time**

The television set manufacturers have some major technology hurdles to overcome in preparing for HDTV. Flat panel display technology in the sizes needed to take advantage of HDTV's wide-screen capabilities seems to be seven to ten years away. The more mature CRT displays for direct-view television are limited by their bulk and weight to about 40".

IDTV is still in its infancy as manufacturers tackle the problems of integrating computer technology and signal processing techniques to improve NTSC signals within the set.

EDTV, with an apparent lack of support from the FCC, might have to wait for HDTV standards to be decided before the risk of going forward with EDTV seems justified. Cable TV, DBS, or pre-recorded programming could provide the incentives for this to happen much sooner, however.

Even with these obstacles, however, the television manufacturers seem committed to moving quickly into the next generation of receiver technology. After all, just imagine the revenue potential when those 180 million NTSC televisions have to be replaced by high definition models - or, better yet, by an improved or enhanced definition television first and a high definition set five years later. Horowitz's assertion may not be far from wrong.

The Television Industry Scorecard follows.

# Television Industry Scorecard

## Video Marketplace Issues

Market Presence	HIGH	....X.....	LOW
Industry Growth	HIGH	.....X.....	LOW
Competition in Market	HIGH	.....X.....	LOW
Depth of Pockets	HIGH	.....X.....	LOW

## Political/Regulatory Issues

Political Impediments	HIGH	.....X.....	LOW
Political Support	HIGH	.....X.....	LOW
Political Strength	HIGH	.....X.....	LOW
Political Strength of Competitors	HIGH	.....X.....	LOW

## HDTV Technology Issues

Complexity for Industry	HIGH	...X.....	LOW
Cost of Participating	HIGH	...X.....	LOW
Cost of Implementing	HIGH	...X.....	LOW
Timing of Implementation	SHORT TERM	.....X.....	LONG TERM

## Importance of HDTV to Stakeholder

SURVIVAL	CRITICAL	IMPORTANT	OPPORTUNITY	INCIDENTAL	WHO CARES
...X.....					

## HDTV and the Computer Industry

The computer industry has the distinction of being included twice as a stakeholder in HDTV. Computer manufacturers and software companies are adopting HDTV technology for computer-aided-design systems, multimedia workstations, specialized graphics systems, and interactive video applications. This role of the computer industry as a user stakeholder of HDTV is described in more detail in appendix H, "HDTV in the Commercial World."

However, because of the industry's public policy concerns over HDTV's impact on computer workstations, personal computers, semiconductors, and display technology, the computer industry perceives itself to be a major stakeholder in the HDTV supplier debate – and not just as a user of the technology. So, for the time being, the computer industry is included here – not so much as an industry supplier stakeholder – but as a technology stakeholder.

The computer folks seem to stake their claim as a major HDTV stakeholder in several ways.

First, to those in the industry, computers have been involved in high definition for some time. As Thomas McMahon, director of R&D for Symbolics, expressed it, "the 1000 line videosystems that all engineering workstations have are, in a sense, HDTV. It's really nothing different from what computer people have been doing for ten years now."<sup>37</sup> The typical 1280-by-1024 workstation screen contains about six times the information in an NTSC image but only two-thirds of the 2 million pixels (picture elements – the amount of information on the screen) that make up HDTV images.<sup>38</sup> The development of new high definition tape systems, coupled with the computer's ability to store and process huge amount of data, "all of a sudden offer a medium for the storage and retrieval of information at phenomenal bandwidths and phenomenal densities in real time," according to McMahon.<sup>39</sup>

Second, the computer industry is moving rapidly to integrate HDTV technology into new generations of personal computers and workstations. In March 1990, Symbolics introduced a new system called videographics processor, which combines computer graphics and high definition technology for medical imaging, weather forecasting, and similar applications.<sup>40</sup> Larry Kaplan, vice president of Tektronix's Information Display Group, predicts that the next generation of Tektronix workstations will be based on high definition standards.<sup>41</sup>

Third, as noted in greater detail in the TV manufacturers' discussion of this appendix, computers and televisions share similar interests in display, semiconductor, and digital processing technology. In fact, both computers and televisions have basically similar functions – processing, transmitting, and displaying video information – but for different purposes and with different basic technologies. It appears that it is the difference in philosophy between these basic technologies – digital (computers) vs. analog (television) – that most inspires the computer industry to carve a place for itself as a major stakeholder in the HDTV. It is this analog vs. digital debate in which the computer industry most views itself as a major stakeholder in HDTV. A brief description of this debate, called "The Analog/Digital Wars," follows.

#### **The Analog/Digital Wars**

On one side of this issue are the television manufacturers, broadcast networks, and cable TV industry (the analog camp), and on the other is an amalgam of computer industry people, telecommunications interests, consultants, politicians, and academics (the digital camp).

The assertion of the digital camp is that HDTV is inherently a scheme for digitizing analog video information and transmission, with potential beyond just providing better pictures for entertainment purposes. All of the broadcast standards being proposed would end up converting the HDTV digital signal back to analog for display on television sets. The digital camp contends that transmission, display, or production standards should be aimed at maximizing the digital capabilities of HDTV – not scaled down to solely fit the television broadcasting world.

Basing a future standard for transmitting HDTV on an analog standard seems backward to the digital camp. As Larry Smarr, director of the University of Illinois' Supercomputer Center, puts it, "it would be like requiring a car to have backward compatibility with a horse."<sup>42</sup>

There are some real advantages to digitized television. Analog signals vary continuously and are much more susceptible to interference than digital signaling. In addition, the "noise" created by interference to an analog signal is almost impossible to detect and filter out of the signal. However, noise in a digital signal can be detected and removed easily through digital signal processing techniques at the television set. Moreover, digital signal processing facilitates the compression of the 30 MHz HDTV signal into the FCC-required 6MHz transmission scheme.<sup>43</sup>

Going directly from digital processing to digital transmission -- instead of switching back to analog -- offers other benefits as well. John Taylor of Zenith explains, "you skip a step of processing, which improves performance and makes it more cost effective." A digital approach also has the advantage of greatly reducing the amount of power required at the broadcasting transmitter. Zenith estimates that its HDTV signal will use less than 0.2 percent of the power needed for regular transmission.<sup>44</sup> The digital camp maintains that this creates a more efficient use of the radio spectrum because the space between television channels -- currently needed to avoid interference from more powerful analog signals -- can now be used or reduced without fear of interference.<sup>45</sup>

The digital camp believes that all of the time, energy and expense devoted to over-the-air transmission standards detract from development of a more elegant transmission medium -- a broadband fiber optic network. Once converted to a digital format, there is no differentiation between voice, data, graphics, or text. Digitized voice and data is becoming prevalent in many wide area and local area communications networks, both public and private, today. The digital camp sees high definition video,

sent in a digital format, to be no different -- except in the amount of bandwidth required to transmit full motion video.

This view of HDTV -- as just one part of a series of digitized information services -- was articulated in Digital Equipment Corporation's letter of 27 January 1989 to Congressman Markey:

Thus a wider consideration of the HDTV issue suggests that consumer video is not the only, and possibly not the most important, market expected to emerge from the combination of digitized information processing and highspeed fiber optic networks. Given these trends, we should now see HDTV as representing the entire electronics "food chain."<sup>46</sup>

The digital camp also maintains that digital transmission is a far more robust way of communication than analog. W. Russell Neuman, director of the Communications Research Group at MIT's Media Lab, in his 4 October 1989 testimony before the House Subcommittee on Telecommunications and Finance, summarized this perspective of the digital camp:

The advantages of digital over analog communication are overwhelming. At the moment, capturing, storing, and transmitting sound, video and text in digital form is sometimes more expensive or requires more bandwidth than current channels of analog communications permit. But convenient as they might be, analog communication represents a mature set of technologies. We have already traversed the learning curve, and costs and capacities are relatively unchanging. In contrast, the declining costs and increased capacity of digital communication is punctuated by almost daily announcements of breakthroughs from the research labs of academe and industry. Digital communication will be higher quality, more flexible, more reliable and, in time, less expensive.<sup>47</sup>

According to the Fiber Optics Division of the Telecommunications Industry Association (TIA), the advantage of HDTV digital transmission over fiber optic line is in preserving the integrity of the HDTV signal through digital encoding of the signal and transmission to the receiver

with as little compression as possible. TIA goes on to say that fiber optic transmission systems - in addition to the enormous bandwidth they offer - also are immune to noise and external interference, can accommodate both analog and digital formats, and are bi-directional.<sup>48</sup>

Countering the digital camp's point of view, Jeffery Krauss, a member of the National Cable Television Association Engineering Committee, seems to speak for the analog camp:

Video is inherently an analog signal, and digital coding is not yet at the point where it is equally efficient. Even with personal computers, the latest video interface standard, known as VGA, consists of analog signals. Actually compressed digital HDTV might not be needed. Analog, rather than digital transmission of video over fiber seems to be coming along quickly. The cable television industry plans to aggressively install fiber as a replacement for coaxial cable over the next decade. Cable industry plans call for analog transmission of video over fiber, not digital.<sup>49</sup>

This divergence of opinion seems to reflect a short-term (analog camp) vs. long-term (digital camp) view as well as major differences in perspective between consumer, entertainment-oriented HDTV (analog camp) and commercial information-services-oriented HDTV (digital camp).

In fact, the characterization of "analog" and "digital" may be nothing more than metaphors for the different marketing, technology, and political agendas of different sets of stakeholders. Those not part of either camp may have trouble trying to make sense of the issue because the debate sounds much like a dispute over the "form" or "process" of presenting video information without much thought to its effect on the "substance" of the video presentation itself. This distinction between "forms" of HDTV transmission and presentation may be of great esoteric importance to the parties involved, but of little significance to users. According to Tony Oettinger, chairman of the Program on Information Resources Policy at Harvard University



When you have a pre-recorded videocassette of "Rocky III" and play it on a television set, is the medium film or television? Someone watching the show on a TV set may not know and likely will not care whether he or she is watching a broadcast, a cablecast, or a disc. Where the bundler sees a distinctive bundle, the consumer sees a commodity perhaps as fungible as any dollar bill is with any other.<sup>50</sup>

In this context, the debate would seem to have little meaning if both the digital and analog formats – or for that matter, the IDTV or EDTV – can deliver the next generation of "Rocky" movies with relatively the same degree of high definition quality as perceived by the consumer.

One must dig a little deeper to uncover the real significance of this debate. Again, Oettinger provides a clue to the real significance of the analog/digital debate to the respective camps:

Whether the product is delivered by cassette, disc, coaxial cable, optical fiber, or broadcast *can be vital to form and efficiency* but does not of itself affect substance and effectiveness. Arguments over the effect of form (that is, format-and-process) on substance, *as contrasted to the effect of form on practical economics*, often have the flavor of philosophical arguments over when a quantitative change becomes a qualitative one.<sup>51</sup> [Emphasis added]

At issue, it then appears, is the price/performance of the two competing technologies in delivering and presenting HDTV. Here, one must suspect that the more mature technology for video services – analog – does at this time offer a higher degree of cost effectiveness in delivery of HDTV. By the way of analogy, Oettinger illustrates how competing transmission technologies may be evaluated:

If for some reason you could run no more than one pipe between Point A and Point B, then a pipe that can carry 100,000 circuits is higher performance than a pipe that can carry only 100 circuits. If you could run as many pipes as you wished without penalty, a thousand small-capacity pipes would do precisely what one large-capacity pipe would do. The cost and performance gain is then purely a cost gain....

If you don't need 100,000 circuits, paying for that total capacity to get lower unit cost is as absurd as it would be to lay a fire hose from a reservoir just to water your lawn. But it might be worthwhile to cooperate with the neighbors to bring a fire hose to the neighborhood, so that each household might pay only its share of the hose plus a short, small connecting pipe, instead of each neighbor's laying lots of long, small connecting pipes all the way to the reservoir. So a share of the cost and performance gain could be yours if you could work out the politics.<sup>52</sup>

The lesson here is that one does not make quantum leaps from one technology to another; rather, "hybrid" versions of both technologies must coexist as the analog world slowly gives way to a digital one. What drives the transition is the incremental gains in cost and performance where the digital format meets the practical requirements of the marketplace.

In HDTV, for example, the commercial marketplace seems to be the place where such cost and performance gains are most likely to be realized first, while the consumer marketplace would be more apt to hold on to the analog for a longer period -- especially if the consumer does not perceive a dramatic improvement in the "substance." If the technological histories of the telephone network, the phonograph, and wrist watch are a guide, the computer industry will some day be correct in asserting that digital over the analog view of video systems.

It seems, then, that the computer industry's role as a major stakeholder in HDTV has three dimensions: as a user, which is covered in appendix H, "HDTV in the Commercial World"; as an advocate for a specific public policy, which is not within the scope of this paper; and, as just described, as the "conscience" of digital technology's future role in HDTV.

### Computer Industry Scorecard

#### Video Marketplace Issues

Market Presence	HIGH	.....X.....	LOW
Industry Growth	HIGH	.....X.....	LOW
Competition in Market	HIGH	.....X.....	LOW
Depth of Pockets	HIGH	.....X.....	LOW

#### Political/Regulatory Issues

Political Impediments	HIGH	.....X.....	LOW
Political Support	HIGH	.....X.....	LOW
Political Strength	HIGH	.....X.....	LOW
Political Strength of Competitors	HIGH	.....X.....	LOW

#### HDTV Technology Issues

Complexity for Industry	HIGH	.....X.....	LOW
Cost of Participating	HIGH	.....X.....	LOW
Cost of Implementing	HIGH	.....X.....	LOW
Timing of Implementation	SHORT TERM	.....X.....	LONG TERM

#### Importance of HDTV to Stakeholder

SURVIVAL	CRITICAL	IMPORTANT	OPPORTUNITY	INCIDENTAL	WHO CARES
.....	.....	.....X.....	.....	.....	.....

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## APPENDIX H

### HDTV IN THE COMMERCIAL WORLD: LIFE IS WHAT HAPPENS WHILE YOU'RE MAKING OTHER PLANS

While at this moment the public debate rages over terrestrial broadcast standards, the efficacy and cost of fiber to the home, and the "chicken or egg" arguments that HDTV won't happen until new HDTV televisions have penetrated 3 percent of the consumers' homes, there is a class of stakeholders - users - who have found reasons to implement HDTV technologies for its immediate benefit. These early adopters of HDTV in the commercial world are using HDTV technologies as productivity enhancements - to improve on older processes or procedures - and/or in directly improving their products or services, both of which may give these users a competitive edge in existing or new markets.

Early adopters are the pioneers of new technology - finding unique and cost-justified ways of implementing technology while paying off the entry costs of research and development, and providing suppliers with the feedback necessary to improve the price-performance of the technology. The early adopters of any new technology play an important role in the ultimate acceptance and incorporation of the technology for consumer or mass markets. They sensitize the next level of adopter by exposing them to the benefits of the technology - often subliminally - thereby creating a new level of demand. The success of automobiles, calculators, and personal computers, for example, were all rooted in the refinement and creative use of the respective technology by these early users, while at the same time demonstrating the benefits to an ever-widening circle of potential users.

So it is with HDTV today. While others plan for HDTV, the early adopters are using it - paying the R&D expenses and exposing it to the rest of us. To illustrate the extent to which HDTV technology is being used now, or expected to be used in the next two years by its early adopters, consider the following scenario.

On Monday morning, Jane Smith rises and prepares for her work day. While she and her eighteen-year-old daughter, Jackie, eat their wheat toast and oat bran cereal with strawberries, they watch the "Today Show" coverage of the latest pictures of Neptune sent to Earth from the Voyager spacecraft. After they part at the door of their townhouse, Jackie walks down the street and takes the number 3 bus to her high school, noticing the advertisement on the side of the bus for the latest style of "Guess" jeans. Jane stops at a newsstand to pick up the copy of Time Magazine celebrating the 200th Anniversary of the French Revolution before taking a taxi to the airport to meet an out-of-town client. At the airport, Jane scans the large screen display for the latest flight information on her client's arrival and pauses to watch the commercial for the new Lancia Dedra before heading to Gate 12.

Back at her office, while her client meets the rest of her staff, Jane sits at her computer workstation putting the finishing touches on the multimedia presentation she has prepared. In addition to the overview of her company with the usual graphs and financial data, Jane adds a video "walk-through" of one of the buildings she has just designed and decorated and goes off to make the presentation. At Millard Fillmore High School, Jackie is researching the life and works of Monet from the video encyclopedia on the personal computer in the school library in preparation for the class trip to the Fine Arts Museum that afternoon. She then attends her lunchtime meeting of the Young Physicians' Club where she, and 30 other pre-med hopefuls with strong stomachs, view a videotape of a heart by-pass procedure while munching their sandwiches.

After her presentation and a quick lunch at the hotdog stand on the corner, Jane takes the subway across town to meet with one of her fabric suppliers. Hurrying from the subway



entrance, she ruefully eyes the Pepto-Bismol advertisement on the billboard across the street. Inside the conference room of her supplier, Jane previewes the color and weave of some new fabrics - by videoconference - with the supplier's manufacturer in Singapore. After placing an order in anticipation of concluding a deal with today's client, Jane stops at the clinic to get the results of the blood test she had taken yesterday. The receptionist tells her that her doctor finished reviewing the blood sample with the pathologist - in their respective offices - that morning and the results were negative. With that good news, Jane returns to her office to finish her afternoon's work.

Meanwhile, Jackie and her classmates are comparing the live exhibit of Monet's works at the Fine Arts Museum with a televised exhibit of Renoir's paintings currently on display in another city. The director of the museum points out the minute differences in the brush strokes and the subtle color values of the respective Impressionist painters. On its way out of the museum, the class stops to watch a computer artist create a full-motion 3-D rendering of a futuristic automobile for the museum's coming exhibit on commercial art.

Flushed with the excitement and success of their day, Jackie and Jane decide to treat themselves to dinner and a movie that evening. They make reservations at the new Video Theater, where they enjoy a meal while watching Indiana Jones and the Last Crusade on the 23-foot screen. On their way out, Jane makes reservations for the following Saturday to see the Rolling Stones concert to be broadcast live to the theater. Mother and daughter then return home, turn on the TV, yawn, and promptly fall asleep on the couch. Another typical Monday comes to an end.

Although Jane and Jackie were most likely unaware of it, each episode above uses some aspect of HDTV technology to create or enhance a visual experience. To be sure, most of these applications of HDTV in the commercial world are not yet widespread, and it is unlikely they all currently exist in a single city. They are, however, either implemented or in advanced stages of development with the expectation of becoming commercially viable in the near future. The balance of this section details the real applications of HDTV throughout the commercial world.

#### **HDTV in Military and Space Operations**

The Department of Defense has been in the forefront of encouraging HDTV development for military use. In 1989, the Defense Advanced Research Projects Agency (DARPA) awarded several contracts to manufacturers and laboratories to develop video compression technologies, imaging-processing systems, and video display technology for use in military applications.<sup>1</sup> Exactly how HDTV technology is, or would be, used was the subject of a recent GAO Survey of HDTV applications, as reported in *Aerospace Daily*, 23 January 1990<sup>2</sup>:

- **Aerial Reconnaissance:** The Air Force plans to replace its aerial reconnaissance 35mm film cameras with HDTV video to eliminate film processing time and the delays associated with shipping data on film.
- **Defense Map Displays:** The Defense Mapping Agency (DMA) uses custom-built HDTV displays for the development and editing of its digital maps.
- **Cockpit Displays:** HDTV is one technology under development to keep pace in displaying the data output of rapidly-advancing sensor systems. One Defense analyst told GAO researchers HDTV cockpit displays could reduce costs by about 33 percent.
- **Simulators:** Networked visual display simulators can provide training realism by having large numbers of aircraft interact in simulated combat activities without sacrificing safety.
- **Large-Screen Displays for Command Centers:** The GAO found existing video does not provide the resolution needed in modern command, control, communications, and intelligence (C<sup>3</sup>I) centers, while HDTV would allow such resolution even in teleconferences.

The use of HDTV displays in fighter aircraft is particularly important to DARPA because of the vast amount of radar, electronic warfare, and map information that must be integrated and made instantly available to give the pilot "situational awareness."<sup>3</sup> The new A-12 attack fighter currently integrates sensor information on an eight-inch display but according to Gene Adams, senior cockpit designer at McDonnell Douglas, "this size is close to the limit for cathode ray tubes in aircraft. We are attempting to put 200 miles of electronic warfare, radar, and other sensor information into a 8-inch tube and it just does not work."<sup>4</sup> Because of the greater amount of information that HDTV screens can display, Adams believes that flat-panel HDTV technology in the cockpit could display all of the sensor, electronic warfare, and joint-tactical information overlaid on a "big picture."<sup>5</sup>

Whether in response to the Challenger accident or merely coincidental, the National Aeronautics and Space Administration (NASA) has begun to evaluate HDTV in its management of space shuttle flight programs. In 1989, NASA demonstrated a fiber-optic HDTV network, provided by BellSouth, for launch control and evaluation of the lift-off of the shuttle *Discovery*.<sup>6</sup> NASA reported the HDTV images were comparable to 35mm film with the added advantage of the video data being available for immediate play-back and computer enhancement for close analysis of the launch.<sup>7</sup>

In January 1990, NASA - in conjunction with Sony, Hitachi, and NHK (the Japanese Broadcasting Corporation) - positioned four HDTV cameras around the shuttle *Columbia* and videotaped the lift-off.<sup>8</sup> According to Robert Shaefer, director of Television Development at NASA, certain aspects of the launch were analyzed by processing the tapes to highlight details such as engine performance during lift-off and engine plumes during the ascent into orbit.<sup>9</sup> The objective of this experiment was to evaluate "real-time or near real-time manipulation of high definition images for purposes of analysis or demonstration."<sup>10</sup> NASA is also considering HDTV technology for certain Space Station applications, such as remote grappling with a robotic arm (telerobotics), scientific experiments and earth photography.<sup>11</sup>

## HDTV in Medicine

Although the concept of "telemedicine" has been around for several years, the application of communications technology to medical procedures has been limited mostly to sending X-rays over telephone lines for remote diagnosis.<sup>12</sup> HDTV technology is being used to develop a set of new applications for enhancing, and extending, the value of medical imaging systems beyond the pathology labs and the radiology departments of major hospitals. Medical imaging systems – such as ultra-sound, magnetic resonance imaging (MRI), computerized axial tomography scanning (CAT Scans), and X-rays – depend heavily on exact representations of color and detail to enable a radiologist to accurately interpret them and make a diagnosis.

To the trained eye of a pathologist, the shades of red, green, and yellow in a stained slide of a tissue sample suggest a specific set of conditions regarding that sample. While these images are computer-enhanced and displayed on high-resolution monitors in the six hundred or so hospitals which have these systems, other doctors – at the approximately nine thousand health care units in the country without these facilities – wishing to consult with these specialists traditionally are required to send either their patients or a hard copy of the image itself to the specialist.<sup>13</sup>

According to Dr. Robin J. Willcourt, president of the Seattle Corporation and a physician practicing in the area of high-risk obstetrics, such images cannot be transmitted over the current NTSC "low-definition" video systems because of their "poor visual detail, inferior color reproduction, and the loss of orientation due to aspect ratio limitations."<sup>14</sup> Using HDTV technology and fiber optic links, these limitations of NTSC systems may be in the process of being overcome. In March 1990, the Texas Children's Hospital demonstrated a high-definition network that allowed a neurologist in downtown Houston to successfully diagnose a patient located in a newly-established Remote Consultation Center six miles away.<sup>15</sup> Using HDTV cameras and monitors at both sites, the neurologist was able to check the dilation of the

patient's eyes, observe her reflexes, and examine the lesions on her skin. He confirmed the referring physician's diagnosis and concluded that the medication prescribed was correct.<sup>16</sup>

In addition to remote medical diagnosis, the Center for Remote Medical Consultation will research and demonstrate teleradiology and telepathology, which involve the transmission of radiological images and pathology slides, respectively, to remote sites.<sup>17</sup> According to Mark Wallace, CEO of Texas Children's Hospital, "the potential exists for this technology to have a tremendous impact on the accessibility of specialty health care, particularly in rural America."<sup>18</sup>

Before remote consultation by way of HDTV becomes widespread, however, two obstacles apparently must be overcome. This assessment comes from Myron Keller of Southwestern Bell, which provided the fiber optic links for the demonstration.<sup>19</sup> In Keller's opinion, there is a need for low-cost coder/decoders, which change the analogue video signals to digital format for transmission over the fiber, capable of compressing HDTV signals onto a single fiber. The industry also needs small, low-cost broadband switches supporting eight or sixteen ports. According to Keller, these would allow organizations such as the hospital to support HDTV links to multiple sites without having to establish direct fiber links to each.<sup>20</sup>

Willcourt also believes that the high resolution and the fidelity of color produced by HDTV would be a valuable aid in traditional, as well as continuing, medical education. In his remarks at the 2nd Annual Conference and Exhibition on HDTV in Arlington, Virginia, on 14 February 1990, Willcourt described HDTV as a valuable tool for demonstrating new surgical techniques by way of live broadcast - ala video-conferencing - allowing for immediate and widespread dissemination to the nationwide medical community.<sup>21</sup> He maintains that HDTV provides the high degree of detail, color, texture, and orientation necessary to effectively use HDTV video systems as a teaching tool for surgery.<sup>22</sup> According to Keiichi Kubota, senior scientist for NHK, Japanese medical students are

already being remotely trained in surgical procedures using HDTV technology.<sup>23</sup>

[As a personal observation, I attended this particular conference and was treated to a viewing of a coronary by-pass operation presented in both NTSC and HDTV formats. To my medically untutored eye, the NTSC video - on a 20-inch monitor - was a muddled confusion of colors with little differentiation between the beating mass in the center of the picture and the surrounding tissues. The HDTV video - shown on a ten-foot screen - however, very clearly showed the heart, surrounding thoracic cavity, and the needle and sutures being used on the offending artery. None of these details was visible on the NTSC tape. Willcourt later mentioned that the artery was as thick as a pencil, the needle three times larger than a human hair, and the sutures as fine as a human hair. The demonstration also confirmed my decision to drop out of pre-med in college.]

As a final note, Willcourt also believes that using interactive video-disks with an HDTV format - integrating textual and laboratory material with the visual experience of live surgery - would be an invaluable teaching tool in medical schools. In his opinion, it would be particularly effective for basic clinical sciences such as anatomy, physiology, histology, and pathology, which are taught in stages over the first three years of medical school. Such a teaching tool, he believes, could advance a medical student's training by perhaps one year.<sup>24</sup>

#### **HDTV in Education and Public Information Systems**

Taking some license with their true definitions, education and public information are used here to include a broad category of presentation of knowledge or information to the public at large. Although some elements of advertising are present here, the presentation of information in this context is meant to inform the public rather than sell to it. HDTV technology is used in this context by such institutions as museums,

zoos, libraries, and schools – as well as airports and shopping malls. HDTV used specifically in advertising is treated later in this section.

In July 1989, the St. Louis Zoo opened its new \$18 million education facility, The Living World. In addition to a robotic Charles Darwin that greets people at the entrance, the centerpiece of the facility is an HDTV videodisc presentation called Orbit.<sup>25</sup> Orbit is a twelve-minute video, using images from LandSat, that depicts a panorama of the surface of the earth as viewed from an orbiting space station.<sup>26</sup> According to Gary D. London, Technical Exhibits Coordinator at the zoo, the HDTV format was chosen over 35mm film for two important reasons. Since the show runs 363 days a year from 9am to 5pm daily, durability of the medium was an important consideration. London estimated that the cost of providing a 35mm film loop would be about \$60,000 and several copies would have to be made for back-up purposes. Moreover, maintenance of the film would have added to the cost.<sup>27</sup>

As London described the choices, "the use of a videodisc provided more reliability and less upkeep, helping to justify the additional upfront cost [\$50,000] for the Sony videodisc player and HDTV projection system."<sup>28</sup> Presenting Orbit in an NTSC format was not considered because it did not provide the level of detail in the satellite images needed for an educational tool at the zoo.<sup>29</sup> London also said that the zoo is considering using HDTV for veterinary medicine applications similar to those described by Willcourt, above.<sup>30</sup>

Museums are also using HDTV technology both as an instructional tool and as a way to exhibit art located in other museums. At the Gifu Prefecture Museum of Art in Japan, two rooms with 60" displays – and a third with a 110" screen – offer visitors still images of fine art from around the world. The images are recorded on optical discs and displayed with HDTV quality.<sup>31</sup> The system is also integrated with a personal computer, which allows visitors to select specific works of art – by painter, subject, or period – and receive written information on the screen while viewing the painting. The written information can also be printed out and taken home by the visitor.<sup>32</sup>

The National Arts Center in Ottawa, Canada, working with Telesat Canada, has begun a program to extend Canada's cultural heritage to rural communities. The HDTV production, satellite transmission, and display equipment is in place to broadcast specialized programming - featuring lectures and exhibits from the National Arts Center - to community theaters and civic buildings around the country.<sup>33</sup>

In a slightly more commercial vein, the Port Authority of New York and New Jersey is designing a system to produce, distribute, and exhibit HDTV programming at major passenger air terminals.<sup>34</sup> Joseph Milano, supervisor of Information and Telecommunications Technologies for the Port Authority, says that the average time a passenger spends in transit at an airport is more than two hours, and there are 1.5 million air travelers per day in this country.<sup>35</sup> Viewing this both as a problem of sorts - how to keep passengers entertained and informed - and an opportunity - a "captive" audience for advertisers - Milano believes that AIRMEDIA, a high-definition information system can assist in both areas<sup>36</sup>:

Airport operators have long sought to find better ways of communicating with their rapidly growing patron population. Virtually every new media or technology has been seriously discussed and even field tested (e.g., electronic yellow pages, ... video tapes of tenant commercials, video magazines, ... video text, etc.). None of these have been particularly successful.... We now have within reach a new, very high quality form of image technology [HDTV] which is not only very realistic in terms of definition, but sufficiently versatile in that it permits economical new expressions of information programming. Responsive to the information needs, mobility and psychology of travelers in an air terminal environment, the wall sized (video and audio) full-motion advertiser supported displays would generate revenue for the airport operators and program suppliers.<sup>37</sup>

Milano believes the key to attracting both travelers and advertisers will be "magnet" information such as flight information - of any flight in the country - weather conditions in any travel area, as well as short (one to ten minutes) programs on special events in town, local news, information on trade shows, and other such information. This



information will be interspersed with advertising clips of both local and national interest.<sup>38</sup> He also hopes to exchange HDTV programming and advertising with other airports both here and abroad by way of satellite and fiber optic lines.<sup>39</sup>

#### HDTV in Computer-Aided Design (CAD)

In the Design Center at Ford Motor Company in Dearborn, Michigan, there are six high-resolution graphics systems equipped with Sony HDTV monitors being used to sketch and modify automobile designs.<sup>40</sup> HDTV's improved resolution (approximately 2:1 over NTSC) as well as the wider aspect ratio of 16:9 (width:height) are particularly well-suited to mechanical engineering applications. The wider aspect ratio allows engineering drawings to better fit the screen, and the higher resolution allows for a sharper, more detailed image to the user.<sup>41</sup> According to Dave Royer, design manager, Ford uses the HDTV engineering workstations to sketch original designs, modify scanned photos of existing cars, and render car designs from package specifications.<sup>42</sup>

The flexibility of modifying designs - changing a hardtop to a convertible, for example - and the instant playback from video discs allows for a quicker evaluation of new designs or modifications.<sup>43</sup> At Ford, the designs are even projected on a wall to full size to evaluate the design.<sup>44</sup> Because the HDTV CAD system allows for manipulation of the video image, "you can videotape a car turning on a showroom turntable and modify it, rather than wait for a photograph to be developed, which would then have to be scanned in," according to Royer.<sup>45</sup> John Messerschmitt, senior director for Scientific-Atlantic Advanced Television Systems, estimates that high-definition CAD systems could eventually eliminate the clay model stage of automotive design and reduce the entire design cycle by seven months.<sup>46</sup>

## HDTV in Business Communications

The most prominent application of HDTV to support business communication requirements is in certain types of video-conferencing. Where the conferencing requires more than just meetings between people - NTSC transmission seems to be adequate if you can ignore the scanning lines on a large screen - HDTV provides certain advantages with its high resolution and color fidelity. One such application took place over four days in February 1990 in Andover, Massachusetts. Mast Industries, Inc., the design and procurement arm of the retail clothing chain The Limited, Inc., connected its Andover headquarters with its fashion manufacturing facility in Kowloon, Hong Kong, in a combined satellite-fiber optic HDTV video conference.<sup>47</sup>

Martin Trust, president of Mast, commented on the HDTV trial:

In our business, color, texture, style, quality and timeliness are essential factors in making buying decisions. Prior to this pilot implementation of HDTV videoconferencing technologies, we relied on time consuming and expensive buying trips. Now we know we can make decisions on the spot and expedite our buying process. The benefit to Mast is that by remaining on the leading edge of communications technology, we can more quickly supply fashion-right merchandise to our retail accounts.<sup>48</sup>

Mast had apparently tried videoconferencing in August 1989, transmitting NTSC images over two 56 kbs lines. According to Ed Somol, vice-president of MIS for Mast, the earlier videoconference couldn't compare to the HDTV conference:

The color quality isn't the same as HDTV. The resolution isn't there, because the bandwidth isn't there. In terms of videoconferencing, that's adequate technology; as far as trying to do determinations on color and print, that technology does not work.<sup>49</sup>

HDTV videoconferencing also could find applications in similar areas where high resolution and color quality is required. Design teams from Ford in different locations could evaluate new car designs; semiconductor design and manufacturing personnel located on opposite

coasts could review new chip designs; architects and builders in separate parts of the country could confer over changes in building plans. The cost today, however, is not cheap. Somol estimates that to equip Mast with the cameras, videotape recorders, monitors, and projection equipment for compressed-NTSC conferencing in both Hong Kong and Andover would cost about \$200,000.<sup>50</sup> The same equipment for HDTV conferencing in both locations he estimates at several million dollars - primarily because the technology is so new.<sup>51</sup>

Another application of HDTV technology in the broad area of business communications has potential in customer presentation and training practices. This is listed as a potential area because, in addition to HDTV, the technology of multimedia workstations is also an emerging one. Apple, IBM/Intel, and Commodore have all introduced multimedia cards and software for their respective personal computers.<sup>52</sup> These new "desk-top video" systems will enable users to prepare their own versions of business presentations integrating text, graphics, audio, still images, and full-motion video. Whereas personal computers are still a ways away from being able to provide HDTV quality images, Apple recently introduced a product that compresses and decompresses full-color video images in real time on the Macintosh. It can also display live video in several windows.<sup>53</sup>

Video software on video disc or CD-ROM for the Apple MediaMaker has been announced by six suppliers - ranging from Harvard's Kennedy School of Government's videodisc called "Three Mile Island," which allows the user to simulate responses to potentially dangerous events such as the nuclear reactor leak at Three Mile Island, to Warner News Media's CD-ROM based music titles with CD quality audio, the first of which will be Mozart's "The Magic Flute."<sup>54</sup> IBM/Intel and Commodore are producing similar capabilities, albeit with a different video compression scheme, for their respective personal computers.

The reason for discussing multimedia, without HDTV capabilities, is because of the industry's recognition that for these products to be successful in the longer term, the quality of the video and flexibility

for the user depends upon HDTV technology being integrated. Today the images for these workstations are not yet as sharp as current broadcast TV.<sup>55</sup> However, development work by IBM/Intel at the Sarnoff Labs is expected to produce near-HDTV quality video chips by 1992 and full-HDTV quality shortly thereafter.<sup>56</sup> It seems reasonable to expect that business users will be able to find new ways to produce customized training, sales, and customer presentations that will justify the initial cost of these systems.

#### **HDTV in Advertising and Printing/Publishing**

HDTV technology provides benefits for advertisers and printing/publishing in the production of still and video images, and the visual presentation of the result. The examples that Jane and Jackie encountered in their fictional day – Guess Jeans on the side of the bus, Pepto-Bismol on the billboard, the cover of *Time Magazine* – were all based on existing uses of HDTV-production technology. Dom Serio, senior vice president of Studio and Broadcast Operations at HBO, at the 2nd Annual Conference on HDTV in February 1990, listed some of the uses of HDTV-formatted production process where he must meet his client's requirements for high-quality print imaging<sup>57</sup>:

- **January 1990 Esquire Cover:** The Dubious Achievements Issue with Cher on the cover. Special effects produced to put faces of "award winners" in balloons floating on the cover.
- **Billboard for Dr. Pepper ad:** Commercial retouching on an 8" x 10" original image to add a "hand" from another image to hold the can of soda and adding "spray" from the just-opened can. This image was made into a billboard-size poster.
- ***Sports Illustrated* bus poster ad:** Required removing some of the figures of football players in the background of a photographic image and adding to one player a foot, which had been cropped from the picture. This image was later made into a 2' x 6' poster.
- **Photo Background for WCBS News Set:** A daytime and nighttime skyline of New York behind the set of the news set at WCBS in NY.

Since the two skylines were not shot from the same vantage point, special effects and retouching added cloud formations and tinting to the buildings as well as moving the Empire State Building ten blocks north so it would line up behind the anchorman's left shoulder. This was then made into a 9' x 27' print.

In each of these applications - using a Quantel Graphic Paintbox and HDTV video production and post-production equipment - moving images from one medium to another (photo to video to transparency), large scale high-definition images and flexibility were required to meet the advertising or printing requirements of the customer.<sup>58</sup>

A prime example of using HDTV in the production and post-production of video advertising is the showing of the new Fiat Dedra automobile that Jane paused to watch at the airport. Euphon International is a production studio in Turin, Italy (partially owned by Fiat), which produced three car commercials - including the Dedra - for Fiat in HDTV.<sup>59</sup> Also appearing at the 2nd Annual Conference on HDTV in February 1990, Giancarlo Rocchietti, managing director of Euphon, made some interesting observations concerning the costs and use of HDTV technologies in video advertising<sup>60</sup>:

The Dedra film lasts thirty minutes and was projected onto a 150" screen to European journalists in Spain.

The size and weight of the HDTV cameras created some technical difficulties when used inside the car for showing the car in motion from the driver's perspective.

The third production turned out to be the most spectacular since it is projected onto three adjacent screens; the central one [showing the car in studio and on location] is in high definition, and those on the sides are low definition [showing text and technical data on the car].

The experience accumulated during this first year of working with high definition leads us to the conclusion that, faced with the project of producing a film, a customer has no doubts about the [HDTV] standard. Problems only arise in relation to cost.

It is true that HD technology costs as 4 or 5 times as much as similar PAL or NTSC systems. This does not mean, however, that the final product cost 4 or 5 times as much.

Our accounts demonstrate that the cost of relatively large-sized productions [whose global costs exceed \$300,000] is only 20% higher than using conventional video. We are certain that, on these conditions, there are many who would be willing to pay the extra 20% to obtain such spectacular results.

We have a whole series of small productions with individual budgets of around \$50,000 and in these cases we have calculated that HD production results in approximately a two- or three-fold increase in costs.

This type of problem will only be resolved when hardware costs fall by 30-40% and, above all, it becomes possible to use lighter and more compact recording systems.

As with other stakeholders exploring the use of HDTV, cost and ease-of-use are among the set of issues to be addressed in implementing the emerging technology.

#### HDTV and "Electronic Cinema"

It may be that the average consumer -- like Jane and Jackie -- will be able to sample HDTV in its entertainment format without waiting for the cable TV, broadcasters, and Hollywood to make up their minds about a transmission standard. A variation on the pay-per-view (PPV) device which may allow that is the development of electronic cinemas. One version of the electronic cinema is the Club Theater Network (CTN), which is beginning operations in Boca Raton, Florida. CTN plans to operate an initial network of fourteen theaters in Florida with BellSouth, providing the fiber optic links among the theaters, CTN's studio in Pompano Beach, and BellSouth switching center.<sup>61</sup> The production facility will do film to tape transfer, high-definition transmission for the network, and provide high-definition production services.<sup>62</sup>

The high-definition mini-theaters are designed as luxury entertainment spots in wealthy Florida areas for resorts, apartment complexes, and hotels. The admission price is expected to range from \$35 to \$100 per person, which will include a first-run movie and a gourmet meal – as well as special shopping events featuring auctions and sales of goods and fashions from around the world.<sup>63</sup> According to Ron Ratner, owner and president of CTN, "between the receipts from the dining and entertainment package and the revenues generated from our various marketing applications, our program will prove economically feasible to all of our advertisers, merchandisers, franchisees, and the network itself."<sup>64</sup>

Ratner also has other uses for the Club Theaters:

We expect to open the Club Theaters to nearly everything. Eighty percent of our programming will be movies. The other 20 percent will be all of these other things which are made possible using HDTV. Professional sellers and buyers can use the network for doing business, medical procedures can be taught, conventions can be extended, etc. The interactivity gives it near-teleconference ability [although two-way video is absent].<sup>65</sup>

Ratner expects to franchise CTN for \$250,000 per theater and supply movie transmission on a fee basis.<sup>66</sup> Lest one start to think that Ratner has delusions of becoming the Ray Kroc of HDTV theaters, he has also apparently concluded a deal with Ted Turner for exclusive rights to transfer the 3,000 movie titles in Turner's movie library to HDTV and is close to a distribution agreement for those movies in high definition.<sup>67</sup> Ratner's plans may be ambitious, but he seems to be acquiring the "products" necessary to appeal to people who view the movie experience external to the home.

#### **From Early Adopter to Mass Market**

There are two distinct notions flowing from this discussion of users of HDTV. First, the role of these commercial users as early adopters of HDTV technology may be an important piece of HDTV evolution as it moves

toward a consumer-oriented system. HDTV, if it is to become a consumer product, seems to be following the path of other technologies, which began with the early adopter finding ways to use its value commercially. The list of early HDTV adopters is diverse – perhaps ensuring widespread exposure – and they seem to possess the deep pockets necessary to ride out the price/performance curve. The Department of Defense, the military, and NASA applications alone can go a long way to "subsidizing" the initial costs of research and development for HDTV. Advertisers in both print and video media, who can realize cost-saving and productivity benefits from HDTV, also possess the financial strength to invest in the technology as well as the clout to motivate HDTV equipment suppliers to improve their products.

Early adopter applications may give the next level of sophisticated users increased exposure to the enhanced visual experience of HDTV in the workplace by way of computer-based applications such as CAD and multimedia workstations as well as high-quality videoconferencing. As HDTV enhances the visual experience of people in their workplace and at airports, video theaters, libraries, museums, hospitals, taverns, and hotels, more people might demand the same high-quality visual experience from the network and cable programs they return to each night.

And so while others debate market penetration levels, interlace or progressive scanning, installation strategies for fiber optics, and broadcast standards, the early adopters are incorporating HDTV technology into their products, services, and business operations. If there is a lesson for the consumer market stakeholders to be learned about the evolution of technology, it is to watch the progress of the early adopters: the commercial users may have more to do with the success of an HDTV consumer market than all of the plans, strategies, proceedings, and seminars circulating in the ether today.

When – and if – that happens, then the early adopters in HDTV will have fulfilled their role as a catalyst for the HDTV consumer market. Then, perhaps, Jane and Jackie would not only not fall asleep when they



turn on their television at night, they might even stay home to work, study, and be entertained.

Second, these users have found solid justifiable reasons for adopting HDTV's varied technological benefits for use now. A common thread running throughout these applications is that each of the early adopters is using HDTV technology independent of the sphere of controversy over broadcast standards, fiber optic infrastructures, and television receiver formats. HDTV technology offers a range of enhancements to the visual experience in applications that have specific value to these users today. These benefits - high video resolution, color fidelity, flexibility in image manipulation, enhanced "realism," wide aspect ratio, and sharpness and clarity on large screens - provide these early adopters with some sort of competitive edge in their markets today. So, rather than having a scorecard similar to the other stakeholders, it seems to make more sense to show how HDTV's functions are - and can be - utilized by the commercial users (see Figure H-1).

USER STAKEHOLDER	USER'S REASONS FOR SELECTING HDTV								Transmission Mode
	Aspect Ratio "Wide Screen"	Large Screen Viewing	High Resolution "Detail"	Color Rendition Fidelity Range	Format Flexibility	Durability of Medium	Image Manipulation		
Military	✓	✓	✓			✓		Computer, Disk/Tape	
Space		✓	✓	✓			✓	Fiber LAN, Disk/Tape	
Medicine	✓		✓	✓	✓			Fiber LAN/WAN, Disk/Tape	
Education- Public Information		✓	✓	✓		✓		Disk/Tape	
CAD	✓		✓		✓		✓	Computer, Fiber LAN/WAN	
Video Conference	✓	✓	✓	✓	✓			Satellite/Fiber	
Training	✓		✓		✓		✓	Computer, Disk/Tape	
Customer Presentation		✓	✓		✓		✓	Computer, Disk/Tape	
Advertising	✓		✓	✓	✓		✓	Computer, Disk/Tape	
Printing/ Publishing	✓		✓	✓	✓		✓	Computer, Disk/Tape	
Desktop Video	✓		✓		✓		✓	Computer, Disk/Tape	

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Figure H-1  
HDTV Users "Scorecard"

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## APPENDIX I

### EPILOGUE: UPDATE ON TECHNOLOGY AND INDUSTRY DEVELOPMENTS

One of the dangers of reporting on high technology issues and dynamic industries is the possibility that fast moving events will render conclusions and observations obsolete. Much of the research for this paper was gathered from data reported in 1989 and the first six months of 1990. Since August 1990, while the paper has been under external review, some significant changes in industry and technology have occurred. This appendix captures these changes and their strategic importance in order to update the HDTV picture as of January 1991.

#### HDTV Technology Developments

The most dramatic development of the last six months has been the introduction of an all-digital system for HDTV transmission. Most stakeholders have now jumped on the digital bandwagon – seemingly abandoning the analog systems previously advocated by the television manufacturers, broadcasters, and cable television stakeholders.

In June 1990, General Instruments Corporation asked the FCC's HDTV Advisory Committee for permission to test its DigiCypher transmission system.<sup>1</sup> General Instruments' digital proposal drew little comment at the time. However, late in the summer of 1990, DigiCypher was demonstrated in public using computer simulations – both proving the feasibility of digitized video transmission and impressing industry experts with the quality of the resulting picture.<sup>2</sup>

Faced with the reality of digital television – now including the transmission of broadcast signals, coupled with the current implementation of digital technology used in improved definition television sets – the earlier proponents of analog-based transmission systems have jumped on the digital bandwagon. On November 13, 1990, the consortium formed by NBC, Thomson, Philips, and the David Sarnoff

Research Center announced its plan to replace its current analog HDTV system with a fully-digital one.<sup>3</sup>

In December 1990, Zenith and AT&T announced that they will also scrap their earlier proposal for a hybrid digital/analog receiver and create an all-digital system.<sup>4</sup> MIT's Media Lab has successfully completed a computer simulation for an all-digital system for HDTV but is still seeking additional financing to develop a system that can be tested.<sup>5</sup> In fact, the only HDTV system scheduled to be tested by the FCC that remains analog is the Japanese MUSE proposal.<sup>6</sup>

These first digital solutions for HDTV go a long way toward alleviating a major issue for the FCC in allocating the limited bandwidth for broadcast. General Instruments, Zenith, and the NBC-Thomson-Philips-Sarnoff consortium all maintain that their respective digital compression techniques will allow the huge amount of data in an HDTV picture to be fit into a standard 6 MHz broadcast signal. In addition, a digital HDTV signal can be transmitted at significantly lower power levels than an analog HDTV signal, thereby eliminating interference with adjacent television channels -- allowing for more efficient use of the available spectrum.<sup>7</sup> Both of these attributes are important in meeting the FCC's requirements for simulcast transmission of both HDTV and NTSC signals during the transition phase to full HDTV.

The computer industry is also introducing new video technology that might have an important impact on the development of HDTV. In November 1990, Intel announced a new chip that will allow PCs to edit and store moving images much like text. The chip adds only \$1000 to the cost of the PC -- half the cost of the older video chip technology Intel introduced one year ago.<sup>8</sup>

Also significant is the agreement of IBM, Tandy, AT&T, Zenith Data Systems, Fujitsu, NEC, and Olivetti to support the multimedia version of Windows from Microsoft on the next generation of PCs with built-in CD-ROMs.<sup>9</sup> Agreement on a multimedia standard may spark an outpouring of multimedia software, shortening the timeline for video applications



appearing on PCs and the convergence of televisions and personal computers. Coupled with the recent enthusiasm surrounding digital transmission of HDTV, these computer industry developments may shift the political scale in favor of the U.S.' HDTV efforts in relation to Japan's.

### Industry Developments

Two significant developments took place in the video distribution and entertainment areas in the second half of 1990. In August, a new direct broadcast satellite service from SkyPix Corporation announced it would begin operations in early 1991.<sup>10</sup> And on November 26, when MCA/Universal - the folks who brought us "Leave It to Beaver" and *E.T.* - agreed to be acquired by Matsushita, the Japanese consumer electronics giant.<sup>11</sup>

While the MCA/Matsushita deal received most of the headlines, if successful, the formation of SkyPix might have a more dramatic impact on HDTV. SkyPix plans to offer an 80-channel DBS service utilizing a digital video compression system from Compression Technologies, Inc. A private start-up company, SkyPix bills itself as "the world's first in-home video store"; it plans to offer subscribers a choice of 40 to 50 movies via pay-per-view (PPV) as well as packages of 10 superstations and other programming services.<sup>12</sup> If successful, SkyPix will leap ahead of its competitors K Prime Partners (which is limited to just 10 video channels without video compression) and SkyCable (which is not expected to go online with a high-powered satellite until 1993 or 1994).<sup>13</sup>

To ensure a steady supply of desirable programming, SkyPix has licensing agreements with Paramount, Warner Bros., and Twentieth Century Fox in 50:50 revenue-sharing deals. It expects to price the PPV movies competitively with video rental stores, charging \$3-4 for new hits and \$1-2 for older movies. SkyPix claims to have an "unbeatable" anti-taping system to prevent subscribers from video taping its movies. However, in a unique revenue-producing twist, it may turn off its anti-

taping device and allow subscribers to tape movies for a price of \$10.<sup>14</sup> SkyPix's entry brings to four the number of competitors expecting to provide DBS services within the next few years. It may be that a critical mass has been reached that will provide a springboard for HDTV services to soon follow.

Whatever the political, trade, or "national interest" ramifications, the MCA/Matsushita deal – in combination with the Sony/Columbia union – may also provide a critical mass of video programming and consumer electronics products beneficial to the development of HDTV. While Sony often receives the headlines for innovation in consumer electronics and aggressiveness in the marketplace, Matsushita, in fact, is the world's largest producer of TVs, VCRs, stereos, and other consumer products under the Panasonic, JVC, Technics, and Quasar labels.<sup>15</sup>

And despite criticism that it is slow to develop its own technology, it was Matsushita, with its VHS format, that eventually won the battle of VCR standards over Sony's Beta format.<sup>16</sup> Like the other television receiver manufacturers, Matsushita views HDTV as the next great leap in video technology and has set up a research and development facility in Burlington, N.J.<sup>17</sup> It has also commissioned the Davis Sarnoff Research Center to develop HDTV technology for use in the U.S.<sup>18</sup>

The acquisition of MCA now gives Matsushita the ability to integrate HDTV video programming with HDTV receivers and alternative viewing products such as videocassette recorders and video disk players. MCA is the country's fourth-largest entertainment company, with Universal Pictures providing box office hits such as *E.T.*, *Jaws*, *Field of Dreams*, and the *Back to the Future* trilogy.<sup>19</sup> MCA's television program library includes "Coach," "Murder, She Wrote," and earlier television hits such as "Miami Vice," "Magnum P.I.," and "Leave It to Beaver."<sup>20</sup>

This rich library of video software – after a relatively inexpensive conversion to an HDTV format – provides Matsushita with the necessary programming for its HDTV televisions, VCRs, and video disk players. The door is now open for the HDTV market to develop much faster than before

the MCA/Matsushita acquisition. The competition between Sony and Matsushita might well provide an acceleration in HDTV receiver and video product development unanticipated twelve months ago.

In a final footnote to recent HDTV developments, Sony introduced its first HDTV television for sale in Japan in December 1990. Matsushita and Hitachi are expected to introduce their respective HDTV receivers shortly.<sup>21</sup> Although Sony's set costs \$34,000 – that's no misprint – the manufacturers expect that more than one million sets will be sold in Japan during the next five years and that the price should drop to about \$7500.<sup>22</sup>

#### **What's New with the Stakeholders**

These recent developments in industry and technology are likely to create strategic shifts in industry positions, with significantly different consequences than were presumed six or twelve months ago. Some possible changes may be as follow:

- ▶ The development of low-powered digital transmission systems for HDTV could significantly benefit broadcasters by reducing the estimated high costs of constructing new broadcast transmitting systems associated with analog HDTV.
- ▶ The adoption of a digital transmission system by broadcasters would also narrow the lead that the cable and DBS stakeholders have in independently developing their own HDTV transmission systems and perhaps enhance the compatibility between broadcasting and alternative HDTV transmission standards.
- ▶ If an end-to-end digital HDTV system for broadcasting does indeed become a reality, then the ability to send broadcast signals not only over the air but also through fiber optic or coaxial cable can be accomplished without conversion to different HDTV transmission standards. This may well facilitate the distribution of HDTV by cable television operators by lowering the costs of cable head end conversions of network programming. Moreover, it may assist the telephone companies in more easily accommodating broadcast signals for transmission over fiber.
- ▶ The new emphasis on digital transmission of HDTV and the rapid adaptation of video technologies may shrink the timeline and the functional differences between televisions and personal computers.

Digital transmission techniques by themselves may spark the commercial development of networked multimedia applications utilizing high definition technology.

- ▶ Whereas a short time ago the DBS operators were considered to be "dark horse" candidates in the transmission of HDTV, with the appearance of SkyPix, they must now be considered to be running neck-and-neck with the broadcast and cable operators.
- ▶ The real significance of Matsushita's acquisition of MCA may well be the degree of competition it fosters in HDTV consumer electronics. The presence of two vertically integrated video software and consumer electronics giants - Matsushita and Sony - may well accelerate the development of HDTV as both companies seek to differentiate themselves competitively.

Of course, one should not become swept up in the euphoria of new technology or shifting industry strategies. Many issues have not been resolved yet by these recent developments. There are political, regulatory, financial, technical, and other issues that plague all stakeholders to one degree or another. The success of individual stakeholders in HDTV will most likely depend on which of them can minimize the impact of these other issues in a timely and effective manner.

#### What Does the Future Hold?

What all these recent developments may mean to the evolution of a consumer HDTV service is still subject to stakeholder interpretation. To Edward Horowitz, senior vice president of Viacom, International, the past few months have crystallized the HDTV situation in his mind:

In my view the question of "if" HDTV will be introduced has definitely been answered in the positive. The "when," "where," "how" and "with what programming" also have been defined quite well. The "how" is via high powered DBS (installed by cable companies until such time that they have rebuilt their systems and adequate consumer penetration of HD sets [10%] has been reached). The "when" and "where" is 1992 to commercial establishments (sports bars, public viewing areas, etc.). The consumer will buy it in 1993. The programming sequence will be 1) subscription pay, 2) pay-per-view, 3) high

profile sporting events on ESPN and regional cable sports channels, and 4) VCR/disk. Over the air television will follow along with basic ad supported services.<sup>23</sup>

Horowitz's opinion notwithstanding, it is difficult – and perhaps even foolhardy – to predict the future of technology development and stakeholder strategies. The experience of writing this paper has demonstrated that even a short six months can drastically alter one's preconceptions and conclusions. External influences, such as market, company, and political dynamics, can either accelerate or retard the integration of HDTV technologies. But technology can also create a momentum of its own – particularly a technology such as HDTV, which impacts such diverse sets of industries and users – which can overwhelm obstacles and cause dramatic shifts in stakeholder perceptions and plans. Whether the events of the last few months indicate that HDTV has acquired that degree of momentum remains to be seen, but ensuing developments certainly bear watching by those stakeholders directly or peripherally interested in, or affected by, HDTV.

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## Acronyms

ATV	Advanced Television
CCD	Charge-Coupled Device
CD	Compact Disk
DARPA	Defense Advanced Research Projects Agency (DoD)
DBS	Direct Broadcast Satellite
DoD	Department of Defense
DRAM	Dynamic Random Access Memory
DSP	Digital Signal Processor
DVI	Digital Video Interactive
EDTV	Enhanced Definition Television
FCC	Federal Communications Commission
GHz	Gigahertz
HD-MAC	High Definition Multiplexed Analog Component
HRS	High Resolution Systems
HDTV	High Definition Television
IDTV	Improved Definition Television
LCD	Liquid Crystal Display
MHz	Megahertz
MSO	Multiple System Operator
MPAA	Motion Picture Association of America
MUSE	Multiple Sub-Nyquist Sample Encoding
NAB	National Association of Broadcasters
NCTA	National Cable Television Association
NHK	Nippon Hoso Kyokai (Japan)
NTIA	National Telecommunications and Information Administration
NTSC	National Television Systems Committee
PPV	Pay-Per-View
SMPTE	Society of Motion Picture and Television Engineers
UHF	Ultra High Frequency
VCR	Video Cassette Recorder
VHF	Very High Frequency
VHS	Video Home System
VRAM	Video Random Access Memory



## Glossary

**1050/60; 1125/60; 1250/50:** The number of scan lines followed by the field rate for various HDTV system proposals, corresponding to the United States, Japan, and Europe, respectively.

**Active Matrix Liquid Crystal Display (AM/LCD):** An advance type of liquid crystal display.

**Advanced Television (ATV):** Refers generically to all the improvements in TV over today's system, including HDTV, EDTV, and IDTV.

**Aspect Ratio:** The ratio of a screen's width to its height. Today's TVs have a 4:3 aspect ratio. HDTV systems typically call for a 5:3 or 16:9 ratio.

**Bandwidth:** The range of frequencies available for or used to carry an electronic signal.

**Broadband:** A signal that requires a large bandwidth to be transmitted or equipment that must be capable of receiving and transmitting accurately a signal with a large bandwidth.

**Charge-Coupled Devices (CCD):** A type of solid-state electronic device used as a sensor in some types of cameras.

**ClearVision:** The Japanese EDTV system.

**Compact Disk (CD):** An optical storage medium used for music and computer data, among others.

**Digital Signal Processor (DSP):** A type of digital chip that manipulates a video signal to enhance the clarity of the final picture. Now used in today's generation of improved definition TVs.

**Digital Video Interactive (DVI):** A digital technology which allows a viewer to control and interact with video images.

**Direct Broadcast Satellite (DBS):** Transmission of TV or video signals directly to satellite receiver dishes at a viewer's home.

**Enhanced Definition Television (EDTV):** A form of TV that provides a better picture than today's TV using current broadcast signals, but has less resolution than HDTV.

**Federal Communications Commission (FCC):** The U.S. Government Agency responsible for communications and spectrum allocation policy and issues.

**FCC Advisory Committee on Advanced Television Service:** The industry committee set up by the FCC to make recommendations on advanced television system broadcasting standards.

**Fiber (also Optical Fiber):** Optical fibers used to carry information, usually in the form of pulses of light. Optical fiber has an extremely high bandwidth capacity which exceeds that of coaxial cable and copper wire.

**Field:** The alternate lines that compose half of a complete television picture or frame. In the United States, fields are shown at a rate of 60 fields per second, in Europe at 50 fields per second.

**Frame:** A complete television picture, including both even and odd alternating scans. If frames are shown at too slow a rate, there can be an annoying flicker to the picture.

**Gigahertz (GHz):** One billion cycles per second.

**Headend:** A cable TV systems control center which gathers incoming signals from satellites and other sources and then transmits them over cable to subscribers.

**Hertz (Hz):** Cycles per second.

**High Definition Multiplexed Analog Component (HD-MAC):** The European HDTV system for DBS delivery.

**High Definition Television (HDTV):** Usually defined as having roughly twice the resolution of today's TV systems, a wider aspect ratio (5:3 or more), and compact disk quality sound.

**High Resolution Systems (HRS):** Information systems that provide a high resolution visual image. Most often used in connection with computer-based applications such as computer-aided-design.

**HiVision:** The Japanese HDTV system based on their MUSE standard.

**Improved Definition Television (IDTV):** A television that used digital technologies to improve the picture. Seen even with today's conventional broadcasts.

**Interlaced Scan:** A broadcasting technique which first shows all the even lines of a TV picture or frame and then shows all the odd lines. Each set of lines corresponds to one field. This allows the picture to be shown without flicker, while reducing the total bandwidth necessary to transmit the picture.

**Kilohertz (KHz):** One thousand cycles per second.

**Liquid Crystal Display (LCD):** A type of viewing screen commonly seen on digital watches and laptop computers.

**Megahertz (MHz):** One million cycles per second.

**Multimedia:** A computer system, usually a personal computer or workstation, with specialized software which combines text, graphics, and limited full-motion video integrated together.

**Multiple Sub-Nyquist Sampling Encoding (MUSE):** The bandwidth compression technique developed by Japan's NHK for delivery of HDTV over a DBS system.

**National Telecommunications and Information Agency (NTIA):** A U.S. Government Agency under the Department of Commerce.

**National Television Systems Committee (NTSC):** The industry advisory group that defined the current U.S. B&W and color TV standards. The NTSC system is used in the U.S., Canada, Japan, and elsewhere.

**Nippon Hoso Kyokai (NHK):** The national radio and television broadcasting organization for Japan. Has extensively funded and coordinated HDTV development in Japan.

**Optical Disks:** Recording media including CDs that store information in patterns of microscopic pits on the surface of the disk, which can then be detected and "read" by a solid state laser and detector system and reproduced as sound, images, or data.

**Pay-Per-View (PPV):** Program services purchased by subscribers on a per program rather than a per month basis.

**Progressive Scan:** A TV picture that is showed in a single scan - like a book is read - rather than by alternately scanning all even and odd lines, as with interlaced scan. Computer workstations and PCs use progressive scan techniques, as do some of the newer IDTV receivers.

**Resolution:** A measure of a TV picture's detail.

**Taboo Channel:** A TV channel left unused in order to prevent interference on adjacent active TV channels in the same geographic areas.

**Transponder:** A component of a satellite which receives and then re-transmits a TV signal or perhaps narrower band data channels.

**Ultra High Frequency (UHF):** The band including TV channels 14 through 83.

**Very High Frequency (VHF):** The band including TV channels 2 through 13; VHF are more powerful than UHF channels.

**Video Cassette Recorder (VCR):** Electronic equipment used for recording and replaying TV broadcasts or pre-recorded video material at home. There are also studio production VCRs for editing movies and TV programs.

**Video Home System (VHS):** The most common format for today's home VCRs.