Chapter 7

Digital Television in the United States

Introduction

Chapter 5 provides a history of the U.S. debate over HDTV standards up to the
decision in May 23, 1993, to merge the competing electronics firms into a "Grand Alliance"
for a digital high definition television system. This chapter starts from that point and brings
the history up to and bit beyond April 3, 1997, when the Federal Communications
Commission formally adopted a standard for digital television (DTV) in the United States.
During this period, there was a change in the attitude of the members of the National
Association of Broadcasters toward HDTV: they began to see it as an answer to the problem
of declining audience shares. There were also continuous but only partially successful
lobbying efforts on the part of major computer firms to have the HDTV standards modified
to accomodate their perceived interests. The most important change was brought about by
the victory of William Jefferson Clinton in the 1992 presidential elections. Clinton's Vice
President, Albert Gore, was a strong exponent of governmental support for the building of
an "information superhighway." Clinton, Gore, and their appointed head of the Federal
Communications Commission, Reed Hundt, came to believe in the idea of "digital
convergence" and had strong views on the role that television should play in that larger
project.

Interlace vs. Progressive-Scan: Round One

There was furious bargaining within the Grand Alliance prior to the announcement
of its formation on May 24, 1993, to reconcile the differences in the four digital systems.
Most contentious was the question of whether the merged system should be capable of
processing progressively scanned or interlaced images, or both. Another important issue
related to scanning was the number of horizontal scanning lines. As is evident in Table 1,
the ATRC and GI proposed interlaced systems, while AT&T/Zenith and MIT had proposed progressive scanning. The AT&T/Zenith and MIT systems had fewer horizontal scanning lines (720) than the interlaced systems because one could obtain higher picture resolution (both static and dynamic) with fewer scanning lines in progressively-scanned systems.

A rather heated debate on the virtues of progressive scanning ensued. Michael Liebhold of Apple Computer argued very forcefully at the February 1993 special panel meeting of the ACATS that progressive scanning was the most desirable route because of the difficulty of handling interlaced source material in advanced, video-oriented computers and workstations. The computer and workstation world was headed toward nearly universal reliance on progressively scanned video inputs and displays and would be handicapped if the input/output systems and video processors inside computers continued to have to be designed to handle both interlaced and progressively-scanned source material, especially if the two types of sources continued to be in incompatible formats.

In addition, if HDTV signals were to be carried over the new information highways that were coming in the next decades, they should have the same sort of digital "headers" and "footers" that voice and data traffic have on existing telephone networks that permit new services like ISDN and caller ID. This would permit the manufacturers of television equipment to modify and upgrade their products and broadcasters or cable operators to offer new services to consumers without making existing equipment obsolete. In short, the computer types, represented here mainly by Mike Liebhold, but also by Robert Graves of AT&T and Jae Lim of MIT, were pushing for a sort of open architecture approach to HDTV that was familiar to the microcomputer producers but inconsistent with the more closed architecture approach of the traditional TV manufacturers.

On the other side of this issue were the mass producers of television sets and the
broadcasters (network and local) who argued that progressive scanning added to the cost of TV production equipment and receivers without producing better pictures. While it made sense to convert films in film libraries into progressively scanned video images, because one might be able to charge a premium for the higher quality of images, it made no sense to do this with video libraries. Live TV programming, like TV news and soap operas, would continue to be shot in interlaced video, or at least until inexpensive progressive-scan cameras were widely available.

The TV producers argued that televisions and computers were used differently by consumers and that the two industries were not merging as rapidly as the computer industry thought they were. Consumers, in their view, were not as demanding as computer users with respect to static picture resolution and were more likely to be confused than gratified by the extension of the open architecture approach to TVs. Also, they argued that since there were as yet no TV studio cameras to produce progressively scanned video, insisting upon an exclusive use of progressive scanning was a major flaw in the argument of the computer representatives.

The computer industry people countered with a variety of arguments. First, they pointed out that progressively scanned displays were not more expensive to produce than interlaced ones and that designing progressively scanned cameras was not a major difficulty, especially if the FCC created the financial incentives for doing so by opting for an all-progressive digital HDTV system. They conceded that some interlaced image sources would continue to be attractive to program producers, broadcasters, and consumers, but that eventually all would come to expect the higher quality of images that one could obtain with progressive scanning. Their strongest argument, in the end, was that the TV manufacturers and the broadcasters were trying to preserve a television infrastructure that was obsolescing or obsolete.

Most of the participants in this debate realized that an all-digital HDTV system would have important advantages over an analog system in permitting manufacturers to add
computer-like features to television sets and set-top boxes, and that these features would require some agreement to limit the types of image formats and digital information that the digital HDTV signal could carry. Thus, a compromise was worked out prior to the May 24, 1993, announcement of the formation of the Grand Alliance. This compromise called for the U.S. digital HDTV transmission standard to be capable of encoding and decoding both interlaced and progressive source material. The interlaced material would have 960 scanning lines at 30 frames per second; the progressive would have 720 lines at 60 frames per second. Thanks to Kell's Law, which states that the resolution of interlaced displays is roughly seven tenths of the resolution of progressive displays with the same number of lines, the two HDTV image formats proposed by the Grand Alliance would produce pictures of comparable resolution.

The original press release for the Grand Alliance announcement reported that all displays larger than 34 inches must be progressively scanned, but apparently that was an error. The Grand Alliance members felt that this would be an unnecessary handicap for them should nonmembers decide to offer (presumably cheaper) interlaced displays for large-screen TVs. Since they could not legally force all nonmembers to use progressive displays, they decided to abandon the requirement.

When the Grand Alliance took its compromise to ACATS, some members of ACATS objected particularly strenuously to the number of scanning lines in the interlaced format. They claimed that it would be a major disadvantage for video producers wishing to sell into Europe to start with source material that had fewer than a thousand scanning lines. They expressed a strong preference for the interlaced format to have 1,080 active lines. The members of ACATS who were pushing for this change had some support outside the broadcasting and video production communities. Bell Labs, for example, also, expressed a preference for the 1,080 lines format, despite the fact that another part of AT&T, the part that had worked with Zenith on signal encoding and decoding, supported the 960 lines format. NHK said that it would switch its MUSE Hi-Vision system from 1,035 scanning
lines to 1,080 lines if the ACATS did so. So, in response to pressure from ACATS, the Grand Alliance modified the two formats from 960/30/i and 720/60/p to 1,080/30/i and 720/60/p.

**Initial Reasoning Behind Liebhold's Position on Interlace**

For computer industry spokespersons like Apple Computer's Mike Liebhold, this change was further reason for abandoning interlacing altogether. In order to get the 1,080 active scanning lines in interlaced format, according to Liebhold, one had to reduce the horizontal resolution of the image and to accept nonsymmetrical pixels. The computer industry had been pushing for "square" or symmetrical pixels for HDTV as early as 1988. The proponents of the Grand Alliance system actually made the opposite point at the time that the move to 1,080 lines would make it easier not harder to get symmetrical pixels.

Because of Liebhold's strenuous complaints, and because of concerns about the additional expense of building equipment that could handle multiple formats, the HDTV community began to explore the possibility of moving eventually to a single progressive format of 1,080 lines at 60 frames per second. This became for a short time the explicit long-term goal of the Grand Alliance. Doing progressive scanning of 1,080 lines at 60 frames per second represented a serious technological challenge, however, and was not possible within the Grand Alliance's self-imposed upper limit of a data rate of 19.3 megabits per second. The existing video compression methods and circuit technology were not capable of squeezing that much visual information into the required bandwidth without serious degradation of the image. Meeting that goal would require better compression algorithms and/or faster IC processing speeds.

Liebhold sent a letter to Richard Wiley on June 8, 1993, requesting that he be appointed to the Technical Subgroup of ACATS. Wiley told him that that membership in that group had already been filled. Liebhold then wrote back protesting the exclusion of the "stakeholders in the National Information Infrastructure" from the ACATS process.
Liebhold testified before the House Committee on Science, Space, and Technology in June 1993 that the Grand Alliance decision to support both interlaced and progressive-scan formats would result in a de facto interlaced standard. This would be unfortunate because interlace did not permit flickerless rendering of text and graphics.\(^4\)

Commentators at the time criticized Liebhold's position on a variety of grounds. First, they objected that some computer firms, notably IBM, Digital, and AT&T had been represented in ACATS working groups. Second, they disagreed with Liebhold that interlace would become the de facto standard. They asserted that it was the intention of the equipment manufacturers to move to an all-progressive system as soon as possible. Finally, some claimed that what Liebhold, and his friends in the computer industry, were really trying to do was to force the television industry to adopt a system that would shift the costs of making television monitors compatible with computers onto the television industry, which these particular critics felt was a selfish and irresponsible position. The higher priced TV sets that would result would impose costs on both TV consumers and TV producers and would make it impossible to successfully introduce HDTV into the marketplace.

Wiley really hated dealing with Liebhold, but saw that the interest of the Clinton administration in the National Information Infrastructure (the phrase that had replaced the "information superhighway" in official circles) had made it necessary to at least appear to try to accommodate the wishes of the computer manufacturers. So he suggested the appointment of an "interoperability subgroup" for ACATS, later to be called the Joint Experts Group on Interoperability. Wiley appointed Robert Sanderson of Kodak to be its chair. Sanderson, in turn, invited Mike Liebhold to be vice chairman. Wiley was not happy about this, nor were other members of ACATS like Robert Rast of General Instrument.

Liebhold was supported in his efforts by a newly formed group called the Program on Digital, Open High-Resolution Systems (DOHRS), which was headquartered at the MIT Media Lab and staffed by Media Lab employees like Russ Neuman, Suzanne Neil, and Lee McKnight. The director the Media Lab, Nicholas Negroponte, was also openly critical
about HDTV and the ACATS process. After a series of rather heated confrontations with Wiley and other ACATS members, Liebhold decided in late October 1993 to withdraw from the anti-interlace campaign, convinced that there was no possibility of achieving his aims from inside the system. Liebhold's campaign was revived in December 1995, however, by a considerably larger and more powerful coalition called CICATS (Computer Industry Coalition on Advanced Television Services).\(^5\)

**HDTV and the Information Superhighway**

In the meantime, Reed Hundt had not yet been confirmed as chairman of the FCC and the Clinton administration initially showed little interest in HDTV or the ACATS deliberations. Hundt himself was noncommittal. He was influenced in his views by his discussions with Negroponte and other computer industry notables. Hundt was looking for HDTV to play a role in the emergence of the National Information Infrastructure (NII). He wanted HDTV to be more like what George Gilder called a "teleputer" -- a television/computer device that was seemlessly connected with computer networks. Wiley was worried that Hundt and the rest of the Clinton administration would scrap the HDTV deals made by the Republicans in the Bush administration. He felt that he no longer had the support of the chairman of the FCC as he did under Al Sikes. The National Association of Broadcasters chose this time of vulnerability to weigh in again against HDTV.

John Abel of the NAB began to focus on the opportunities presented by digital television as opposed to HDTV. Digital TV did not have to involve HDTV images. Instead, digital compression of standard definition signals would enable existing broadcasters to compress more than one program into a single channel, allowing them to provide a greater diversity of programming through a form of multiplexing. A digital broadcasting environment would permit broadcasters to offer all sorts of digital services such as data broadcasting, email, paging, telephony, software delivery, etc.

In February 1994, Michael Sherlock, Vice President of NBC, said that many
broadcasters were interested in using the second channel that they would be given in the transition to HDTV for digital services. He knew that the only reason that the second channel was being given to broadcasters was so that they would be able to provide free over-the-air services for NTSC set owners until a large proportion of the viewing public could receive digital broadcasts. Nevertheless, he argued that the non-HDTV digital services might be more lucrative for the broadcasters than HDTV itself.⁶

Similarly, in March 1994, Rupert Murdoch began to talk about satellite and cable systems with large numbers of channels. In a March 1994 interview with Forbes magazine, Murdoch said, "The current proposal is that the FCC will give us that spectrum for high-definition television. But high definition is a luxury. Compared with a modern TV set it's not that different. Why shouldn't that extra spectrum be given to me or you or anyone to put on that extra number of channels?"⁷

The NAB pursued this logic politically by proposing an amendment to the Telecommunications Act of 1995, called the "broadcast spectrum flexibility amendment." This amendment would broaden the range of services that broadcasters could provide on the second channel given to them in the transition to "advanced television." John Abel continued to argue that neither the broadcasters nor the consumers were demanding HDTV specifically, so broadcasters should not be forced to offer HDTV services.⁸ The Telecommunications Act failed to pass in 1995, however, due to overwhelming Republican opposition to what they argued was an overly regulatory Democratic bill. The Republicans were strengthened in their opposition to the bill by their resounding victory in the 1994 Congressional elections.

**Completion of the Grand Alliance System**

Testing of the Grand Alliance system continued through the end of 1993 and into early 1995. The Grand Alliance's schedule called for completion of the system in 1995 and a demonstration of its capabilities at the 1996 Olympics in Atlanta. Technical evaluations
were performed in 1994 at the Advanced Television Test Center in Alexandria, Virginia and at the Cable Television Laboratories (also called CableLabs) near Boulder, Colorado. Subjective viewer tests were performed at the Advanced Television Evaluation Laboratory in Ottawa, Canada. Field transmission tests were conducted by the Public Broadcasting Service, the Association for Maximum Service Television, Inc. (MSTV) and CableLabs in Charlotte, North Carolina. The transmission tests demonstrated some of the peculiar characteristics of digital broadcasting -- the quick break up of picture quality beyond the transmission range of the antenna -- as opposed to the more gradual degradation of picture quality with analog transmission, but on the whole they were successful.

At the beginning of 1995, completion of the Grand Alliance system was delayed because of technical difficulties. The main problem was the encoder that turned baseband high-definition video into compressed digital high-definition video at the transmission end. The two Grand Alliance companies in charge of this effort were General Instrument and AT&T. Due to delays in getting the new combined system to work, the companies requested a postponement of the final testing date. This time, instead of readily accepting the delay, FCC Chairman Reed Hundt decided to speed things up. He pushed Richard Wiley, the head of ACATS, to put pressure on the Grand Alliance members to complete their system.

Hundt's perception of the value of HDTV had changed noticeably. Hundt was impressed with the emerging Grand Alliance system, particularly its usage of a packetized data structure similar to those used in telecommunications systems. A Grand Alliance HDTV receiver was a lot more like a computer, with its ability to process a variety of video signals and to display both interlaced and progressive-scan images, than earlier HDTV receivers. The successful introduction of digital NTSC satellite services in the form of the Thomson/Hughes DirecTV or DSS services, using a direct broadcast satellite to deliver digitized signals to homes with small satellite dishes, satellite tuners, and regular NTSC televisions, may also have influenced Hundt's change of perspective. The rapid consumer
adoption of DBS services was eating into the audience share of both cable operators and terrestrial broadcasters thanks to the very high quality of the images and the large number of channels available on DBS services. Many of the successful satellite and cable channels in Europe and Asia also relied on digitized signals, especially for pay-TV channels where encryption was necessary to exclude nonsubscribers from receiving the signal.

**The Issue of Auctions: Round One**

With the successful auction of spectrum for PCS (personnel communications systems) telephone services in 1994-95, the FCC became increasingly convinced of the desirability of auctioning spectrum rather than just giving it away to licensees, as had been done in the past. Selling spectrum had a number of advantages. The revenues raised could help to reduce the government's deficit. There would be no "wasting" of spectrum as had occurred in the past, for example, in the case of UHF channels. The highest bidder would have an incentive to utilize the spectrum in the most commercially viable way, within the parameters set by the terms of sale. And resale of spectrum would reallocate the spectrum purchased by auction winners who failed to achieve their financial objectives.

This shift in policy militated against the NAB's strategy of pushing for greater flexibility in the use of the "second channel." Now the NAB was threatened with a number of proposals for auctions instead of grants and other communications companies began to ask out loud whether it made sense to give spectrum to television broadcasters who were not going to use it for television broadcasting. Just as digitalization had introduced greater flexibility into the possible use of spectrum by broadcasters, so had it eroded their special status in the eyes of others.

Senator Lieberman (D-Connecticut) wrote the FCC in early September 1995 about the effect of auctioning TV spectrum on broadcasters and on the transition to digital television. The Commission wrote back to the Senator on September 6, 1995, telling him that "many broadcasters will compete for and likely win many digital licenses if Congress
chooses to auction them." FCC Chairman Hundt apparently had raised the same issue in a meeting at the Office of Management and the Budget that week. The Association for Maximum Service Television (MSTV) wrote Lieberman on September 12, attacking the "incorrect assumption" in the FCC's letter that an auction would not harm the transition to digital television.9

On September 12, 1995, the chairman of the Senate Commerce Committee, Senator Larry Pressler (R-South Dakota), unveiled a plan to auction off HDTV and other advanced TV spectrum in the largest 25 television markets. According to Pressler, the auction would raise more than $14 billion, which Pressler wanted to use to establish a trust fund for public broadcasting. Federal funding for NPR and PBS was under attack from the new Republican majority in Congress. The National Association of Broadcasters immediately criticized the plan and announced that they would oppose it.10 Pressler dropped his proposal on September 28.

Debates over the desirability of spectrum auctions continued, however (see section below on Round Two of the auctions debate). The FCC issued a request for comments on the issue. The due date for comments was October 18, 1995. FCC replies were due December 1, 1995. Larry Irving of the NTIA continued to favor an auction. So did the Benton Foundation, Americans for Tax Reform, and Thomas Hazlett, an economist and an expert on telecommunications policy.11 In early December, the Clinton administration floated a proposal for the auctioning of HDTV spectrum to create a fund for subsidizing consumer purchases of digital TV converters. The proposal called for a subsidy of around $50 per consumer.12 The NAB and MSTV again objected to the idea of auctions and Irving's idea was strongly opposed by an FCC official on a televised debate. Nothing more of substance on auctions appeared until the middle of the 1996 election campaign.

ACATS Approves the Grand Alliance System

On November 28, 1995, ACATS made its final recommendations to the FCC on the
HDTV standard, based on the laboratory and field testing of the digital Grand Alliance system. ACATS reported that each of six formats proposed for the HDTV system (see Tables 2 and 3) exceeded targets established for static and dynamic luminance and chrominance resolution. ACATS ruled that the MPEG-2 compression system was superior to the four original ATV video compression systems and it selected the Dolby AC-3 audio system as superior to competing systems, including DTS (a digital sound system engineered by Lucasfilms with some Microsoft backing that was already in use in movie theaters). According to ACATS, the Grand Alliance's packetized data transport subsystem performed well, and appeared to be compatible with Asynchronous Transport Mode (ATM) telecommunications technologies. Finally, ACATS selected Zenith's VSB (vestigial sideband) transmission system rather than QAM (quadrature amplitude modulation) or COFDM (coded orthogonal frequency division multiplex) as the best method for assuring high-quality terrestrial over-the-air and cable transmission.

The system recommended by ACATS to the FCC had been vetted earlier to the American Television Services Committee (ATSC). The ATSC was asked by ACATS to determine which aspects of the Grand Alliance System required action by the FCC in the form of mandatory standards and which should be voluntary. The ATSC divided into five groups of specialists and proceeded to recommend mandatory standards in five areas: video, audio, transport, RF/Transmission, and receiver characteristics. For this reason, the ACATS recommendations presented to the FCC in November 1995 were later referred to as the "ATSC DTV Standard."

The National Association of Broadcasters announced that they would not oppose the adoption of the ACATS recommendations by the FCC, but were concerned about requirements to broadcast HDTV signals. As before, they worried out loud about the
expense of equipping stations for HDTV broadcasting and their ability to obtain new revenues to offset these expenses. They continued to argue for the benefits of multiplexing NTSC signals instead of moving to HDTV. John Abel, recently retired from the NAB, said: "Consumers have always gone for more video choices rather than higher video quality." CBS Lobbyist Marty Franks said that there was "no evidence that the public, if presented with one great picture or five pretty good ones, will pick just the one great one." Some local broadcasters disagreed, arguing that multiplexing would only further fragment audiences and thereby reduce advertising revenues. Phil Jones, president of Meredith Broadcasting in Des Moines, Iowa, said "People are smoking something funny if they think multiplexing is good for local broadcasters."\(^{16}\)

On December 12, 1995, the FCC held en banc hearings on advanced TV systems. At those hearings, FCC Chairman Hundt said that Congress not the FCC would decide whether the spectrum needed for HDTV broadcasts would be auctioned, but that the FCC would still decide whether licensees were required to use their new spectrum for HDTV broadcasts. He also argued that broadcasters might be required to provide "public services" in exchange for the privilege of licensing the new spectrum. Hundt raised the question of the degree to which the regulatory structure already in use for NTSC broadcasting would translate into an appropriate structure for the new digital broadcasting system. He left this issue open for future discussion and deliberation.

At the December 12 hearings, Bruce M. Allan, Senior Vice President for Business Development at Thomson Consumer Electronics, urged the FCC to give prompt approval for the Grand Alliance digital system. Allan argued that "consumers are ready for the superior pictures and sound of digital TV." He was supported in these views by the Advanced Television (ATV) Task Force of the Electronic Industries Association (EIA), an organization which represented primarily the manufacturers of consumer electronics equipment. The reader will recall from Chapter 5 that the EIA represented the mostly foreign-owned firms that produced these items for the U.S. market.
Also at the December 12 hearings, a new organization called the Computer Industry Coalition on Advanced Television Services (CICATS), represented by Joseph Tasker of Compaq Corporation, argued for abandonment of the interlaced video format. Tasker warned that "Unless the deficits of the proposed standards are remedied, the potential of the technology revolution will be stifled at birth... Television will fail to live up to its potential, but will instead remain simply a vehicle for entertainment, news, documentaries, and advertisements." The members of CICATS at this time were: Apple, Compaq, Hewlett-Packard, Intel, Microsoft, Oracle, Silicon Graphics, and Tandem Computers.

CICATS was to lead the fight in 1996 to alter the Grand Alliance System prior to its acceptance by the FCC, focusing particularly on the question of requiring equipment manufacturers to support both progressive-scan and interlaced video formats in HDTV receivers. CICATS took up many of the arguments first articulated by Michael Liebhold, but added a few new ones. More importantly, a wider variety of industry notables stepped forward as advocates of the computer industry position, including Bill Gates of Microsoft and Andy Grove of Intel, leaders of the emerging Wintel (Windows and Intel) coalition that was already setting de facto microprocessor and operating system standards for desktop and laptop computers worldwide. They managed also to get the support of a number of Hollywood directors, producers, and actors for their views on HDTV. At the same time, the cost for broadcasters of converting to HDTV transmission, the idea of auctioning spectrum instead of loaning it to broadcasters, and the right of broadcasters to choose NTSC multiplexing instead of HDTV broadcasting for their "second channel" all remained contentious issues.

To these old disputes were added a few new ones. The two most important of these were whether the "must carry" rules for cable operators would be extended to ATV broadcasts and how to deal with the interests of low power television (LPTV) broadcasters who served small and remote communities mainly by repeating the broadcasts of larger stations. Cable operators were required to carry the signals of local broadcasters so that both
over-the-air and cable customers would have access to the "free television" that terrestrial local broadcasters provided. Cable operators were, on the whole, happy to do this but wanted to exercise some choice when it came to which local stations to carry. They were concerned that "must carry" in the ATV world would force them to allocate scarce channel space to ATV signals when it might make more sense for them to multiplex. The NCTA had challenged the "must carry" rules in the courts; the Supreme Court was to decide this issue in the summer of 1997.  

From this point on, most people began to speak about digital television (DTV) or advanced television (ATV) instead of HDTV. The Grand Alliance system (also called the ACATS or ATSC DTV system) was more than an HDTV system because of its adoption of a packetized digital transport system and internationally accepted compression standards like MPEG-2. Now it was possible to think about flexibly combining both high and low resolution video (and other kinds of digital information) on the same channels using "smart" television receivers. It is was also possible to think of DTV as permitting both passive and interactive video applications.

**Interlace vs. Progressive: Round Two**

On April 11, 1996, the Polaroid Corporation announced the introduction of a broadcast television camera capable of producing HDTV quality images using progressive scanning. The camera had been developed with funding from IBM, Philips, Broadcast Television Systems of Breda, the Netherlands, and the Advanced Research Projects Agency of the U.S. Department of Defense. IBM helped to produce the charge-coupled devices (CCDs) that provided the imaging sensors for the camera. The first camera would be sold to MIT for experimental purposes and prices initially were around $500 thousand per unit (about twice the price of a regular broadcast TV camera). This was clearly a shot across the bow by supporters of CICATS to counter the contention of broadcasters and consumer electronics firms that interlaced video would be necessary for TV programming because no
progressive-scan cameras were available. Commissioner Susan Ness began around this time to take the initiative within the FCC to reconcile the conflict between the computer industry and the other side. At the annual meeting of the National Association of Broadcasters on April 15, 1996, she argued that it was desirable to move quickly on the adoption of DTV standards: "The burden of proof on showing why we shouldn't adopt it is on the opponents...Let's not let the opportunity for world leadership slip away in the search for a perfect solution." Ironicaly, at the same meeting, FCC Chairman Reed Hundt announced that there would be an FCC inquiry to determine whether the Grand Alliance DTV standard allowed for advances in video compression and other digital broadcast technologies. Hundt and his deputy, Saul Shapiro, began to hint that they opposed mandating the Grand Alliance DTV standards, so that broadcasters and equipment manufacturers might continue to innovate new technologies and practices.

The FCC voted 4-0 at a meeting on May 9, 1996, to issue a notice of intent to issue a standard for digital television. At the May 9th meeting, Chairman Hundt mentioned that the computer industry had raised some concerns about the Grand Alliance DTV system and that the American Society of Cinematographers had objected to the inclusion of the 16:9 aspect ratio in the system. Hundt noted that "These concerns cannot be dismissed out of hand."

The split between Hundt and the other FCC Commissioners broadened as Hundt tilted increasingly in the direction of the computer industry. The May 9th vote was the basis for the release of the Fifth Further Notice of Proposed Rule Making on May 20. That document became the basis for a new round of submissions to the FCC concerning the desirability of setting a DTV standard and the possible implications of doing so.

It turns out that Hundt had been consulting on the side with representatives of major computer hardware and software firms like Intel and Microsoft since 1993. Hundt was quoted in a news story published in July 1997 (after submitting his resignation from the Commission) that he was concerned about what he considered to be a "done deal" on
HDTV.

When my team and I got here in late 1993, we were presented with a steamroller of a lobbying effort that was self-declared to be the Grand Alliance...Fundamentally, it was a political deal between the networks and TV manufacturers, spearheaded by executives from Zenith, the NAB, and CBS. Their fundamental view was that I ought to get out of the way or get rolled over [so] they get the spectrum.24

Hundt approached Disney Corporation's Mickey Schulhof and Andrew Grove of Intel for advice on the Grand Alliance system. In early 1995, Hundt paid a visit to Microsoft headquarters in Redmond, Washington, to meet with chairman Bill Gates and chief technical officer Nathan Myhrvold. One of Hundt's purposes was to get the management of Microsoft to weigh in on the major controversies surrounding DTV. Microsoft was a little nervous about this given that the Department of Justice had just concluded an antitrust investigation of their firm in July 1994, and had blocked the acquisition of Intuit Inc., makers of Quicken, a popular personal accounting package, in April 1995. But Gates was working on his soon-to-be-published book, The Road Ahead, and he quizzed Hundt on the DTV debate so that he could say something about it in the book.25

As a result of the meeting with Hundt, Gates asked Craig Mundie, head of Microsoft's Consumer Platforms Division, to study DTV and represent the firm in the national debates. Hundt quickly appointed Mundie to ACATS, but too late (in Hundt's view) to prevent the adoption of the Grand Alliance system. Mundie also began to represent Microsoft in CICATS and helped it to build bridges to Hollywood interests.

The Senate Commerce Committee held hearings on HDTV standards on June 20, 1996. The computer and film production industries testified in favor of a progressive-scan only DTV system at these hearings. Mundie of Microsoft objected, as Mike Liebhold of Apple had done before, to the inclusion of interlaced formats in the system. The cause of the computer and film production industries was taken up by Senator Larry Pressler (R-South Dakota), the chairman of the committee, while the consumer electronics and
broadcasting industry position was defended by Senators Ted Stevens (R-Alaska) and Dan Coats (R-Indiana). Coats was particularly concerned about the impact of another delay in setting HDTV/DTV standards on employment at Thomson Consumer Electronics, which had its headquarters in Indianapolis and a major assembly plant in Bloomington. Coats argued that a standard was necessary to assure a successful introduction of DTV -- citing the failure of the introduction of stereo AM radio as an example of what can happen when the FCC neglects to set a standard.

On July 11, Larry Irving, Assistant Secretary of Commerce for Communications and Information and the administrator of the NTIA, wrote to Chairman Hundt to express his strong support for the Grand Alliance DTV system. He said that he supported the idea of revisiting the decision to include interlaced formats in the system at a later time, but encouraged the Commission to get on with setting the standard and launching the system. He recommended that "The Commission should ensure that the industries involved develop a clearly-defined plan to ensure that the migration to an all-progressive scan system moves at an expeditious rate, including a target date for full transition, taking relevant factors such as the pace of technological development into consideration."26

On July 11, CICATS wrote to Chairman Hundt to warn the FCC that the broadcasters and the consumer electronics firms were foisting a very costly DTV solution on the public. CICATS argued that consumers were not really interested in HDTV, but under the Grand Alliance system they would get it and pay for it whether they wanted it or not. CICATS offered -- for the first time -- a counterproposal that would create a system that they claimed was technologically superior and would cost the taxpayers $44 billion less over the next seven years.

Part of the counterproposal was drafted by Gary Demos, an employee of Apple Computer and also President and CEO of a small firm called DemoGraFX which provided digital video services mostly to Hollywood film producers. Demos had been involved in the U.S. debate on HDTV since 1988. He had been one of the early opponents of interlaced
video formats in DOHRS and an early exponent of interoperable digital video systems -- that is, video systems that bridged the TV and computer worlds. Demos's draft was incorporated into an umbrella document written by Alvy Ray Smith, one of the founders of Pixar (famous for producing the hit film "Toy Story" for Disney Studios), who was at that time an employee of Microsoft. Smith's criticisms of the ACATS recommendation became part of a larger document submitted to the FCC for CICATS by Economics and Technology, Inc., an economic consulting firm run by Lee Selwyn and the law firm of Levine, Blaszak, Block, and Boothby.27

Demos's proposal called for a "layered" system in which the base layer would be standard definition television (SDTV). William Schreiber explains this aspect of the proposal:

Since the cost of the MPEG decoder, which will be a significant part of the cost of a minimum receiver, depends primarily on its processing speed and the amount of memory, and because a standard-definition system requires only one fourth the speed and memory as an HDTV system, this difference is important. In the CICATS scheme, packets are available for enhancement since the SD base layer does not consume all the channel capacity. However, at least part of the base receiver circuity must operate at the higher speed, and the total channel capacity available for enhanced receivers is just the 20-25 megabits per second provided in the GA [Grand Alliance] system.28

CICATS opposed the adoption of the ACATS recommendations and suggested that voluntary standards would be better than mandatory ones because of the rapidity of technological change in digital video and the likelihood that DTV receivers under the ACATS approach would be too expensive for most consumers, at least initially. In the absence of voluntary standards, CICATS recommend a "baseline" system which supported only three video formats (all progressively scanned): 480 x 640 with a 4:3 aspect ratio at three frame rates -- 24, 36, and 72 frames per second. They presented a few other alternative "baseline" systems, but the basic point they tried to make was that the ATSC
DTV standards mandated support for too many video formats and that by doing so they guaranteed that DTV receivers would be too expensive for most consumers. Their submission to the FCC argued that their alternative approach would result in lower cost receivers and a more successful introduction of digital television.

The main defect of the CICATS approach in the eyes of broadcasting and consumer electronics industry representatives was that it called for an initial emphasis on SDTV instead of HDTV, and therefore would not constitute a sufficiently large jump in image quality to entice consumers to buy new sets despite the possible lower costs. These interests reiterated their belief that it was unrealistic to eliminate interlaced video formats, especially the 1080-line interlaced format, from the list of mandated formats, because of the ready availability of programming and video production equipment in that format and the need to broadcast HDTV programs as soon as DTV receivers were made commercially available. Representatives of companies like CBS, linked by long association with Sony Corporation, and Matsushita were particularly vehement on this matter. CICATS countered this argument with contentions that interlacing was obsolete and that the broadcasting and consumer electronics firms were "dinosaurs" unaware of the real dynamics of digital technologies.

In a surprising development, the representatives of the cable industry in the National Cable Television Association (NCTA) also came out against the adoption of the ATSC DTV standard in their letter to the FCC of July 12. Although they justified their position on the basis of the need to avoid freezing technologies during a period of rapid technological progress, their real basis for opposition at this time had more to do with the extension of "must carry" rules into the DTV era and the difficulty of adapting their QAM systems to the VSB transmission method favored in the Grand Alliance specs. Nevertheless, CICATS welcomed the NCTA into the anti-Grand Alliance fold.29

A segment of the film production industry also rallied to the side of CICATS, focusing on the aspect ratio problem. Many film makers liked working with widescreen
images that would not fit in the 16:9 formats included in the Grand Alliance DTV system. The Directors Guild, the American Society of Cinematographers, and the Photographers Guild favored a 2:1 aspect ratio. It should be noted, however, that the Motion Picture Association of America (MPAA), representing the largest Hollywood movie studios, was a supporter of the Grand Alliance system.

Table 4 below represents the two opposing coalitions at this time.

[insert Table 4 about here]

**Auctions: Round Two**

On Jan. 2, 1996, Senator Robert Dole (R-Kansas) insisted that HDTV frequencies should be auctioned, and linked his support for Telecom Reform Act to the adoption of this proposal. Even though this linkage was severed prior to the passage of the Telecommunication Act of 1996, Dole held onto this issue as he made the transition from majority leader in the Senate to candidate for the presidency.

On February 16, 1996, the Consumer Electronics Manufacturers Association (CEMA) issued a lengthy defense of the FCC’s decision to loan spectrum to broadcasters to ease the transition to DTV. The temporary, cost-free loan of a second channel is essential if the broadcasters are to transition to a digital system. Broadcasters cannot offer both analog and digital transmissions over their current channel. Nor can broadcasters commence digital transmission over their current channel without instantly blacking out the more than 200 million existing analog television sets. To upgrade to digital, broadcasters will need to broadcast on two channels, one analog and one digital.

This is not a 'give away' of spectrum, nor does it allow the broadcasters to initiate an additional service. Instead, it is a one-for-one exchange of channels, with one channel to
be returned to the government when the transition is complete.  

The formation of the Citizens for HDTV Coalition was announced by James Carnes, president of the Sarnoff Research Center (a member of the Grand Alliance), on March 8, 1996. The members of the coalition are listed in Table 5 below. Funding for the Coalition came primarily from the CEMA. At the press conference, Carnes and Richard Wiley said that spectrum auctions would delay the rollout of DTV because broadcasters would have to budget expenditures both for auction payments and for equipment purchases. They also argued that auctions would result in more pay and subscription TV programming and less "free" (advertising-supported) TV.

Gigi Sohn, deputy director of the Media Access Project defended auctions as preferable to the "massive corporate welfare" she associated with the lending of spectrum for the DTV transition. Sohn also argued that if the broadcasters did not use the new spectrum for broadcasting HDTV programming, then it really did not make any sense to give them the spectrum for free. She also pointed out that the only consumer entity in the Citizens for HDTV Coalition was the National Consumers League and the only senior citizens' organization was the National Council of Senior Citizens, implying thereby that the Coalition was representing primarily the interests of the consumer electronics manufacturers and associated labor unions.  

In April 1986, Senator Dole was joined by Senator John McCain (R-Arizona) and Representative Barney Frank (D-Massachusetts) in his calls for ATV spectrum auctions. On April 8, 1986, Gigi Sohn was quoted as saying that "HDTV is dead...Broadcasters don't have a lot of interest in high-definition television." Sohn's arguments in favor of auctions had taken on a broadcaster-bashing element. The broadcasters responded by pointing out that
winners of spectrum auctions in the past had quickly passed on the costs of auction bids to end users but that this was unlikely in their case because advertisers would be unwilling to pay more for the same air time, even if the viewers were now receiving sharper images.\textsuperscript{33}

Partly in response to these pressures from consumer advocates and Congress, the White House and the FCC began talking about an accelerated transition to DTV of seven years instead of the ten to fifteen years mentioned earlier. This would speed up the return of the analog channels to the FCC. The revenues obtained from auctioning that spectrum would then help to reduce the budgetary deficit a bit sooner than previously anticipated. FCC Commissioner James Quello objected to this policy shift because he thought that people would hang onto their NTSC sets for considerably longer than seven years and that they would be angry if they had to scrap them prematurely.\textsuperscript{34}

On June 20, 1996, at the Senate Commerce Committee Hearing on HDTV standards, Chairman Hundt again endorsed the idea of auctioning spectrum. Dr. Peter Bingham, president of Philips Research Laboratories, said that the spectrum auction hung "like a sword of Damocles over this digital revolution." He argued that the auction would only produce a marginal improvement in deficit reduction but that it would certainly undermine the economic incentives for broadcasters to introduce digital television expeditiously.\textsuperscript{35}

During the week of July 22, 1996, the House of Representatives was scheduled to consider an amendment to the FY 1997 FCC appropriations bill proposed by Rep. Barney Frank that would prohibit the FCC from assigning licenses for ATV services. This amendment was designed to stymy efforts by the FCC to allocate ATV channels at a meeting on July 25. Apparently the FCC was planning to free up channels 2 to 6 and 52 to 69 for nontelevision uses. The FCC promptly received a letter from ALTV, MSTV, NAB, the three major networks, Chris-Craft and Tribune opposing this. Senator McClain used the occasion to lecture Chairman Hundt in a letter to "keep government intrusion to a minimum" and avoid freezing innovation by setting inappropriate standards. Nevertheless, the FCC voted to announce its intention to allocate ATV channels at the July 25 meeting, although it
left the decision about what channels to allocate and when to a later time.

**NTSC Multiplexing vs. HDTV**

Cracks began to appear within the broadcasting community about the relative
desirability of using the second channel for HDTV broadcasts or multiplexing digital NTSC
signals. As stated above, cable and satellite operators like Ted Turner of Turner
Broadcasting and Rupert Murdoch of News Corporation took an early position in support of
multiplexing. Most other broadcasters were ambivalent. In the spring of 1996, however,
some heavy-weight players began to take the position that terrestrial broadcasters and the
national network systems had to opt for HDTV as a way of countering the erosion in their
audience share caused by competition from cable and direct broadcast satellite channels.
Michael Jordan, Chairman of Westinghouse/CBS Broadcasting, said his network would
almost certainly offer HDTV programming because "we can't afford to give our competitors
a sustained technological advantage." Jordan was encouraged by information that the cost
of equipping stations for DTV broadcasting was already declining and that there were
indications that the government would not require spectrum auctions for DTV channels.36

Jordan's position was echoed shortly thereafter by Edward Horowitz, Senior Vice
President of Viacom, who had always been a strong supporter of HDTV. Horowitz argued
that interactive digital services would be particularly important for cable operators and that
DTV standards would help to move the industry in that direction. Horowitz acknowledged
that it would be necessary to upgrade many local cable systems to provide genuine
interactive services, but looked to the growing popularity of the Internet and the heightened
consumer demand for fast links to the Internet via cable modems to generate the necessary
revenues to pay for this.

In contrast, Edward Grebow, President of Tele-TV, a firm that was pioneering the
delivery of pay TV programming over telephone company infrastructure, argued for the
superiority of multiplexing over HDTV. In Grebow's view, the ability to obtain revenues by
providing services tailored closely to the needs of individual customers was more likely to produce the desired increase in broadcasting revenues than by providing HDTV programming. In the pay TV area, one way to do this was to give customers "near video on demand" (NVOD) access to movies and other programming. To do this, one needed to multiplex. Grebow argued that terrestrial broadcasters and networks were likely to become more like cable operators in the future in providing programming for multiple channels.  

'Must Carry' Rules

Richard Wiley came down strongly on the side of those who favored the extension of must carry rules to ATV in a speech before the National Association Broadcasters on April 16, 1996. This position was strongly opposed by the cable operators and cable networks. The cable industry wanted to clear their channels of certain TV stations in favor of more popular cable offerings. Their attorneys argued their case to the Supreme Court in November 1996.

On March 31, 1997, the U.S. Supreme Court upheld a 1992 federal law requiring cable TV operators to carry local broadcast stations. This was a victory for the broadcasters and the networks. The vote was 5-4. Justice Anthony Kennedy wrote for the majority arguing that "must carry" was essential to assure "audience access and advertising revenue needed to support a multiplicity of stations." The cable industry had argued that "must carry" rules were a violation of its First Amendment rights. Kennedy countered this argument by saying that the Court had to defer to the wishes of Congress on this issue. Dissenting from the majority was Justice Sandra Day O'Connor. O'Connor's dissent stated that she thought that protecting the First Amendment rights of cable operators was more important than deferring to Congress.

The Supreme Court's decision meant that "must carry" requirements would be extended to DTV signals of local terrestrial broadcasters for the same reason that they were applied to analog NTSC signals, to guarantee that all citizens would be exposed to a variety
of broadcast opinions and that communications conduits could not be used by a small number of broadcasters to limit public discussion of important issues. The cable systems operators remained opposed to this, and vowed to fight on in other forums.

The Negotiation of a Compromise with the Computer Interests

CICATS continued to lobby for a change in the ATSC DTV standards throughout 1996, with heavyweights like Bill Gates and Andy Grove weighing in toward the end of the year and with letters, visits and testimony from such film industry notables as Steven Spielberg, Clint Eastwook, Arthur Hiller, Martin Scorsese, Richard Dreyfuss, Dustin Hoffman, Sydney Pollack, and Robert Zemeckis. Many of the film industry representatives were more concerned about the 16:9 aspect ratio of the DTV standard than about interlacing. Martin Scorsese, for example, said that "This new technology will let us show movies at home as they are seen in the theaters...We will no longer have to tolerate the mutilation of films when they are shown on TV."

The computer industry representatives were more concerned about the effect of adopting the ATSC DTV standards on digital convergence. For example, in late October, Microsoft Chairman Bill Gates said: We strongly support efforts to bring digital television to American homes .. Unfortunately some critical parts of the "Grand Alliance" proposal would unnecessarily slow the convergence of PCs and televisions. Getting these standards right is vital to achieving the digital future where consumers will be able to watch television on their PCs or access the Internet from their TVs.

Gates' position on DTV was undoubtedly influenced by his perception of the increased stake of Microsoft Corporation in helping customers use the world wide web. Microsoft purchased WebTV Neworks of Palo Alto, California, a small firm that made set-top boxes for TV sets to permit TV owners to cruise the web inexpensively, for $425 million. This purchase was announced in April 1997 but probably was already in the works
in late 1996. Microsoft bought 11.5 percent of the shares in Comcast Corporation, a cable television operator, in June 1997. These investments were part of a shift in Microsoft strategy toward a more web-oriented approach to software. Gates began talking about supporting a "Web lifestyle" with Microsoft products, especially after the phenomenal early success of Netscape Communications, a startup firm which battled Microsoft for control of the market for web browsers and servers.\textsuperscript{41}

CICATS members formed a new group called the Americans for Better Digital TV (see Table 8 below for membership). The combined lobbying efforts of the members of this group apparently convinced President Clinton to take a stand. On September 23, 1996, in an interview with a reporter from Broadcasting and Cable magazine, Clinton weighed in on the side of digital convergence:

The best standard would be one developed and supported by all the affected industries, which could then be endorsed by the FCC...We want to make sure that there are no roadblocks to future compatibility between televisions and computers.

Accordingly, on October 24, 1996, Commissioner Susan Ness sent a letter to the Broadcasters Caucus, the Consumer Electronics Manufacturers Association and CICATS urging them to seek a consensus on DTV standards by November 25. A series of intensive negotiations ensued resulting ultimately in a compromise to modify the ATSC DTV standard by removing the requirement that DTV receivers support the 18 video formats in Table 6 and leaving it instead to each equipment manufacturer to decide which formats to support. This compromise, in effect, recognized the split between computer and consumer electronics firms over interlaced formats and allowed them to pursue their own strategies. A letter documenting the compromise was signed on November 27, 1996, in Washington by Michael Sherlock of NBC, representing the Broadcasters Caucus, Gary Shapiro of the
CEMA, and Paul Misener of Intel representing CICATS. This cleared the way for the FCC to issue its decisions on DTV without fear of further reprisals from the computer industry.

**The FCC Decisions of December 26, 1976 and April 3, 1997**

On December 27, 1996, the FCC released its Fourth Order and Report accepting the recommendation of ACATS to adopt a modified version of the ATSC standard for digital television in the United States.\(^{42}\) The decision was strongly praised by the broadcasting and consumer electronics firms and their representatives. The computer industry and particularly the members of CICATS also expressed satisfaction with the outcome. Media coverage of the DTV decision began to emphasize some of the problems that conversion to DTV broadcasting would create for the smaller terrestrial broadcasters, consumer electronics retailers, and owners of NTSC receivers. The FCC turned to the question of how to allocate the channels it would loan to broadcasters for the transition to DTV.

On April 3, 1997, the FCC issued its Fifth and Sixth Report and Order in the U.S. Advanced television proceedings. This document spelled out in great detail the plans for allocating loaner channels to terrestrial broadcasters. The problems they had to solve had to do mainly with assuring existing broadcasters that their new digital channels would permit them to cover approximately the same territory as their old analog channels. In addition, many low-powered television broadcasters in rural or mountainous regions were acting as repeaters for nearby terrestrial broadcasters. These stations were low-budget affairs with just enough revenues from advertising to generate a small profit. Such stations could not afford to quickly convert to digital broadcasting. So special provisions had to be made for them. A similar problem existed for public broadcasters, and they were granted more time to make the transition than commercial broadcasters.

An important part of the April 1997 decision was the plan to recover for nontelevision uses 138 MHz of spectrum -- 60 MHz immediately and 78 MHz within ten years. 60 MHz would come from the former television Channels 60 to 69 in the VHF band,
which would no longer be reserved for television broadcasts (these channels were only infrequently used anyway, and then only in the most crowded urban areas). When the transition to DTV ended, in 2006, all the NTSC channels would be returned to the FCC, which would make an additional 78 MHz of spectrum available. The recovered spectrum would be auctioned or otherwise allocated to licensees for various purposes. The FCC committed itself in the Sixth Report to allocate 24 MHz of recovered spectrum in the VHF band for police and public safety purposes.

The idea of auctioning spectrum sooner rather than later was particularly appealing to the Clinton administration, which at the time was looking for a way to guarantee further reductions in the deficit before 2002. Hence, one initiative undertaken by Chairman Hundt was to try to get the broadcasters in the largest urban media markets to accelerate their deployment of DTV. Instead of a transition period of ten years, he pushed the broadcasters to do it in two years. This generated great resistance on their part, but in the end the broadcasters committed themselves to a two-year transition in some major markets and a three-year transition in others.

Finally, an important aspect of the April 1997 decision was to reaffirm the earlier decision to allow broadcasters to choose between HDTV broadcasting and SDTV multiplexing, and between passive and interactive services, on their digital channels. Commissioner Hundt thought this proved that the FCC had embraced a "market orientation" that would give "broadcasters the flexibility to use the spectrum to respond to market opportunities."\textsuperscript{43} Hundt's efforts to link the DTV spectrum allocation to new commitments on the part of broadcasters for public service announcements and children's broadcasting, resulted in the appointment of a special commission to consider the matter.

\textbf{Reactions to the April 1997 Decisions}

Now that both the standard and the channel allocation system had been decided, the major stakeholders in digital television began to play a new set of games. Whereas before
the key question was whether the FCC would adopt any standard at all, now the game turned to optimizing one's chances for success under the new standard.

The most important reaction to the April 1997 FCC decisions on DTV came from the computer industry. On April 7, 1997, Compaq, Microsoft, and Intel announced the formation of the DTV Team composed initially of the three firms at the annual meeting of the National Association of Broadcasters in Las Vegas, Nevada. The DTV Team proposed to develop DTV for computers that supported a subset of the ATSC DTV video formats and pointedly excluded all but the simplest interlaced formats. They argued once again that doing this would make DTV receivers cheaper than those which supported all 18 of the video formats of the ATSC DTV standard.

The DTV Team proposed that DTV receivers following their standard would support only nine of the 18 video formats in the ATSC DTV standard. Table 7 below lists them.

Note that the only interlaced format included in the DTV Team's proposal permitted the DTV Team's receivers to display interlaced programming produced in NTSC formats and to downconvert 1,080 x 1,920 interlaced HDTV images. Note also that the only true HDTV format in the DTV Team's list in Table 7 is the first one. This is the result of the DTV Team's belief that the current processing capability of microprocessors and digital signal processors was not yet capable of handling progressive scan images of higher resolution using the MPEG-2 compression algorithm. They argued, as before, that Moore's Law, under which the memory and digital signal processing capability of integrated circuits doubles every 18 months, would permit upgrading of DTV receivers later to process higher resolution video at acceptable performance levels. This is reminiscent of the "layered" or "baseline" approach of the CICATS DTV counterproposal of July 11, 1996, which indeed was the main inspiration for the DTV Team's approach.
A new emphasis in the DTV Team's rationale for its approach was the argument that interlaced programming was inherently passive, whereas progressive scan programming permitted the easier integration of conventional video with digital multimedia content which was inherently interactive. Particularly interesting was the DTV Team's contention that their approach permitted broadcasters to diversify their programming content by combining video easily with world wide web content. The key problem with interlace, in their view, was the difficulty of displaying text (except in large formats with a limited number of fonts). They cited the increasing tendency of upper income U.S. households to cruise the World Wide Web rather than watching network televisions during prime time viewing hours as evidence of the compelling attraction of interactive digital multimedia content, even with inferior video quality. They pointed out that advertisers were switching to other media that offered better access to the "eyeballs" in these households, and would continue to do so especially if larger numbers of less affluent households started to cruise the web.

Another important development was yet another flip-flop on the part of a major television network on the issue of HDTV vs. multiplexing of SDTV signals on the newly allocated digital channels. In early August 1997, Preston Padden, president of the ABC Television Network (and formerly a key employee in Rupert Murdoch's News Corporation), said that he saw no way to make money from broadcasting HDTV and so ABC and other Disney Corporation broadcasters would use their digital channels to broadcast multiplexed SDTV -- possibly with some pay-TV channels included. NBC and CBS, in contrast, stuck with their earlier commitments to broadcast HDTV. Padden had only joined ABC in May 1997, and he justified his position by arguing that "Our share of the viewing audience will continue to erode as long as we remain a single channel in an expanding multi-channel universe."\textsuperscript{44}

Thus, the split between future manufacturers of ATSC DTV receivers (mostly TV manufacturers) and DTV Team receivers (mostly computer firms) would be accompanied by a split between HDTV broadcasting networks and SDTV multiplexing networks, thus
creating -- at least initially -- further confusion among consumers and other industry players about what to do next. These two splits were a consequence of the compromise between the computer industry and the TV and broadcasting industries embodied in the December 1996 decision of the FCC to allow the market to decide what kinds of digital television it wanted to consume. The compromise itself was a product of the desire of the computer industry to defend the possibility of digital convergence. Only time will tell if this was a wise strategy.

Conclusions

In 1993, the U.S. debate on digital television focused on the feasibility of a unified Grand Alliance approach. By 1997, the debate had shifted away from a focus on television per se toward a consideration of the broader implications of digital television for the future of the American broadcasting and electronics manufacturing industries. The increased importance of the Internet and the world wide web, particularly for the Clinton Administration, but also for key players like Compaq, Intel and Microsoft, had made a big difference in the level of attention given to HDTV and digital television by major political forces in the country. The Grand Alliance and ATSC approach had helped to focus the attention of these other players on the DTV issue by adopting digital packetization and transport schemes that were consistent with the idea of digital convergence but deviated from that ideal by forcing manufacturers to make more expensive DTV receivers and set-top boxes in order to satisfy the concerns of their coalition partners.

The Chairman of the FCC, Reed Hundt, and Commissioner Susan Ness played a crucial role in forcing the members of the Grand Alliance coalition to compromise with the "johnnie-come-latelies" of the computer industry, but in doing so they were simply reflecting the ability of the computer industry to generate support at high levels in a White House that had already tilted in their direction on a number of other occasions. Efforts on the part of members of Congress, even Presidential candidates like Bob Dole, to force the FCC to auction DTV spectrum came to naught. Congress was split on this issue, with
Senators Dole and McCain countered by Senators Coats and Stevens. Congress was also split on whether to support the TV broadcasters and manufacturers or the computer industry at various points in the debate. The FCC normally leans in the direction of TV interests because of the way in which commissioners are recruited and selected, but in this case that did not occur because the Chairman confronted a divided Congress and a White House eager to placate the computer industry. The result, as discussed in the summary paragraphs of the previous section, was a compromise standard that reduced uncertainty about the future of digital television considerably but did not eliminate it.
Table 1. Digital Systems Tested by the ATTC prior to Formation of Grand Alliance

<table>
<thead>
<tr>
<th>System Features</th>
<th>GI</th>
<th>AT&amp;T/Zenith</th>
<th>ATRC</th>
<th>MIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulation Method</td>
<td>16-QAM</td>
<td>2-VSB</td>
<td>16-QAM</td>
<td>like GI</td>
</tr>
<tr>
<td></td>
<td>32-QAM</td>
<td>4-VSB</td>
<td>32-QAM</td>
<td></td>
</tr>
<tr>
<td>No.of Horizontal Scanning lines</td>
<td>960</td>
<td>720</td>
<td>960</td>
<td>720</td>
</tr>
<tr>
<td>Vertical Resolution</td>
<td>1,408</td>
<td>1,280</td>
<td>1,440</td>
<td>1,280</td>
</tr>
<tr>
<td>Frame Rate, f/s</td>
<td>30</td>
<td>60</td>
<td>30,60</td>
<td>60</td>
</tr>
<tr>
<td>Interlaced?</td>
<td>yes</td>
<td>no</td>
<td>both</td>
<td>no</td>
</tr>
<tr>
<td>Pixel Rate, Msmpls/s</td>
<td>40.6</td>
<td>55.3</td>
<td>41.5</td>
<td>55.3</td>
</tr>
<tr>
<td>Adaptive Selection Coding Method</td>
<td>MPEG style</td>
<td>Vector Coding</td>
<td>MPEG</td>
<td>Vector Coding</td>
</tr>
<tr>
<td>Audio</td>
<td>Dolby AC2</td>
<td>Dolby AC2</td>
<td>Musicam</td>
<td>MIT-AC</td>
</tr>
</tbody>
</table>

Table 2. Six Video Formats in Grand Alliance System as of November 1994

<table>
<thead>
<tr>
<th>Width x Height</th>
<th>Frames per Second</th>
<th>Encoding Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1280 x 720</td>
<td>24fps</td>
<td>progressive</td>
</tr>
<tr>
<td></td>
<td>30fps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60fps</td>
<td></td>
</tr>
<tr>
<td>1920 x 1080</td>
<td>24fps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30fps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60fps</td>
<td>interlaced</td>
</tr>
</tbody>
</table>
Table 3. Members of ACATS

<table>
<thead>
<tr>
<th>Richard Wiley, Chairman</th>
</tr>
</thead>
</table>

**Voting Members**
Frank Biondi, President and CEO, Viacom
Joel Chaseman, Chairman, Chaseman Enterprises International
Joseph Collins, Chairman and CEO, American Television and Communications Corp. (Time-Warner)
William Connolly
Marin Davis, Wellspring Associates Inc.
Irwin Dorros (former chief of Bellcore)
James Dowdle, Tribune Broadcasting Co.
Ervin S. Duggan, Public Broadcasting Service
Joseph Flaherty, Senior V.P. for Technology, CBS Inc.
Samuel Fuller, Digital Equipment Corp.
Stanley S. Hubbard, President and CEO, Hubbard Broadcasting
James Kennedy, Chairman and CEO, Cox Enterprises
James C. McKinney, Chairman, Advanced Television Systems Committee
Craig Mundie, Microsoft Corporation
Thomas S. Murphy, Chairman, Capital Cities/ABC Inc.
Rupert Murdoch, Fox Inc.
Jerry K. Pearlman, Zenith Electronics Corp.
F. Jack Pluckhahn, President and COO, Quasar
Ward Quall, the Ward L. Quall Co.
Richard D. Roberts, TeleCable Corp.
Burton Staniar, Chairman and CEO, Westinghouse Broadcasting (later The Knoll Group)
James Tietjen, SRI International
Laurence Tisch, President and CEO, CBS Inc.
Robert Wright, President and CEO, NBC

**Ex-Officio, Nonvoting Members**
Peter Bingham, President, Philips Laboratories
Wendell Bailey, Vice President, National Cable Television Association
Henry L. Baumann, Executive Vice President and General Counsel, National Association of Broadcasters
Joseph Donahue, retired Executive V.P., Thomson Consumer Electronics
Brenda L. Fox, Dow, Lohnes & Albertson
Richard Friedland, Chairman and CEO, General Instrument Corp.
Robert Graves, AT&T
Larry Irving, NTIA, U.S. Department of Commerce
Keiichi Kuboto, Deputy Director of Advanced Television Research Division, NHK Science and Technical Research Labs
Jae Lim, professor of engineering, MIT
Vonya B. McCann, Deputy Assistant Secretary, U.S. Department of State
George Vradenburg III, Latham & Watkins
Margita White, President, Association for Maximum Service Television
Table 4. Supporters and Opponents of the Grand Alliance System, July 1996

<table>
<thead>
<tr>
<th>Supporters</th>
<th>Opponents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citizens for HDTV</td>
<td>Consumer Federation of America</td>
</tr>
<tr>
<td>CEMA</td>
<td>CICATS</td>
</tr>
<tr>
<td>NAB</td>
<td>NCTA</td>
</tr>
<tr>
<td>ALTV</td>
<td>Media Access Project</td>
</tr>
<tr>
<td>MSTV</td>
<td>Directors Guild</td>
</tr>
<tr>
<td>APTS</td>
<td>American Society of Cinematographers</td>
</tr>
<tr>
<td>ABC,NBC,CBS,Fox</td>
<td>Photographers Guild</td>
</tr>
<tr>
<td>PBS</td>
<td></td>
</tr>
<tr>
<td>Tribune</td>
<td></td>
</tr>
<tr>
<td>Chris-Craft</td>
<td></td>
</tr>
<tr>
<td>MPAA</td>
<td></td>
</tr>
</tbody>
</table>

Source: See text.

Table 5. Members of Citizens for HDTV Coalition

- CEMA of EIA
- EIA ATV Committee
- Home Record Rights Coalition
- NARDA
- PARA
- Digital Multimedia Compression, Inc.
- Digital HDTV Grand Alliance
- National Consumers League
- National Council of Senior Citizens
- Communications Workers of America/NABET
- Intl. Brotherhood of Electrical Workers
- IUE

Table 6. Eighteen Video Formats in ATSC DTV Standard, May 1996

<table>
<thead>
<tr>
<th>Vertical Lines</th>
<th>Horizontal Pixels</th>
<th>Aspect Ratio</th>
<th>Picture Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1080 x 1920</td>
<td>16:9</td>
<td>60I 30P 24P</td>
<td></td>
</tr>
<tr>
<td>720 x 1280</td>
<td>16:9</td>
<td>60P 30P 24P</td>
<td></td>
</tr>
<tr>
<td>480 x 704</td>
<td>16:9</td>
<td>60I 60P 30P 24P</td>
<td></td>
</tr>
<tr>
<td>480 x 640</td>
<td>4:3</td>
<td>&quot; &quot; &quot; &quot;</td>
<td></td>
</tr>
</tbody>
</table>


Table 7. Video Formats Supported by the DTV Team

<table>
<thead>
<tr>
<th>Vertical Lines</th>
<th>Horizontal Pixels</th>
<th>Aspect Ratio</th>
<th>Picture Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>720 x 1280</td>
<td>16:9</td>
<td>24P</td>
<td></td>
</tr>
<tr>
<td>480 x 704</td>
<td>16:9</td>
<td>24P 30P 60P 60I</td>
<td></td>
</tr>
<tr>
<td>&quot;</td>
<td>4:3</td>
<td>&quot; &quot; &quot; &quot;</td>
<td></td>
</tr>
</tbody>
</table>
Table 8. Members of Americans for Digital TV

CICATS
Directors Guild of America
Media Access Project
International Photographers Guild
American Society of Cinematographers
Digital Theater Systems (DTS)
Todd-AO Corporation
Artists Rights Foundation
Panavision International
American Homeowners Foundation
Computing Technology Industry Association
Business Software Alliance

Notes

1. One of them was Joseph Flaherty of CBS.


5. Brinkley, p. 283.


15. Fifth Further Notice, paragraphs 6 and 7.

Daily Variety, October 20, 1995, p. 6, via Nexis-Lexis.


18. Ibid.


25. Ibid. At around the same time Apple Computer's representative in Washington, James Burger, was pressing his Microsoft counterpart, Jack Krumholtz, to get more involved in the DTV debate.


