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The History and Politics of DTV

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Chapter One: The History of DTV

From The Guide To Digital Television

Published by
United Entertainment Media
460 Park Avenue South, 9th Floor
New York, NY 10016
(212) 378-0449

For more information:
www.digitaltelevision.com

From concept to reality, the quest for a new viewing experience has reshaped the technical and regulatory landscape of broadcasting in North America, and indeed, around the world. Although HDTV production equipment had been available since 1984, standardization for broadcast service was slowed by lack of agreement on how the public could best be served. The primary consideration was whether to adopt a system compatible with NTSC or a simulcast system requiring additional transmission spectrum and equipment.

On November 17, 1987, at the request of 58 U.S. broadcasters, the FCC initiated a rulemaking on advanced television (ATV) services and established a blue ribbon Advisory Committee on Advanced Television Service (ACATS) for the purpose of recommending a broadcast standard. Former FCC Chairman Richard E. Wiley was appointed to chair ACATS. At that time, it was generally believed that HDTV could not be broadcast using 6 MHz terrestrial broadcasting channels. Broadcasting organizations were concerned that alternative media would be used to deliver HDTV to the viewing public, placing terrestrial broadcasters at a severe disadvantage. The FCC agreed that this was a subject of importance and initiated a proceeding (MM Docket No. 87-268) to consider the technical and public policy issues of ATV.

The first interim report of the ACATS, filed on June 16, 1988, was based primarily on the work of the Planning Subcommittee. The report noted that proposals to implement improvements in the existing NTSC television standard ranged from simply enhancing the current standard all the way to providing full-quality HDTV. The spectrum requirements for the proposals fell into three categories: 6 MHz, 9 MHz, and 12 MHz. Advocates of a 12 MHz approach suggested using two channels in one of two ways:

1) An existing NTSC-compatible channel supplemented by a 6 MHz augmentation channel (either contiguous or noncontiguous)

2) An existing NTSC-compatible channel, unchanged, and a separate 6 MHz channel containing an independent non-NTSC-compatible HDTV signal

It was pointed out that both of these methods would be “compatible” in the sense that existing TV receivers could continue to be serviced by an NTSC signal.

The first interim report stated that, “based on current bandwidth-compression techniques, it appears that full HDTV will require greater spectrum than 6 MHz.” The report went on to say that the Advisory Committee believed that efforts should focus on establishing, at least ultimately, an HDTV standard for terrestrial broadcasting. The report concluded that one advantage to simulcasting was that at some point in the future—after the NTSC standard and NTSC-equipped receivers were retired—part of the spectrum being utilized might be reemployed for other purposes. On the basis of preliminary engineering studies, the Advisory Committee stated that it believed sufficient spectrum capacity in the current television allocations table might be available to allow all existing stations to provide ATV through either an augmentation or simulcast approach.

The process begins

With this launch, the economic, political, and technical implications of HDTV caused a frenzy of activity in technical circles around the world; proponents came forward to offer their ideas. The Advanced Television Test Center (ATTC) was set up to consider the proposals and evaluate their practicality. In the first round of tests, 21 proposed methods of transmitting some form of ATV signals (from 15 different organizations) were considered. The ATTC work was difficult for a number of reasons, but primarily because the 21 systems were in various stages of readiness. Most, if not all, were undergoing continual refinement. Only a few systems existed as real, live black boxes, with “inputs” and “outputs”. Computer simulation made up the bulk of what was demonstrated in the first rounds. The ATTC efforts promised, incidentally, to be as

much a test of computer simulation as a test of hardware. Of the 21 initial proposals submitted to ACATS in September 1988, only six actually were completed in hardware and tested.

The race begun, engineering teams at various companies began assembling the elements of an ATV service. One of the first was the Advanced Compatible Television (ACTV) system, developed by the Sarnoff Research Center. On April 20, 1989, a short ACTV program segment was transmitted from the center, in New Jersey, to New York for broadcast over a WNBC-TV evening news program. The goal was to demonstrate the NTSC compatibility of ACTV. Consisting of two companion systems, the scheme was developed to comply with the FCC's tentative decision of September 1988, which required an HDTV broadcast standard to be compatible with NTSC receivers.

The basic signal, ACTV-I, was intended to provide a wide-screen picture with improved picture and sound quality on new HDTV receivers, while being compatible with NTSC receivers on a single 6 MHz channel. A second signal, ACTV-II, would provide full HDTV service on a second augmentation channel when such additional spectrum might be available.

In the second interim report of the ACATS (April 26, 1989), the committee suggested that its life be extended from November 1989 to November 1991. It also suggested that the FCC should be in a position to establish a single terrestrial ATV standard sometime in 1992. The Advisory Committee noted that work was ongoing in defining tests to be performed on proponent systems. An issue was raised relating to subjective tests and whether source material required for testing should be produced in only one format and transcoded into the formats used by different systems to be tested, or whether source material should be produced in all required formats. The Advisory Committee also sought guidance from the FCC on the minimum number of audio channels that an ATV system would be expected to provide.

The large number of system proponents, and delays in developing hardware, made it impossible to meet the aggressive timeline set for this process. It was assumed by experts at the time that consumers would be able to purchase HDTV, or at least advanced television, sets for home use by early 1992.

The FCC's tentative decision on compatibility, although not unexpected, laid a false set of ground rules for the early transmission system proponents. The requirement also raised the question of the availability of frequency spectrum to accommodate the added information of the ATV signal. Most if not all of the proposed ATV systems required total bandwidths of one, one and a half, or two standard TV channels (6 MHz, 9 MHz, or 12 MHz). In some cases, the added spectrum space that carried the ATV information beyond the basic 6 MHz did not have to be contiguous with the main channel.

Any additional use of the present VHF- and UHF-TV broadcast bands would have to take into account co-channel and adjacent-channel interference protection. At UHF, an additional important unanswered question was the effect of the UHF "taboo channels" on the availability of extra frequency space for ATV signals. These "taboos" were restrictions on the use of certain UHF channels because of the imperfect response of then-existing TV receivers to unwanted signals, such as those on image frequencies, or those caused by local oscillator radiation and front-end intermodulation.

The mobile radio industry had been a longtime combatant with broadcasters over the limited available spectrum. Land mobile had been asking for additional spectrum for years, saying it was needed for public safety and other worthwhile purposes. At that time, therefore, the chances of the FCC allocating additional spectrum to television broadcasters in the face of land mobile demands were not thought to be very good. Such was the case; the land mobile industry (and other groups) made a better case for the spectrum.

In any event, the FCC informally indicated that it intended to select a simulcast standard for HDTV broadcasting in the United States using existing television band spectrum and would not consider any augmentation-channel proposals.

System testing: Round 2

With new groundwork clearly laid by the FCC, the second round of serious system testing was ready to begin. Concurrent with the study of the various system proposals, the ACATS began in late 1990 to evaluate the means for transmission of seven proposed formats for the purpose of determining their suitability as the U.S. standard for VHF and UHF terrestrial broadcasting. The initial round of tests were scheduled for completion by September 30, 1992.

The FCC announced on March 21, 1990 that it favored a technical approach in which high-definition programs would be broadcast on existing 6 MHz VHF and UHF channels separate from the 6 MHz channels used for conventional (NTSC) program transmission, but the commission did not specifically address the expected bandwidth requirements for HDTV. However, the implication was that only a single channel would be allocated for transmission of an HDTV signal. It followed that this limitation to a 6 MHz channel would require the use of video-compression techniques. In addition, it was stated that no authorization would be given for any enhanced TV system, so as not to detract from development of full high-definition television. The spring of

1993 was suggested by the FCC as the time for a final decision on the selection of an HDTV broadcasting system.

Under the simulcast policy, broadcasters would be required to transmit NTSC simultaneously on one channel of the VHF and UHF spectra and the chosen HDTV standard on another 6 MHz TV broadcast channel. This approach was similar to that followed by the British in their introduction of color television, which required monochrome programming to continue on VHF for about 20 years after 625/50 PAL color broadcasting on UHF was introduced. Standards converters working between 625-line PAL color and 405-line monochrome provided the program input for the simultaneous black-and-white network transmitters. The British policy obviously benefited the owners of old monochrome receivers who did not wish to invest in new color receivers; it also permitted program production and receiver sales for the new standard to develop at a rate compatible with industry capabilities. All television transmission in Great Britain now is on UHF, with the VHF channels reassigned to other radio services.

For the development of HDTV, the obvious advantage of simulcasting to viewers with NTSC receivers is that they may continue to receive all television broadcasts in either the current 525-line standard or the new HDTV standard—albeit the latter without the benefit of wide-screen and double resolution—without having to purchase a dual-standard receiver or a new HDTV receiver. Although it was not defined by the FCC, it was presumed that the HDTV channels also would carry the programs available only in the NTSC standard. Ideally for the viewer, these programs would be converted to the HDTV transmission standard from the narrower 1.33 aspect ratio and at the lower resolution of the 525-line format. A less desirable solution would be to carry programs available only in the NTSC standard without conversion to HDTV and require HDTV receivers to be capable of switching automatically between standards. A third choice would be not to carry NTSC-only programs on the HDTV channel and to require HDTV receivers to be both HDTV/NTSC channel and format switchable.

The development of HDTV involved exhaustive study of how to improve the existing NTSC system. It also meant the application of new techniques and the refinement of many others, including:

• Receiver enhancements, such as higher horizontal and vertical resolution, digital processing, and implementation of large displays.

• Transmission enhancements, including new camera technologies, image enhancement, adaptive prefilter encoding, digital recording, and advanced signal distribution.

• Signal compression for direct satellite broadcasting. Relay of auxiliary signals within conventional TV channels. Allocation and optimization of transmission frequency assignments.

Concurrently, an extensive study was undertaken concerning the different characteristics of the major systems of program distribution: terrestrial broadcasting, cable distribution by wire or fiber optics, satellite broadcasting, and magnetic and optical recorders. The major purposes of this study were to determine how the wide video baseband of HDTV could be accommodated in each system, and whether a single HDTV standard could embrace the needs of all systems. This work not only provided many of the prerequisites of HDTV, but by advancing the state of the conventional art, it established a higher standard against which the HDTV industry must compete.

In the third interim report (March 21, 1990), the Advisory Committee approved the proposed test plans and agreed that complete systems, including audio, would be required for testing. It also was agreed that proposed systems must be precertified by June 1, 1990. That date, naturally, became quite significant to all proponents. The pace of work was accelerated even further.

It is noteworthy that the first all-digital proposal was submitted shortly before the June deadline. The third interim report also stated that psychophysical tests of ATV systems would be conducted and that the Planning Subcommittee, through its Working Party 3 (PS/ WP3), would undertake the development of preliminary ATV channel allotment plans and assignment options.

In the fourth interim report (April 1, 1991), the Advisory Committee noted changes in proponents and proposed systems. Most significant was that several all-digital systems had been proposed. Testing of proponent systems was scheduled to begin later that year. Changes had been required in the test procedures because of the introduction of the all-digital systems. It was reported also that the System Standards Working Party had defined a process for recommending an ATV system, and that PS/WP3 was working toward the goal of providing essentially all existing broadcasters with a simulcast channel whose coverage characteristics were equivalent to NTSC service.

By the time the fifth interim report was issued (March 24, 1992), there were five proponent systems, all simulcast—one analog and four all-digital. The Planning Subcommittee reported that it had reconstituted its Working Party 4 to study issues related to harmonizing an ATV broadcast transmission standard with other advanced imaging and transmission schemes that would be used in television and nonbroadcast applications. The Systems Subcommittee reported that its Working Party 2 had

developed procedures for field-testing an ATV system. It was noted that the intent of the Advisory Committee was to field-test only the system recommended to the FCC by the Advisory Committee based on the laboratory tests. It also was reported that the Systems Subcommittee Working Party 4 had developed a process for recommending an ATV system and had agreed to a list of 10 selection criteria.

Hundreds of companies and organizations worked together within the numerous sub-committees, working parties, advisory groups, and special panels of ACATS during the 8-year existence of the organization. The ACATS process became a model for international industry-government cooperation. Among its accomplishments was the development of a competitive process by which proponents of systems were required to build prototype hardware that would then be thoroughly tested. This process sparked innovation and entrepreneurial initiative.

Formation of the Grand Alliance

Although the FCC had said in the spring of 1990 that it would determine whether all-digital technology was feasible for a terrestrial HDTV transmission standard, most observers viewed that technology as being many years in the future. Later the same year, however, General Instrument became the first proponent to announce an all-digital system. Later, all-digital systems were announced by MIT, the Philips-Thomson-Sarnoff consortium, and Zenith-AT&T.

The FCC anticipated the need for interoperability of the HDTV standard with other media. Initially, the focus was on interoperability with cable television and satellite delivery; both were crucial to any broadcast standard. But the value of interoperability with computer and telecommunications applications became increasingly apparent with the advent of all-digital systems.

Proponents later incorporated packetized transmission, headers and descriptors, and composite-coded surround sound in their subsystems. (The Philips-Thomson-Sarnoff consortium was the first to do so.) These features maximized the interoperability of HDTV with computer and telecommunications systems. The introduction of all-digital systems had made such interoperability a reality.

The all-digital systems set the stage for another important step, which was taken in February 1992, when the ACATS recommended that the new standard include a flexible, adaptive data-allocation capability (and that the audio also be upgraded from stereo to surround sound). Following testing, the Advisory Committee decided in February 1993 to limit further consideration only to those proponents that had built all-digital systems: two systems proposed by General Instrument and MIT; one proposed by Zenith and AT&T; and one proposed by Sarnoff, Philips, and Thomson. The Advisory Committee further decided that although all of the digital systems provided impressive results, no single system could be proposed to the FCC as the U.S. HDTV standard at that time. The committee ordered a round of supplementary tests to evaluate improvements to the individual systems.

At its February 1993 meeting, the Advisory Committee also adopted a resolution encouraging the digital HDTV groups to try to find a way to merge the four remaining all-digital systems. The committee recognized the merits of being able to combine the best features of those systems into a single “best of the best” system. With this encouragement, negotiations between the parties heated up, and on May 24, the seven companies involved announced formation of the Digital HDTV Grand Alliance.

By the spring of 1994, significant progress had been made toward the final HDTV system proposal. Teams of engineers and researchers had finished building the subsystems that would be integrated into the complete HDTV prototype system for testing later in the year. The subsystems—scanning formats, digital video compression, packetized data, audio, and modulation—all had been approved by the ACATS. Key features and specifications for the system included:

Support of two fundamental arrays of pixels (picture elements): 1920 x 1080 and 1280 x 720. Each of these pixel formats supported a wide-screen 16:9 aspect ratio and square pixels, important for computer interoperability. Frame rates of 60, 30, and 24 Hz were supported, yielding a total of six different possible scanning formats—two different pixel arrays, each having three frame rates. The 60 and 30 Hz frame rates were important for video source material and 24 Hz for film. A key feature of the system was the Grand Alliance’s commitment to using progressive scanning, also widely used in computer displays. Entertainment television traditionally had used interlaced scanning, which was efficient but subject to various unwanted artifacts. Of the six video formats, progressive scanning was used in all three 720-line formats and in the 30 and 24 Hz 1080-line formats. The sixth video format was a 60 Hz 1080-line scheme. It was neither technically or economically feasible to initially provide this as a progressive format, although it was a longer-term goal for the Grand Alliance. The 1080-line, 60-Hz format was handled in the initial standard by using interlaced rather than progressive scanning.

Video compression: Utilizing the MPEG-2 (Moving Picture Experts Group)-proposed international standard allowed HDTV receivers to interoperate with MPEG-2 and MPEG-1 computer, multimedia, and other media applications. Packetized data transport: Also based on MPEG-2, this feature provided for the flexible transmission of virtually any combination of video, audio, and data.

THE GRAND ALLIANCE DIGITAL TELEVISION FORMATS	Horizontal Pixels Across Screen Width (Horizontal Resolution)	Viewable Scan Lines (Vertical Resolution)	Image Aspect Ratio	Picture Refresh Rates
High Definition Television (HDTV)-1080P/1080I	1920	1080	16:9	24/30Hz -Progressive 60Hz -Interlaced
High Definition Television (HDTV)-720P/720I	1280	720	16:9	24/30/60Hz -Progressive
525P/525I and Others	704	480	4:3-16:9	24/30/60Hz -Progressive 60Hz -Interlaced
Standard Definition Television (SDTV)	640	480	4:3	24/30/60Hz -Progressive 60Hz -Interlaced

Compact-disc-quality digital audio: This feature was provided in the form of the 5.1-channel Dolby AC-3 surround sound system.

8-VSB (8-level vestigial sideband): The modulation system selected for transmission provided maximum coverage area for terrestrial digital broadcasting.

The Grand Alliance format employed principles that made it a highly interoperable system. It was designed with a layered digital architecture that was compatible with the international Open Systems Interconnect (OSI) model of data communications that forms the basis of virtually all modern digital systems. This compatibility allowed the system to interface with other systems at any layer, and it permitted many different applications to make use of various layers of the HDTV architecture. Each individual layer of the system was designed to be interoperable with other systems at corresponding layers.

Because of the interoperability of the system between entertainment television and computer and telecommunications technologies, the Grand Alliance HDTV standard was expected to play a major role in the establishment of the national information infrastructure (NII). It was postulated that digital HDTV could be an engine that helped drive deployment of the NII by advancing the development of receivers with high-resolution displays and creating a high-data-rate path to the home for a multitude of entertainment, education, and information services.

Testing the Grand Alliance system

Field tests of the 8-VSB digital transmission subsystem began on April 11, 1994, under the auspices of the ACATS. The 8-VSB transmission scheme, developed by Zenith, had been selected for use in the Grand Alliance system two months earlier, following comparative laboratory tests at the ATTC. The field tests, held at a site near Charlotte, North Carolina, were conducted on channel 53 at a maximum effective radiated power of 500 kW (peak NTSC visual) and on channel 6 at an ERP of 10 kW (peak NTSC visual).

The tests, developed by the Working Party on System Testing, included measurements at approximately 200 receiving sites. Evaluations were based solely on a pseudorandom data signal as the input source; pictures and audio were not transmitted. The 8-VSB measurements included carrier-to-noise ratio (C/N), error rate, and margin tests, performed by adding noise to the received signal until an agreed-upon threshold of performance error rate occurred and noting the difference between the C/N and the C/N without added noise. Testing at the Charlotte facility lasted for about 3 months, under the direction of the Public Broadcasting System (PBS).

In 1995, extensive follow-up tests were conducted, including:
• Laboratory tests at the Advanced Television Test Center in Alexandria, Virginia
• Lab tests at Cable Television Laboratories, Inc. (CableLabs) of Boulder, Colorado
• Subjective viewer testing at the Advanced Television Evaluation Laboratory in Ottawa, Canada
• Continued field testing in Charlotte, North Carolina, by PBS, the Association for Maximum Service Television (MSTV), and CableLabs

The laboratory and field tests evaluated the Grand Alliance system's four principal subsystems: scanning formats, video and audio compression, transport, and transmission. Test results showed that:
• Each of the proposed HDTV scanning formats exceeded targets established for static and dynamic luminance and chrominance resolution.
• Video-compression testing, using 26 different HDTV sequences, showed that the Grand Alliance MPEG-2

compression algorithm was “clearly superior” to the four original ATV systems in both the 1080 interlaced- and 720 progressive-scanning modes. Significantly, the testing also showed little or no deterioration of the image quality while transmitting 3 Mbits/s of ancillary data.

The 5.1-channel digital surround sound audio subsystem of the Grand Alliance system, known as Dolby AC-3, performed better than specifications in multichannel audio testing and met the expectations in long-form entertainment listening tests.

The packetized data transport subsystem performed well when tested to evaluate the switching between compressed data streams, robustness of headers and descriptors, and interoperability between the compression and transport layers. Additional testing also demonstrated the feasibility of carrying the ATV transport stream on an asynchronous transfer mode (ATM) telecommunications network.

Field and laboratory testing of the 8-VSB digital transmission subsystem reinforced test results achieved in the summer of 1994 in Charlotte. Testing for spectrum utilization and transmission robustness again proved that the Grand Alliance system would provide broadcasters significantly better transmission performance than the current analog transmission system, ensuring HDTV service “in many instances where NTSC service is unacceptable.” Extensive testing on cable systems and fiber optic links of the 16-VSB subsystem also showed superior results.

The final technical report, approved on November 28, 1995, by the Advisory Committee, concluded that—based on intensive laboratory and field testing—the Grand Alliance digital television system was superior to any known alternative system in the world, better than any of the four original digital HDTV systems, and had surpassed the performance objectives of the ACATS.

Marking one of the last steps in an 8-year process to establish a U.S. ATV broadcasting standard, the 25-member blue-ribbon ACATS panel recommended the new standard to the FCC on November 28, 1995. Richard E. Wiley, ACATS chairman commented, “This is a landmark day for many communications industries and, especially, for American television viewers.”

The home stretch for the Grand Alliance

With the technical aspects of the Grand Alliance HDTV system firmly in place, work proceeded to step through the necessary regulatory issues. Primary among these efforts was the establishment of a table of DTV assignments, a task that brought with it a number of significant concerns on the part of television broadcasters. Questions raised at the time involved whether a station’s DTV signal should be equivalent to its present NTSC signal, and if so, how this should be accomplished.

Approval of the DTV standard by the FCC was a 3-step process:
1) A notice of proposed rulemaking (NPRM) on policy matters, issued on August 9, 1995.
2) Official acceptance of the Grand Alliance system. On May 9, 1996, the commission voted to propose that a single digital TV standard be mandated for over-the-air terrestrial broadcast of digital television. The standard chosen was that documented under the auspices of the Advanced Television Systems Committee (ATSC).
3) Final acceptance of a table of assignments for DTV service.

During the comment period for the NPRM on Advanced Television Service (MM Docket 87-268), a number of points of view were expressed. Some of the more troublesome—from the standpoint of timely approval of the Grand Alliance standard, at least—came from the computer industry. Among the points raised were:
• Interlaced scanning. Some computer interests wanted to ban the 1920 x 1080 interlaced format.
• Square pixels. Computer interests recommended banning the use of formats that did not incorporate square pixels.
• 60 Hz frame rate. Computer interests recommended a frame rate of 72 Hz and banning of 60 Hz.
Meanwhile, certain interests in the motion picture industry rejected the 16:9 (1.78:1) wide-screen aspect ratio in favor of a 2:1 aspect ratio.

One by one, these objections were dealt with. Negotiations between the two primary groups in this battle—broadcasters and the computer industry—resulted in a compromise that urged the FCC to adopt a standard that does not specify a single video format for digital television, but instead lets the various industries and companies choose formats they think will best suit consumers. The lack of a mandated video format set the stage for a lively competition between set makers and personal computer (PC) manufacturers, who were expected to woo consumers by combining sharp pictures with features peculiar to computers.

By early December, a more-or-less unified front had again been forged, clearing the way for final action by the FCC. With approval in hand, broadcasters then faced the demands of the commission’s timetable for implementation, which included the following key points:

By late 1998, 26 TV stations in the country’s largest cities—representing about 30 percent of U.S. television households—would begin broadcasting the Grand Alliance DTV system.

By mid-1999, the initial group would expand to 40; by

2000, it would expand to 120 stations.

By 2006, every TV station in the country would be broadcasting a digital signal or risk losing its FCC license.

Fierce debates about the wisdom of this plan—and whether such a plan even could be accomplished—then ensued.

Digital broadcasting began in the U.S. on October 29, 1998, with live coverage in HDTV of the launch of Space Shuttle STS-95, which took John Glenn back into space.

Digital broadcasting begins

If HDTV truly was going to be the "next big thing," then it was only fitting to launch it with a bang. The ATSC system received just such a sendoff, playing to excited audiences from coast to coast during the launch of Space Shuttle mission STS-95.

The first nationwide broadcast of a high-definition television program using the ATSC DTV system, complete with promos and commercials, aired on October 29, 1998. The live HDTV broadcast of Senator John Glenn's historic return to space was transmitted by ABC, CBS, Fox, NBC, and PBS affiliates from coast to coast.

The feed was available free for any broadcaster who could receive the signal. The affiliates and other providers transmitted the broadcast to viewing sites in Washington, D.C., New York, Atlanta, Chicago, Los Angeles, and 15 other cities. Audiences in those cities watched the launch on new digital receivers and projectors during special events at museums, retail stores, broadcast stations, and other locations. Many of the stations moved their on-air dates ahead of schedule in order to show the Glenn launch broadcast. The largest scheduled viewing site was the Smithsonian's National Air and Space Museum in Washington, D.C., where viewers watched the launch on an IMAX theatre screen and four new digital receivers.

Beyond the technical details was an even more important story insofar as HDTV production is concerned. All of the cameras used in the coverage provided an HD signal except for one NASApool feed of the launch control center at the Kennedy Space Center, which was upconverted NTSC. On occasion, the director would switch to the launch center feed, providing a dramatic "A/B" comparison of high-definition versus standard-definition. The difference was startling. It easily convinced the industry observers present at the Air and Space Museum of the compelling power of the HDTV image.

The second production issue to come into focus during the broadcast was the editorial value of the wide aspect ratio of HDTV. At one point in the coverage, the program anchor described to the television audience how the Shuttle was fueled the night before. In describing the process, the camera pulled back from the launch pad shot to reveal a fuel storage tank off to one side of the pad. As the reporter continued to explain the procedure, the camera continued to pull back to reveal a second fuel storage tank on the other side of the launch pad. Thanks in no small part to the increased resolution of HDTV and—of course—the 16:9 aspect ratio, the television audience was able to see the entire launch area in a single image. Such a shot would have been wholly impossible with standard-definition imaging.

The STS-95 mission marked a milestone in space, and a milestone in television.

Continuing work on the ATSC standard

The creation by the Advanced Television Systems Committee of the DTV standard in 1995, and the FCC's subsequent adoption of the major elements of the standard into the FCC Rules in 1996, represented landmark achievements in the history of broadcast television. While these events represented the culmination of the ATSC's work in one sense, they also marked the beginning of a whole new effort to take the DTV standard as developed and turn it into a functioning, and profitable, system that would be embraced by both industry and consumers alike. To that end, the ATSC organized and continues to support the work of three separate technical standards-setting groups, each focusing on a different aspect of DTV deployment. These groups are:

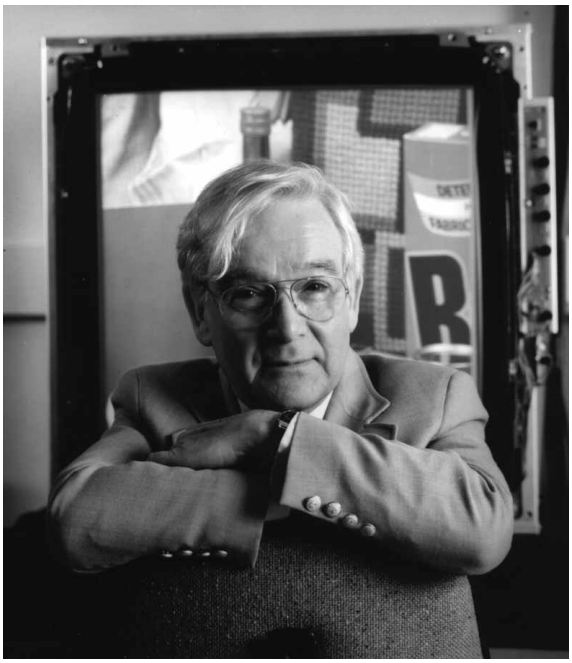
The Technology Group on Distribution (T3), which has as its mission the development and recommendation of voluntary, international technical standards for the distribution of television programs to the public using advanced imaging technology.

Technology Group on Production (T4), established to develop and recommend voluntary, international technical standards for the production of television programs using advanced television technology, encompassing sound, vision, and display sub-systems used for the production of television programming.

DTV Implementation Subcommittee (IS), established to investigate and report on the requirements for implementation of advanced television. The subcommittee evaluates technical requirements, operational impacts, preferred operating methods, time frames, and cost impacts of implementation issues.

The ATSC is composed of more than 160 member corporations, industry associations, standards bodies, research laboratories, and educational institutions. It is an international group whose charter is to develop voluntary standards for the entire range of advanced television

William F. Schreiber was director of the Advanced Television Research Program at the Massachusetts Institute of Technology from 1983 until his retirement in 1990. From 1985 to 1989 this program was part of the Media Lab, MIT's prestigious think tank for future media applications. Dr. Schreiber received the BS and MS in electrical engineering at Columbia and the PhD in applied physics at Harvard University. He worked at Sylvania from 1947 to 1949 and at Technicolor Corporation in Hollywood from 1953 to 1959.



His major professional interest has been image processing applications. He is a member of the National Academy of Engineering and has received the Honors Award from THE Technical Association of Graphic Arts, the David Sarnoff Gold Metal from SMPTE, the gold metal of the International Society for Optical Engineering, and is a four-times recipient of the Journal Award of the SMPTE. Dr. Schreiber has authored over 70 technical papers and holds over 30 patents in the image processing field.

On September, 16, 1997, Contributing Editor Thomas E. Young met with William F. Schreiber in his Cambridge, Massachusetts office to discuss digital television, the Grand Alliance and the future of advanced television broadcasting.

TEY: Dr. Schreiber could you give us a little background concerning MIT and the Advanced Television Research Group that you headed?

WFS: Advanced television as an academic enterprise at MIT began in 1982, although we had been working on many kinds of advanced imaging systems long before that. We were approached by a group of media companies who were looking at the future of television and television broadcasting. Originally the group consisted of nine companies: ABC, NBC, CBS, PBS, HBO, RCA, AMPEX, 3M and HARRIS, but later on KODAK and ZENITH joined in. The reason these various organizations wanted to participate in this program was that many were undergoing severe R&D budget cutbacks and were having a hard time evaluating the new formats and production equipment appearing from Europe and the Far East. They needed a center where they could send people to learn about advanced television systems and make critical technology decisions without having to do it in-house. Training graduate students in the field was also an important, and very successful, part of the program.

TEY: I assume one of the things that precipitated this action by the broadcasters and manufacturers you mentioned was the appearance of the Japanese NHK 1125 line, HDTV system.

WFS: Absolutely. In the early 80s, the NHK system was already being promoted by a number of high-visibility industry people as the new HDTV standard. However, no one really knew if this format was the best avenue to follow, particularly since it had been designed for satellite transmission. In order to assess this, my group looked carefully at it in its original uncoded format, later referred to as the "Studio System": and in the MUSE format, which was intended for broadcast in standard satellite channels. Later we looked at the Narrow MUSE format, which is a bandwidth-reduced format that allows the full 30 megahertz of base bandwidth to be squeezed into a 6-Mhz terrestrial channel.

Our conclusion was simple: it was a poor choice for a future standard because it used the frequency spectrum inefficiently, and it was no more resistant to channel distortions than the existing NTSC format. Channel distortions are things like RFI/EMI, co-channel interference, ghosting and all those things that occur as a television signal gets to your house. These are the things that still reduce the quality of NTSC broadcasts today. An additional problem was that the American television

industry in those days was leaning toward full backward compatibility with the existing television receiver base.

TEY: Since the NHK system didn't pass muster, did MIT suggest another format?

WFS: Yes we did. My group proposed a hybrid analog/digital incompatible format that made use of simulcasting during the transition phase. It was much more resistant to channel impairments. Later, after I retired, I worked on a layered system in which the image resolution depended on the receiver signal to noise ratio. Most of our sponsors disliked the noncompatible hybrid system since they were still pushing compatibility, but eventually Zenith accepted the idea and proposed a similar system of their own. The FCC finally adopted the idea that the new HDTV system was to be totally independent of NTSC broadcasts and the industy reluctantly accepted this decision

TEY: Could you tell us about your hybrid, layered system?

WFS: Our layered system addressed several very important aspects of advanced television broadcasting.

First, we configured the system to have three layers of resolution. The first layer would be a standard definition signal, the second a medium one, and the last a high definition signal. Receivers that utilized that first layer only would be considerably less expensive than those that used two or three layers, and would operate at a lower signal-to-noise ratio giving a larger coverage area. High-end receivers that are far from the transmitter would need better antennas to get the highest quality images. This type of capability is currently not a feature of the Grand Alliance system as selected by the FCC. The FCC has chosen to allow the broadcasters to transmit whatever resolution signal they would like. A HDTV signal does not does not have to be part of it.

The matter of cost is also very important. It is a bad idea to consider any mass technology or format that people can't afford or don't want. Russ Neuman, my colleague, who ran our Audience Research Facility, quantified this in respect to HDTV. The results of this may surprise you. We ran several hundred people through a study that demonstrated studio-quality NTSC television and HDTV television. Some thought "the sharper television" was great, but the clincher comes when we asked them what it was worth, as compared with the quality they were getting at home. 37% said they would not pay anything extra for it, 57% said they would pay $100 more for it, and only 6% said would pay an additional $500 for it. The conclusion is obvious. If you make an HDTV delivery system that costs consumers more than a few hundred dollars to use, you're going to have very few buyers. To get HDTV, or DTV, as is now being emphasized, jump started quickly, there must be inexpensive receivers available.

TEY: This sounds like it could be a problem. The current Grand Alliance DTV standard requires a digital bitstream at 19.3 megabits per second with MPEG-2 compression and Dolby AC-3 sound. This is a pretty heavy computational load and the chip sets to do this are not cheap.

WFS: Precisely. And by contrast, present day NTSC receivers are very cheap. If you analyze how much the electronics cost in present day television receivers you come up with a figure of just a few dollars. The bulk of the money that manufacturers spend to build television receivers goes into the box and the picture tube. This is especially true in the home theater market with respect to rear screen receivers where the box is a really large affair and three separate picture tubes are used to create the image. Now keeping in mind that the market penetration of a technology is a direct function of affordability, we have a dilemma. It is very clear, at least to me, that DTV receivers and set top NTSC-to-DTV converters must be affordable, very affordable, or else they are going to have trouble getting beyond a niche market. The cheapest receiver made to the Grand Alliance specifications will have to have a full HDTV decoder, even the 9-inch set in the kitchen. In addition, it will have to be able to deal with 18 different scanning formats. This comes about partly because the parties to the Grand Alliance were not very enthusiastic about coming together. In the end, no one was willing to give up his favorite format, so they were all included. All of this will raise costs, and is bound to limit the market.

TEY: In your proposal for an advanced television system you advocated simulcasting, the broadcasting of identical program material on the existing system and the new incompatible one. It appears that in the most recent Report and Order from the FCC that this has strategy has been discarded.

WFS: Simulcasting as a means of introducing new television formats has a very successful history. In Germany and Italy, when the PAL color format was introduced in 1965, the old B&W signals were compatible, so a transition strategy was unnecessary. However, at the same time, when PAL was introduced in England, and SECAM in France, the existing B&W signals in those respective countries were not compatible. England was transmitting WITH a 405 line system and France actually had a B&W "HDTV" system with 819 lines. What both of these countries did to ease the transition was TO simulcast ON both the old B&W standard and the new color standard until 1985 -- a period of twenty years. At the end of that time, the old B&W transmitters were turned off and hardly anyone fussed. What's relevant about this historical precedent is the period of simulcasting -- 20 years. Currently the FCC has set a time table of 2006 for the NTSC stations to be shut off. This is crazy! There are

Interlaced Scanning Systems Display 1/2 the image in Each Field

NTSC Field A
(every 1/60th second)

NTSC Field B
(every 1/60th second)

over 200 million NTSC sets and countless VCRs and camcorders currently in use, not to mention all those NTSC videotapes. The proposed time for the transition is much too short. Neither advertisers nor congress will allow that to happen. What the FCC has done is to permit any format at all to be used and what it has not done is to require any simulcasting at all. I cannot understand what they were thinking! I would expect that you will see plenty of legislative action concerning this timetable in the coming years.

TEY: Many of our readers understand that interlaced scanning was a concept developed to ease bandwidth requirements when the present television format was developed in the early 40s. The only reason that we use it today is because NTSC uses the same basic raster scanning format. However, as antiquated as it seems, it appears that interlaced scanning still has advocates, and some of the broadcasters may actually use it in the new DTV signals.

WFS: Lets be perfectly clear about this. Interlaced scanning is a really dumb thing to consider in any new video signal format. Interlaced scanning was not even a good idea when the US B&W standard was defined in 1941! As your readers are probably aware, interlaced scanning can generate very bad artifacts in a video image, things like 30 hertz interline flicker, motion errors, and reduced vertical resolution. This is why computer monitors are not interlaced -- the interline flicker would be unbearable. The reason why there are still proponents of interlacing escapes me, especially when considered in the context of digital broadcasting. Progressive scanning is simply more "digital friendly" than interlaced. When digitally coded, a progressive signal requires no higher data rate than an interlaced signal that has half the bandwidth. I have a hunch that the continued advocacy of interlaced equipment originates from foreign-owned consumer electronics companies that are trying to get back the substantial investments they foolishly made in this obsolete technology!

TEY: One of the philosophies concerning HDTV that has gotten a lot of press is "extensibity" or the capability of a signal to be upgraded over time. How important is this concept, and does the current version of DTV allow it?

WFS: This concept originated here at MIT, but the FCC also adopted this viewpoint, at least verbally, when they called for "nondisruptive improvement over time". That was also one of the important goals of the system we designed at MIT. You see, the B&W portion of our current television signal was formulated in the early 40s and color was added on a subcarrier in the 50s. In that sense, the

Progressive Scanning Systems Display the Entire image in Each Field

S2SF FRAME
(every 1/60th second)

S2SF FRAME
(every 1/60th second)

NTSC system could be improved in a manner that was compatible with existing receivers. The system works well enough but there were compromises made in color quality and spatial resolution. Our philosophy, and that of the FCC up to December 1996, when its Fourth Order and Report was issued, is that any new format should be designed for easy improvement without making the early digital receivers obsolete. Unfortunately, the DTV system as outlined by the FCC is not extensible at all. This is too bad, TV standards last a long time. Any new system should allow for continuous, nondisruptive improvement.

TEY: Many of our readers have seen the table of resolutions that the Grand Alliance presented to the FCC prior to the Fourth Order and Report. This table, which spelled out a multiplicity of resolutions, has been scrapped by the FCC. How do you feel about that?

WFS: I wrote Reed Hunt about this concept, and distributed a memo on the internet. I think it was not a good idea. When he visited MIT he was hinting about "letting the market decide" as to what resolutions should be included in the system. A private meeting was held between the television and computer companies, and their "compromise" was to eliminate the table. The FCC adopted this recommendation without change in it's Fourth Order and Report. The belief that the free market can set good Television standards is equivalent to believing in black magic. It's an irrational, emotional idea that has no basis in fact. In this case, the market could work only if purchasers could see the products side by side with the program choices that would go with each standard, as in the case of VHS and Beta. For better or for worse, the market decided on the winner in that contest, mostly on the basis of program availability. This side-by-side comparison is not practical in entire television systems. In HDTV or DTV, this decision will not be made by consumers; it's going to be made by network executives who are looking out for the interest of their companies and not for the interest of the public. By law, that was supposed to be the job of the FCC, which did not carry it out.

TEY: Unfortunately, we have painted a somewhat confused picture of DTV, but that won't surprise many of our readers. We've all been watching the fits and starts of DTV/HDTV over the years and many of us have taken a "believe it when I see it" attitude.

WFS: Well, yes. The tortured history of DTV illustrates a very unfortunate situation. I believe it transcends the realm of pure technology issues. It illustrates the difficulty we have as a nation in making rational decisions, even on technical matters, matters that do not arouse passions as we might expect in such issues as healthcare, the budget, and abortion. ironically, our nation has machinery in place comprised of elected and appointed officials who are supposed to make decisions in the public interest. In my opinion, the machinery doesn't work and therefore needs an overhaul. I believe that the FCC in its Fourth Order and Report, has failed to carry out its responsibility to protect the public interest. However, if there is wisdom to be gleaned from this situation, it is this: Tell your readers not to waste much time worrying about NTSC disappearing in the near future. We still don't know what form the new digital television standards will take. With NTSC coming into the home from DSS satellites and being played back from DVDs in studio-quality digital forms, high quality video is available right now. Anyone who is looking to purchase a new television should go out and buy one. This is what I tell my friends when they ask.

FROM: Behind The Scenes Of The Grand Alliance
-A conversation with MIT's William F. Schreiber
HOME THEATER MAGAZINE

Chapter Two: The Politics of DTV

WSJ.com THE WALL STREET JOURNAL.

CAN THE FCC FIX THE TRANSITION TO DIGITAL TELEVISION? STAY TUNED

By JON HART and JIM BURGER

Special to WSJ.COM, January 10, 2001

The grand plan to transition the U.S. to digital television is hampered by a set of stubborn interlocking chicken-and-egg problems. On Thursday, the FCC will attempt to bring some clarity to this murky picture. For now, nobody is happy.

Manufacturers aren't happy with their low sales of high-definition TVs. With so few high-definition TV sets out there, broadcasters aren't eager to go to the expense of airing high-definition TV programming. Consumers aren't buying the expensive sets because broadcasters aren't airing much programming for them. And without significant consumer demand, the price of high-definition TV sets won't come down.

On top of all this, providers of next-generation wireless services aren't happy -- because they want the spectrum that the broadcasters are to relinquish as they complete the transition to digital TV. But the government won't get that analog spectrum back until the transition is nearly complete. (If things weren't already complicated enough, the FCC plans to auction off most of that spectrum by 2002, even though it won't be returned until the end of 2006 or, perhaps, later.)

Taxpayers aren't happy because the government can't raise the $30 billion to $70 billion that auctions are expected to yield unless the wireless industry believes the government will be getting the analog spectrum back from broadcasters in the reasonably foreseeable future. And Congress is unhappy because it's counting on those billions in its long-term budget projections.

The Back Story

First a refresher. The analog-TV system currently in place in the U.S. is based on a not-so-sophisticated compression technique called "interlace" that was patented in 1932 and is used in analog-TV systems throughout the world. The technique is "not-so-sophisticated" because it compresses TV pictures to permit transmission but never restores the pictures to their original resolution. The TV camera captures an image, consisting of 480 horizontal lines, every 1/60th of a second. But the chunk of broadcast spectrum allocated to each analog-TV channel isn't wide enough to transmit the full 480-line image 60 times a second, so the signal is compressed by discarding half the lines. The resulting image, not surprisingly, is noticeably less crisp than what you'd get if all 480 lines were transmitted.

To get a sense of the resolution that's lost when half the lines that make up the image are dropped, compare the image you get on your interlace TV to the crisper image you get on your personal-computer monitor. The imaging system used on your computer monitor, called "progressive," displays all the lines that make up the image.

Now some history. In the early 1980s, TV-set manufacturers launched the first high-definition TV system in Japan. That system was an analog one that used interlace compression but added more lines of resolution to obtain crisper pictures. The sets made to receive these enhanced signals were big and very expensive. Though the sets displayed better pictures than standard analog sets, size and price discouraged consumers; in 14 years only 350,000 sets were sold.

In 1986 U.S. broadcasters, concerned because the FCC was about to give away spectrum in the TV band to fire, police and rescue services, invited the Japanese to demonstrate high-definition TV to Congress. As a result, the Federal Communications Commission established the Advisory Committee on Advanced Television Services, or ACATS, to recommend an American high-definition TV system. The FCC also deferred dedicating to emergency services any of the TV spectrum that might be needed to implement such a system.

For eight years ACATS discussed, debated and negotiated. It wrestled with whether the new American high-definition TV system should be analog or digital. A digital system has the advantages of crystal-clear pictures and allowing multiple standard-definition programs (programs with the resolution we get with the existing

analog system) to be transmitted on each channel that under an analog system could carry only one signal. And it wrestled with various TV-standards issues, such as how the picture would be compressed, how it would be displayed (video formats) and how it would be transmitted. Ultimately, ACATS recommended a digital system. But for a number of reasons, some political, it didn't endorse a single video format. Rather, it recommended 14 different formats, including two different high-definition formats -- 1080 lines interlace (referred to as "1080i") and 720 lines progressive (referred to as "720p") -- and two standard-definition TV formats -- 480 lines interlace (the existing format, referred to as "480i") and 480 lines progressive (referred to as "480p"). In addition, each format had variations, such as the current 4-by-3 picture-aspect ratio (width by height) and a new 16-by-9 widescreen picture. An alliance of TV manufacturers and industry suppliers, however, selected one high-definition format to promote to the public -- 1080i. That format is advertised as "HDTV."

The FCC adopted the ACATS recommendation on how to implement a digital system, but it declined to specify a single video format. Instead, it punted, concluding that the marketplace should decide. The FCC granted each television broadcaster access to a second channel to use throughout the transition to digital TV, so that it could continue to broadcast analog signals on one channel while broadcasting the new digital signals on another. The FCC also established a timetable based on market size and type of broadcaster for inauguration of digital-TV service, and declared that U.S. analog-TV broadcasting would cease by the end of 2006, at which point one of the two channels used by broadcasters during the transition would be returned to the government.

Of course, ending analog-TV broadcasting won't be so easy. As of 1998, the last year for which we have accurate figures, there were 250 million analog-TV sets in the U.S., plus an additional 150 million analog receivers in VCRs. That's about $50 billion worth of equipment that will be essentially useless when the plug is pulled on analog-TV broadcasting.

Understandably, Congress couldn't stay out of the politically sensitive decision to shut down analog TV. It passed a law in 1997 easing the 2006 transition deadline. Under the law, a TV station will be permitted to continue analog broadcasting beyond 2006 (and to retain the extra channel it received from the FCC for the transition) if less than 85% of the households in its market have at least one of the following: (1) digital TV delivered by cable or satellite, (2) a digital-TV set or (3) a box that converts digital-TV signals for viewing on an analog set. But this may not be the end of it. Even if penetration reaches 85%, it may be politically impossible for the government to require broadcasters to cease analog broadcasting and return the transition channel.

Imagine it is 2006. Los Angeles just meets the 85% hurdle. If analog-TV broadcasting is shut off, 15% of the households will receive no TV service since their analog sets will no longer work. This means that roughly 1.5 million people won't be able to watch over-the-air TV. In addition, households with cable or satellite TV have, on average, two unconnected TV sets. So an additional 16.8 million TV sets in Los Angeles would be rendered useless. Not a pretty picture.

Slow Sales

Manufacturers have been selling HDTV receivers in the U.S. since August 1998, but have managed to sell only 60,000 units to date. At that rate, HDTV sales will contribute little to meeting the 2006 deadline. (By contrast, in the first 51 weeks of 2000, they sold more than 29.8 million analog color TVs.) Back to the chicken-and-egg problem. The manufacturers complain that little HDTV content is being broadcast (some of which they have to subsidize). Though 173 stations are now capable of airing HDTV programming, only CBS, among the major commercial networks, regularly broadcasts HDTV programming during prime time. HDTV sets are large -- 34 inches to 54 inches -- and the improvement in resolution isn't nearly so dramatic on smaller sets. And they are very expensive: $2,000 to $10,000, not including the set-top box required to receive HDTV signals (add another $750 to $1,000) and, perhaps, a roof-top antenna capable of being rotated to allow reception.

Programmers aren't eager to invest in the new equipment needed to create HDTV programming since few households can view HDTV broadcasts. And early experience suggests that digital-TV signals are more difficult to receive than analog signals, particularly in dense urban areas. (Major TV broadcasters have been conducting a study comparing the U.S. DTV transmission system with the European system and should have results soon.) Moreover, broadcasters in some cities are having trouble finding sites for the new towers they need to transmit HDTV signals. (Washington, D.C., recently halted construction of the huge tower being built by WDCA, the local UPN affiliate.) For their part, cable operators are reluctant to devote valuable channel positions to HDTV signals that duplicate the analog signals of local broadcast stations they're already carrying. The FCCcurrently has before it the contentious question of whether to force cable operators to carry DTV signals before 2006, which broadcasters claim will speed up transition. The DTV cable carriage issue and other issues relating to the DTV transition are scheduled to be considered by the FCC at its Agenda Meeting Thursday, Jan. 11. In this post-election climate, with a new FCC chairman soon to be named, it is far from clear how much actually will be decided at the meeting.

Meanwhile, consumers are reluctant to spend lots of

money on HDTV sets. There are good analog sets available for well under $500, there's precious little HDTV programming available and there's still a possibility that standards will be changed, rendering any equipment they buy obsolete.

(Indeed, some high-end customers have been buying "HDTV-ready" sets not for TV, but rather to get better resolution on their DVD movies.)

Is there a fix? In a recent speech FCC Chairman William Kennard suggested several. He would have Congress reconsider the 85% "loophole" allowing broadcasters to hold onto the analog channel after 2006, tax broadcasters that fail to return the transition channel in 2006 and require TV makers to include DTV converters in all new analog sets.

The first two appear impractical. If Congress reconsiders the so-called loophole it might just get bigger, allowing the transition to digital TV to drag on even longer. (Think of the political pressure that could result from the Los Angeles example.) And Congress won't likely tax any broadcaster that has complied with the FCC timetable for launching DTV, even if it hasn't returned the transition channel by 2006. Mandatory converter capability is probably the most practical. Not surprisingly, set manufacturers are unhappy with this proposal. They say analog-TV prices will increase by hundreds of dollars. But, with roughly 30 million sets being sold each year in the U.S., the cost of adding a DTV receiver to each one should drop quickly.

Unfortunately, if the transmission tests now under way show that digital-TV signals can't be received with a standard indoor antenna, then requiring that every TV come with a digital converter won't be sufficient to ensure that digital TV reaches 85% of all U.S. households. Some 23% of households don't subscribe to cable or satellite TV and must be able to receive digital signals over the air. (And the average household with cable or satellite service has two TVs that aren't connected and receive only over-the-air signals.) If the transmission tests prompt broadcasters to recommend changing the transmission system to facilitate reception, the FCC will have to listen carefully.

How can sales of digital-TV sets be stimulated? First, there is likely to be little growth in market penetration until set prices are $500 or lower for 27-inch models. The rapid adoption of DVDs and consumer reaction to 480p images suggests that it may be possible to sell more affordable 480p DTV sets in large quantities and drive prices under $500 sooner rather than later. If shows were to be broadcast in DVD-quality 480p -- so far only the Fox Network has shown a serious interest in this format -- sales of less-expensive 480p digital-TV sets would be further boosted. In theory, at least, it may be possible to get digital TV into the vast majority of U.S. households by 2006: if all new analog TVs come with digital converters, if manufacturers produce inexpensive digital converters that allow consumers to watch digital programming on their old analog TVs, if the prices of digital TVs drop dramatically as sales increase, if cable and satellite services cooperate with broadcasters and programmers to get more digital programming into homes. But that's a lot of ifs.

Though the world certainly won't come to an end if average Americans can't get crisper pictures on their TVs for a few more years, there's a lot riding on a prompt and successful transition to a digital system. In balancing the budget in 1997, Congress counted on the money the government would get from auctioning off, presumably to the wireless industry, the second channel being used by each broadcaster throughout the transition. Wireless-services providers are very eager to get their hands on this prime spectrum. And consumers are eager to get the services that the wireless providers want to provide using this spectrum. But the spectrum won't be available until the transition to digital TV is complete in a given broadcast market.

That hasn't stopped the FCC, at the instruction of Congress, from proceeding with the auctions, which begin this spring. Now imagine the wireless provider poised to bid. It knows that this is prime spectrum, the best it's ever likely to see. But it doesn't know whether the spectrum will be available in 2006, as originally scheduled, or years later, and it needs additional spectrum soon. And if the company's the successful bidder, it will have to pay for this spectrum within months, even though it won't have access to it for a period the duration of which it can't predict.

This uncertainty about when the spectrum slated for auction will be available, coupled with the requirement that it be paid for immediately, will almost certainly cause it to be sold at a significant discount to its true value. Congress, in its haste to balance the budget with money it didn't have, may wind up having given away tens of billions of dollars that might have been collected if wireless-industry bidders could have been more certain about when they'd get what they were buying. Can Congress and the FCC orchestrate a prompt and predictable transition to digital TV (and get taxpayers top dollar for a valuable public resource), or is it already too late to unscramble this egg? Stay tuned.

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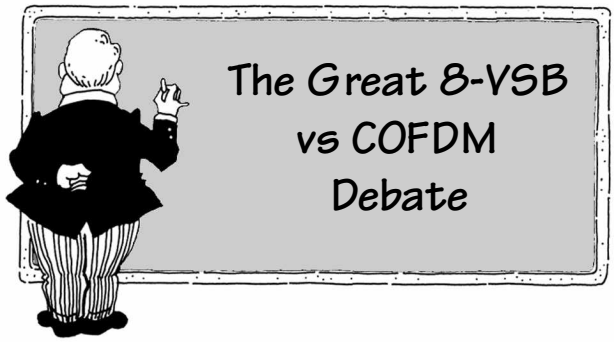


From: The RF Current Newsletter
June 24, 2000 by Doug Lung
dlung@transmitter.com

Sinclair Broadcast Group, as expected, came out against the mandatory 8-VSB standard and urged the FCC to allow U.S. broadcasters to operate using the COFDM-based DVB-T standard, saying, "The ATSC version of 8-VSB is a broken technology that is causing the failure of the DTV transition, and the Commission should abandon its exclusive reliance on this standard." It noted that while CEA said approximately 34,000 DTV receivers capable of receiving 8-VSB signals have been sold in the U.S, the majority of these were likely purchased by consumer electornics distributors and retailers rather than consumers themselves. Sinclair commented:

"While CEAand other proponents of the status quo claim that this minimal DTV development is a result of a shortage of DTV content, neither the Comission nor the public should be fooled, the fundamental reason for the current failure of the DTV transition is the inability of ATSC 8-VSB broadcasters to overcome complex multipath conditions and provide eae of reception and ubiquitous, reliable over-the-air service to viewers using simple, consumer-grade antennas in broadcasters' core business areas.

"Sinclair's own ATSC 8-VSB field trials in Baltimore in the spring and summer of 1999 demonstrated the existence of this fundamental flaw in ATSC 8-VSB reception, and Sinclair's finding have since been confirmed by NBC and others. Indeed, it appears that the ATSC 8-VSB DTV standard does not offer the minimum set of capabilities that should be provided by a DTV system in any country. In addition, given ATSC 8-VSB's forever-frozen data rate of 19.39 Mbps and the absence of hierarchical modulation capability, it appears that 8-VSB for the foreseeable future will not permit the provision of the portable video services that are available today in the NTSC environment." Sinclair rejected promises that new receiver chips would solve the problem: "Neither NxtWave nor Motorola has ever provided any evidence, publicly or privately, from actual field tests that these 'breakthrough' chips resolve the 8-VSB reception problem under real-world conditions, and it now appears that the publicity over these chips was nothing more than a means for buying time and delaying the implementation of a real solution." "Unfortunately, NxtWave and its CEO, Matt Miller, are continuing their strategy with new claims regarding a next-generation 'breakthrough'."

Sinclair also rejected arguments that allowing use of COFDM would delay the DTV transition, decrease coverage and increase receiver costs, stating:"...Sinclair believes that if the Commission decided to permit U.S. broadcasters to operate using the COFDM-based DVB-T standard, implementation of that standard as an alternative to ATSC 8-VSB would likely take little more than a year. Certainly, the initiation of such a regulatory process would bear a smaller risk of meaningful delay than continued reliance on the unsubtantiated and speculative claims of receiver and chipset manufacturers."

With regards to the 2 dB difference in C/N performance for COFDM and its effect on coverage, Sinclair explained, "...this 2 dB difference does not lead to any material difference in the receivability of the 8-VSB and COFDM signals. ...For the very small percentage of TV households at the Grade B fringe that may be unable to obtain high-quality COFDM reception, such reception could be ensured through the purchase and deployment of a preamplifier, which typically costs between $10 and $20. In contrast, there is no reasonable technological solution for the urban viewer whose location suffers from multipath distortion."

Sinclair answered the cost issue by saying it "believes that the cost incurred by receiver manufacturers from a dual-mode standard would be marginal. The DTV receivers sold today in the U.S. market are already configured to receive signals with multiple modulation modes -- these receivers are typically designed to receive signals from DBS systems, cable systems, NTSC, and 8-VSB broadcasters." Sinclair noted there are more than half a million COFDM receivers in service in the U.K. and Europe, 15 times the number of 8-VSB receivers sold in the U.S. over an almost identical period. Sinclair added that other services such as DARS, MMDS, DBS and PCS have been allowed to use multiple standards.

Sinclair said the FCC should listen to broadcasters, rather than equipment and chipset manufacturers as it addresses the 8-VSB reception problem.

Sinclair's Official Press Release Concerning COFDM

Sinclair Demonstration Proves Superiority of COFDM-Based DVB-T Digital Television Standard

HUNT VALLEY, Md., 07/26/01, PR Newswire

Sinclair Broadcast Group, Inc. (Nasdaq: SBGI) demonstrated the superiority of the Digital Video Broadcasting - Terrestrial (DVB-T) digital television standard to a packed Congressional hearing room on Tuesday, July 25, 2000. An anticipated "shoot-out" between the DVB-T standard, which has been adopted by 31 countries worldwide, and the Advanced Television Systems Committee (ATSC) standard adopted by only three countries, including the U.S., underscored the superiority of the DVB-T standard. The oversight hearing before the House Subcommittee on Telecommunications, Trade and Consumer Protection was held at the request of Subcommittee Chairman, Representative W.J. "Billy" Tauzin, in order to view first-hand live demonstrations of the two standards at the heart of the digital television (DTV) standards debate. Sinclair has led a broadcast industry-wide effort to have the Federal Communications Commission authorize the use of DVB-T for digital television broadcasts.

In front of a hushed crowd, a Sinclair engineer carried a simple, omni- directional 12 inch "bow-tie" antenna from the back of the hearing room and placed it on the witness table in front of members of Congress. The bow-tie antenna, inside of the hearing room, was receiving over-the-air DVB-T transmissions from the NBC owned-and-operated DTV station operating from WRC- DT (digital channel 48) in Washington, DC. The DVB-T broadcast was operating at a data rate of 19.77 megabits per second (mbps), a data rate above the maximum ATSC data rate of 19.39 mbps.

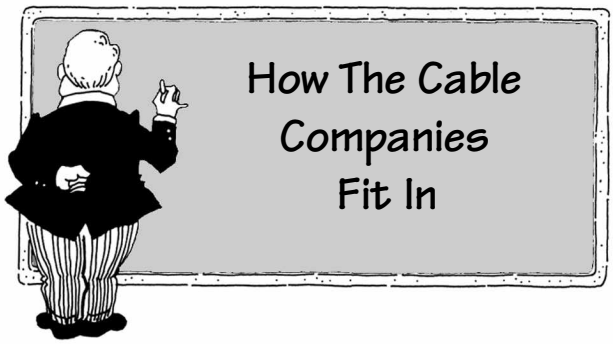
Nxtwave, Zenith and the Consumer Electronics Association conducted live demonstrations of the ATSC standard. The two ATSC demonstrations relied on a pair of carefully aimed, directional antennas hidden from view behind large curtains on two separate windowsills. After repeated questioning from Chairman Tauzin on why the antennas were placed in the windows and not on the witness table, as the DVB-T demonstration had done, Nxtwave CEO Matt Miller admitted that if the directional antennas were removed from the windowsills the ATSC reception "potentially" might fail.

"The hearing demonstrated how robust and consumer friendly the DVB-T COFDM standard is regardless of antenna type inside a building," stated Nat Ostroff, VP of New Technology. "We received higher data rate transmissions in arbitrary locations in the room using a simple five dollar antenna. The ATSC demonstration required the use of a carefully positioned, directional antenna that was hidden behind a curtain and taped to a windowsill. It was as close to being placed outside of the building as possible."

Adoption of the ATSC standard has slid from five to three countries as Argentina and Taiwan have recently announced their intentions to formally rescind adoption of the ATSC standard citing poor indoor reception performance. No country has adopted the ATSC standard since 1998. In contrast, over two-dozen European nations, Australia, New Zealand, India and other countries have adopted the DVB-T standard. Many countries adopted DVB-T after head-to-head field testing comparisons with ATSC. As of May 1st, over 800,000 DVB-T digital television receivers reached a total of 68 million consumers in Sweden and the United Kingdom in less time than it has taken the U.S.'s 273 million consumers to purchase less than 34,000 ATSC standard digital TV receivers.

Sinclair Broadcast Group, Inc. is a diversified broadcasting company that currently owns or programs 61 television stations in 40 markets. Sinclair's television group reaches approximately 25.0% of all U.S. television households and includes ABC, CBS, FOX, NBC, WB, and UPN affiliates. Sinclair, through its wholly owned subsidiary, Sinclair Ventures, Inc., owns equity interests in Internet-related companies including NETfanatics, Inc., an Internet development and integration company, and BeautyBuys.com, Inc. and Synergy Brands, Inc. Other strategic investments of Sinclair Broadcast Group include Acrodyne Communications, Inc., a leading manufacturer of transmitters and other television broadcast equipment.

SOURCE Sinclair Broadcast Group, Inc.
Web Site: http://www.sbgi.net
Company News On Call:
http://www.prnewswire.com/comp/110203.html
or fax, 800-758-5804, ext. 110203



Arlington, VA, 8/30/01 -- The success of digital television (DTV) hinges on access to cable and DTV carriage is essential to meet this goal, the Consumer Electronics Association (CEA) stated in comments filed today with the Commission. The FCC is currently reviewing local DTV broadcast signal carriage issues, specifically procurement of cable carriage. CEA filed the comments in response to the Commission's Further Notice of Proposed Rulemaking on the matter.

"Without assurance that digital broadcast signals will reach the 70 million American households that rely on a cable signal, broadcasters and programmers will have little incentive to produce compelling digital programming," CEA's Vice President of Technology Policy Michael Petricone said. "Consumers will have less incentive to purchase digital television products and it will become less likely that the digital transition will be completed by the 2006 target date. Cable carriage of DTV is imperative."

CEA emphasized the importance of HDTV and digitally originated programming in its filing, which the association called the "linchpin" of DTV's success. Noting that digital content must precede consumer demand for digital equipment, the association also rebuked the "chicken and egg" portrayal of the digital television transition and stated, "Consumers should not be expected to purchase digital receivers in anxious anticipation that value-added content will eventually become available, especially given the current dearth of high-quality, digitally originated programming."

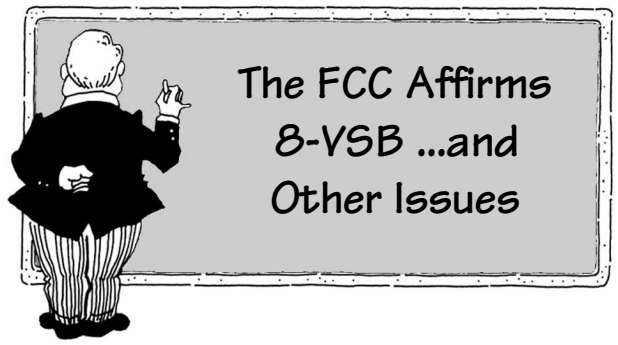
The CEA filing also addressed the future of DTV through advanced services and called on the FCC to broadly define the term "program-related." The definition favored by CEA would encompass "all information in any way related to free, non-subscription broadcast programming." This would include program guides and other interactive content and would differentiate digital content from traditional analog television.

"We must not allow cable gatekeepers to prevent consumers from enjoying DTV or using services that allow them to navigate among content choices or access interactive and advanced services," CEA's Petricone commented. "As we noted in our comments to the FCC, these options and services are the very future of television."

As the trade association of the consumer technology industries, CEA has been an active participant in negotiations as the Commission has formulated its DTV policies. Throughout the carriage of DTV broadcast signal matter at the FCC, CEA has called on the Commission to ensure: (1) that the DTV transition is hastened and facilitated by the dual or multicast carriage of broadcasters' digital signals, (2) that the DTV transition is marked by an abundance of value-added digital programming, and (3) that DTV reaches its potential by fostering the development of advanced and interactive services.

About CEA:
The Consumer Electronics Association (CEA) represents more than 650 U.S. companies involved in the design, development, manufacturing and distribution of audio, video, mobile electronics, wireless and landline communications, information technology, multimedia and accessory products, as well as related services that are sold through consumer channels. Combined, CEA's members account for more than $70 billion in annual sales. CEA's resources are available online at www.CE.org, the definitive source for information about the consumer electronics industry. . CEA represents the consumer electronics industry in association with the Electronic Industries Alliance (EIA).

CEA also sponsors and manages the International CES - Your Source for Workstyle and Lifestyle TechnologySM. All profits from CES are reinvested into industry services, including technical training and education, industry promotion, engineering standards development, market research and legislative advocacy.



FCC ISSUES FURTHER ORDER IN DIGITAL TELEVISION TRANSITION;

ASKS FOR FURTHER COMMENTS ON DTV RECEIVER ISSUES.

Washington - The FCC today issued a Report and Order and a Further Notice of Proposed Rulemaking (FNRPM) in its first periodic review of the digital television (DTV) transition to resolve issues crucial to the rapid conversion of the nation's broadcast television system from analog to digital.

The Commission:

• Affirmed the 8-VSB modulation system of the DTV transmission standard, concluding that there is no reason to revisit its decision denying a request to allow use of an alternative DTV modulation standard.

• Set dates for stations with both analog and digital channel assignments within the DTV core (channels 2-51) to elect which channel they will use for their post-transition digital channel. (December 31, 2003, for commercial stations; December 31, 2004 for non-commercial broadcasters). Election dates for broadcasters with one or both channels outside the DTV core will be set in a future periodic review proceeding.

• Determined that broadcasters need not replicate with their digital signal the entire Grade B service area of their analog station. However, the Commission said that commercial stations will lose interference protection to those portions of their existing NTSC service area that they do not replicate with their DTV signal by December 31, 2004; noncommercial DTV stations will not lose such protection until December 31, 2005.

• Ordered that by December 31, 2004, commercial DTV stations must provide a stronger signal to their communities of license than the DTV service contour they were initially required to provide. Noncommercial DTV stations must provide the enhanced signal strength to their communities by December 31, 2005.

• Denied requests to set performance standards for digital receivers, expressing concern that the effect of setting such standards at this point would be to stifle innovation and limit performance to current capabilities. The Commission said it would continue to monitor receiver issues;

• Instituted procedures for processing mutually exclusive DTV expansion applications and set the date of adoption of today's order as a cut-off date so that all pending DTV "area expansion" applications will be protected against later-filed applications.

The Commission also issued a Further Notice of Proposed Rulemaking to consider whether to require some TV sets to have the capability to demodulate and decode over-the-air DTV signals in addition to displaying the existing analog TV signals.

In raising this issue, the Commission recognized broadcasters' concerns that DTV receivers are not yet available in sufficient volume to support a rapid transition to an all-digital broadcast television service. It asked whether a requirement to include DTV reception capability in certain television sets could help to develop the production volumes needed to bring DTV receiver prices down quickly to where they are more attractive to consumers and could help to promote a more rapid development of high DTV set penetration.

The Commission asked for comments on how best to implement DTV reception capability requirements, if it were to decide to adopt them. It said it recognized the cost considerations associated with such requirements. The Commission suggested that one approach for minimizing the impact on both consumers and manufacturers would be to impose any requirement first on a percentage of large screen televisions, such as 32 inches and larger,

because these are typically higher priced units where the cost of DTV components would be a smaller percentage of the cost of the receiver. In addition, it asked whether any requirement should be phased in over time such that manufacturers would increase each year the percentage of units of a designated screen size or larger that are manufactured each year that would have DTV receive capability. It noted that separate set-top DTV receivers could also be included in meeting the reception capability requirements.

The Commission additionally requested comment on whether it should require any digital television receivers that cannot receive off-the-air digital broadcast signals to carry a label informing consumers of this limitation on the receivers' functionality. This issue concerns receivers that are intended for use only with cable television or broadcast satellite service. The Commission indicated that while it expects that consumers will continue to expect all digital television receivers to be able to receive over-the-air broadcast signals, it suggested that where receivers not able to receive such signals are marketed, consumers should be so notified prior to purchase.

The FCC noted that the Report and Order and the Further Notice of Proposed Rulemaking were designed to expedite the DTV transition and to provide licensees with a measure of certainty that will enhance their ability to plan facilities, order equipment and arrange for construction of their facilities, all of which will speech the transition to digital service.

Action by the Commission by Report and Order and Further Notice of Proposed Rulemaking (FCC 01-24).

MM Docket #00-39
Mass Media Bureau Contacts: Roger Holberg and Mania Baghdadi (202)-418-2120

Office of Engineering & Technology Contacts: Bruce Franca and Alan Stillwell (202) 418-2470

Statement of Chairman Kennard:

STATEMENT OF CHAIRMAN WILLIAM E. KENNARD
Re: Biennial Review - Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television

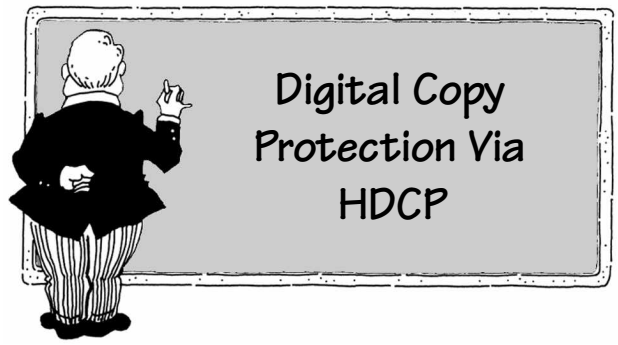
The transition to digital television will bring tremendous benefits to the public, both in enhanced broadcast services and in the return of valuable spectrum for auction. Our actions today go a long way toward moving that transition forward.

Today's decision provides broadcasters with the clarity and flexibility necessary to accelerate the build out of their DTV operations, while ensuring that all Americans will participate in the digital television future. We also reaffirm our selection of the 8-VSB ATSC transmission standard and finally put this lingering debate to rest. I appreciate the efforts of the broadcast industry to confirm that 8-VSB will serve the needs of American consumers in the digital age. I am pleased that after extensive testing of 8-VSB, including tests that compared 8-VSB with alternate transmission standards, the broadcast industry overwhelmingly supports the 8-VSB standard. Now, I encourage broadcasters and manufacturers to come together to refine and improve 8-VSB as necessary.

Finally, I believe that reception capability is a critical part of the transition puzzle. I fully support the decision to seek comment on a requirement that all DTV sets be able receive DTV programming over the air.

Companies Involved in the 8-VSM vs COFDM debate:

National Association of Broadcasters, Consumer Electronics Associations, Joint Broadcasters, Association of Local Television Stations Association of America's Public Television Stations and PBS Advanced Television Systems Committee, NxtWave Communications, Motorola, Philips, Microsoft, Sinclair Broadcast Group, Fox, Paxson Hubbard, Pappas Telecasting, Belo, iBlast, Hammett and Edison Univision, National Council of Senior Citizens



Satellite and Cable TV Industries Announce Support for DVI -- Digital Visual Interface -- in New HDTV Set-Top Boxes

Press Release, Wednesday July 25, 2:16 pm Eastern Time

EL SEGUNDO, Calif.--(BUSINESS WIRE)--July 25, 2001--In a move that promises to significantly enhance home entertainment for consumers across America, a number of leading industries today announced their support of Digital Visual Interface (DVI) with high-bandwidth digital content protection (HDCP) for transmission from set-top boxes and television monitors for high definition video content.

Supporting the new protected digital interface are CableLabs®, DIRECTV, Inc., EchoStar's DISH Network, the Fox Entertainment Group, Satellite Broadcasting & Communications Association, Sony Pictures Entertainment, The Walt Disney Company, Thomson multimedia (NYSE: TMS - news) and Warner Bros.

Industry-wide support for the new protected interface will ensure consistent standards and foster greater availability of high definition video content with optimum viewing for up to 85 million television viewing households in the United States, as well as high definition set-top boxes and display devices.

DVI/HDCP delivers video in an uncompressed format and therefore supports real-time complex graphics displays and user interfaces found in program guides and other interactive features for high-definition digital television. The sheer capacity delivered via the DVI connection permits display devices to fully support features developed by content and set-top box providers that enrich and enhance the overall user experience.

Satellite Industry Supports DVI

Beginning next year, all DIRECTV-licensed consumer electronic manufacturers will begin to incorporate a DVI connector with high-bandwidth digital content protection into new DIRECTV-enabled high definition digital set-top boxes.

``Cross-industry acceptance of DVI/HDCP ensures both content providers and set-top box and display device manufacturers the flexibility of securely offering more high quality, high definition content, which ultimately benefits the consumer,'' said David Baylor, executive vice president, DIRECTV, Inc. ``DIRECTV has taken the initiative to support this new digital interface to ensure that there will be a greater selection of high definition content and digital receiving devices available to consumers in the future.''

EchoStar's DISH Network is also a proponent of DVI in its HDTV satellite TV receivers.

``DISH Network is already working to incorporate a DVI with high bandwidth digital content protection (HDCP) in our next-generation HDTV set-top box,'' said Dave Kummer, senior vice president of Engineering at EchoStar. ``In fact, DISH Network was the first satellite TV provider to demonstrate DVI technology in satellite TV receivers at the 2001 International Consumer Electronics Show in January.''

Kummer added, ``DVI with HDCP will be a key component to expanding DISH Network HDTV programming and equipment offerings that allow for digital video recording (DVR) and Web browsing functionality by providing uncompressed video data to the television monitor. If the connection from the set-top to the TV were limited to only 1394CP (5C), these functions would be much more difficult to achieve.''

DISH Network does recommend the use of 1394CP (5C) as the interface between recordable high definition devices while DVI/HDCP should become the standard for connection to the display device.

``The addition of DVI in both set-top receivers and digital HDTV displays is important to the consumer because it opens new opportunities for expanded availability of HDTV programming,'' said Thomson's Tim Saeger, vice president Research & Development. ``We view the addition of DVI as an enabler for viewers to access the best of satellite home entertainment with the most realistic video performance available today.''

Andy Paul, senior vice president, Government Affairs of the Satellite Broadcasting and Communications Association, said, ``The DVI standard will allow the satellite industry to provide its ultra-high digital picture resolution and delivery to a multitude of uses and formats for digital home distribution. Adoption of the standard is a clear win for consumers. It will give them increased flexibility and enable even greater program quality and enjoyment in the digital home video environment.''

Cable Industry Incorporates DVI

``A commitment to DVI/HDCP adds to the flexibility of the cable industry's digital platform by expanding the set of digital interface capabilities supported by cable,'' said Dr. Richard R. Green, president and CEO of Cable Television Laboratories (CableLabs). ``The support of real-time complex graphics displays and user interfaces will greatly facilitate the cable customer's ability to find and enjoy the broadest array of high definition television and interactive services delivered by cable, and the HDCP technology supports a key cable goal of maximizing availability of high-value content to customers.

``We believe support of DVI will complement the cable industry's support of the 1394 interface with 5C copy protection, which dates back to 1998. Cable is still committed to the 1394/5C interface, and intends to support both DVI and 1394/5C on set-top boxes designed for connection to high-definition television sets.''

Content Providers Applaud Adoption of DVI

Support for HDCP-protected DVI interconnects is growing among the content production industry. Andrew G. Setos, executive vice president of News Technology and senior vice president, Broadcast Operations and Engineering of the Fox Entertainment Group companies, said, ``We applaud the adoption of digital protected links. The arrival of DVI using HDCP to the existing 1394 using DTCP technology provides the designers of systems which deliver high level content to consumers a choice of protected connections -- each optimized for different applications -- and frees them of reliance on the unprotected component analog technology of the past.

``Everyone wins as consumer expectations for high quality images and functionality will be met, and at the same time these technologies will protect the content they carry.''

Phil Lelyveld, vice president of Digital Industry Relations at The Walt Disney Company, added, ``Secure interconnections such as HDCP are important elements of an overall content delivery system, addressing a key need in the development of new channels for high quality digital content delivery.''

``By providing a secure connection for high quality high-definition television delivery into new digital TVs, HDCP is the important link that opens up exciting new program choices for consumers,'' said Chris Cookson, executive vice president/chief technology officer for Warner Bros.

``Adoption of HDCP is a double plus -- a plus for consumers and a plus for content providers,'' stated Jared Jussim, Sony Pictures Entertainment's executive vice president, Intellectual Property Department. ``HDCP establishes a secure digital uncompressed link between the set-top box and the television receiver. This is an important link in the digital home network, one that will enable content providers to supply high definition quality entertainment and will enable consumers to enjoy that content.''

• (a) Estimated number of satellite and cable subscriptions in the United States. Source: Bear, Stearns & Co. Inc. estimates.

Contact:

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DISH Network, Marc Lumpkin, 303/723-2020
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SPE, Stacy Ivers, 310/244-4921
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Thomson Multimedia, James Harper, 317/587-4347
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Fox Entertainment Group, Steven Feldstein, 310/369-5369
or
Warner Bros., Scott Rowe 818/954-5806

Five majors are looking to allow consumers to copy digital-video programs for home use

By Michael Grotticelli
Broadcasting & Cable
7/30/2001

The major Hollywood studios seem to be close to a consensus on copy protection. Five top studios have proposed a solution that would allow consumers to copy video programs in their homes while prohibiting digital material from being sent out over the Internet or elsewhere.

Walt Disney, Paramount, 20th Century Fox, Universal and MGM presented their proposal to the Digital Transmission Licensing Authority (also called 5C and DTLA) a week after Sony and Warner Bros. came to a similar agreement with the organization. The 5C group is composed of Hitachi, Toshiba, Sony, Intel and Matsushita Electric.

The proposal, not yet formally accepted, could pave the way for TV movies and digital shows and feature films to be distributed via satellite, cable and the Internet within two years. It goes further than the Sony/Warner agreement in that it includes digital watermarking technology that enables TV-content owners to protect against retransmission outside the home.

Unlike the Sony/Warner agreement, the five studios are looking to protect terrestrial digital broadcasting from the problems that the record companies have with distribution of unauthorized digital copies of content over the Internet.

"[Our proposal] is about protecting a distribution mechanism, not about content," says Andrew G. Setos, Fox Entertainment Group executive vice president. "We own TV stations, so it's in our interest to preserve that distribution platform."

Setos describes the technology in the proposal as a "belt-and-suspenders" approach. The studios, he says, are looking to develop an industry-standard label that recognizes a copyright and can be included in the Advanced Television Systems Committee's DTV standard. The inclusion of a digital watermark would prevent the broadcast content from being copied.

Once the proposal is finalized, a process that could take as long as a year, the DTLAmust work with consumer electronics companies to integrate protection chips into digital products like set-top boxes and videotape and disk recorders.

Even with this proposal in play, there are still issues to be decided. For example, until a specific manufacturer's watermarking scheme is selected, consumer electronics manufacturers won't build encryption technology into their products. There are several under consideration, and Setos says that issue could take at least 18 months to resolve.

Despite the work still to be done, there is the belief that progress is being made. "After speaking with all of the various manufacturers," Setos says, "I feel confident that we might have something here."

The goal is to enable three levels of digital copyright protection. The lowest level restricts the content from retransmission outside the home (for example, the broadcast proposal). The second limits recording to one time only, and the third, reserved for DVD and pay-per-view, allows viewing without the ability to copy the content.

BusinessWeek

COMMENTARY
By Jane Black and Olga Kharif
MARCH 1, 2001

A Way Out of the HDTV Mess
Here's how to undo a failed federal policy that has broadcasters squatting on spectrum space that could fetch the Treasury billions

Wireless-Spectrum Bidders Beware

So much for the high-definition TV revolution. Four years ago, the transition to digital HDTV promised to provide superclear, virtually 3-D video that would change the way America watched TV. Today, it looks like we'll be lucky to get standard digital TV in every American household before 2010.

That poses a big problem, and not because consumers are crying out for crystal-clear pictures on ordinary TV. The problem is that broadcasters are sitting on a huge chunk of valuable spectrum space they thought would be carrying HDTV signals by now. And they don't want to give it up -- even though the Federal Communications Commission has scheduled an auction to sell it off in September, 2001. Now, both sides are bracing for a battle royal.

There's no denying it: HDTV's promise is dead. And no act of God -- or Congress -- is going to bring it back. Instead, the government needs to focus on making sure broadcasters return the spectrum they were given for free to develop HDTV. The liberation of this spectrum is now key to the development of "third-generation" wireless networks. All that spectrum space should be freed as soon as possible for bidding by new technologies, such as nascent 3G wireless networks, which both covet it and are willing to pay handsomely.

IMMENSE DAMPER. That's what the U.S. government is banking on. Congress has already penciled $28 billion in anticipated revenues from the sale of this spectrum into its projections for the federal budget surplus. Just one problem: As long as the broadcasters are acting like squatters on federal property, going ahead with the September auction is likely to put an immense damper on the bidding.

What to do? On Mar. 1, the Senate Commerce Committee begins hearings on how to remedy the failed policy. The lawmakers will mull the issue through the spring and summer. But a three-pronged attack is in order.

First, new FCC Chairman Michael Powell should delay the auction until the agency is sure it can clear the airspace. Second, Congress should eliminate one of the main reasons broadcasters are holding onto the spectrum: not all TVs are wired to receive digital signals. By mandating that consumer-electronics companies add digital-tuning capabilities to all TV sets they sell, broadcasters could return to the analog spectrum they already have in abundance because they don't need high-end digital spectrum to beam standard digital signals into America's living rooms. Finally, a new auction schedule should include consequences for broadcasters that still don't want to relinquish their spectrum. If they don't give it up, Congress should make them pay the market rate.

FOOLS ON THE HILL. How did we get in this mess? The HDTV debacle was born in a heady mix of fear and international rivalry. In 1983, Japan's NHK debuted an analog version of HDTV at an electronics conference in Switzerland. Fearful of being surpassed yet again by the indefatigable Japanese, the U.S. government accepted HDTV as the wave of the future.

But while working on an HDTV standard, American electronics experts discovered that TV programming could be digitized to transmit high-definition pictures. This, experts argued, was a far superior solution to NHK's analog approach. Consumers would get exceptionally high-quality video, and a compressed digital signal would allow a huge band of valuable spectrum to be freed for new technologies.

Congress soon got in on the act. Assured repeatedly by broadcasters and the TV industry that a more sophisticated version of HDTV was just around the corner,

lawmakers directed the FCC to grant broadcasters an extra channel of spectrum -- at no charge -- to develop HDTV. The extra spectrum would allow them to broadcast in both analog and digital until the switchover.

WHERE'S THE MONEY? The catch was an ambitious timetable for the transition. Broadcasters would have to return the spectrum by 2006, or when 85% of Americans could receive digital signals. After that, they could broadcast their signals in some new space -- freeing the valuable spectrum for auction. Capitol Hill just assumed that broadcasters -- and TV viewers -- would thank them for this gift of crystal-clear pictures, so it made no specific mandate for HDTV, nor did it attach any penalties to tardy completion of the transition.

But after securing the spectrum, broadcasters quickly found that there was no way to make money on HDTV -- free spectrum or not. Broadcasters earn money from advertisers, which pay according to the number of viewers, not according to whether the signal is being displayed on a 5-inch black-and-white or a 65-inch gas-plasma screen. Since only so many people live in each market, broadcasters now argue -- correctly this time -- that they'll attract the same number of eyeballs whether they broadcast in high-definition or standard-definition digital.

"Will Proctor & Gamble pay more because the soap bubbles look sharper? No. Will we buy more soap if the picture is clearer? No. There is no economic model for HDTV," says Jim Burger, a lawyer with Dow, Lohnes & Albertson in Washington who focuses on the intersection of technology and media.

BASIC MATH. Oh, the broadcasters have figured out a way to make money with digital signals. But not by using HDTV. After broadcasters return their current spectrum allotment, they'll have a digital stream that carries 19.3 MB per second. In that space, they can send either programming for one high-definition digital channel or programming for five or six standard-definition programs. They won't need the special high-definition spectrum to do it. This technique, which creates mini-networks within each digital stream, is called multicasting.

"We're not under any obligation to provide HDTV," says Bud Paxson, chairman of Pax TV, which owns 18 stations nationwide. "It's what a lot of members of Congress thought we were going to do. However plans change, things evolve." Paxson, a co-founder of the Home Shopping Network, says he has no plans to broadcast in high definition. "With HDTV, we have one network. With multicasting, we can have five, lower our costs, and possibly make money."

Good for them. But letting the broadcasters do so in a space where they're essentially squatters isn't sound federal policy. Just like a house with a bad property deed, the spectrum space can never be truly valued until the deed is clean.

WAIT FOR A MODEL. Besides, this is no time for the FCC to go ahead with a big spectrum auction. The urgency behind 3G networks has eased. In Europe, telcos overpaid for 3G licenses and now are unclear about how they'll make a profit. With an eye on this carnage, U.S. telcos have indicated that they're in no hurry to launch these networks. Furthermore, holding off on the auctions until 3G profit models have clarified and the spectrum deed has cleared would likely make the licenses more valuable. That means more money for Uncle Sam.

Meantime, if Congress were to mandate that TV-set makers include digital tuners in every set, it would enforce nationwide adoption of digital TV. Last year, 33 million analog TVs were sold in the U.S., vs. just 26,000 digital-capable sets. So much for market forces. The upshot of mandating digital tuners? Grandma in Oklahoma with her rabbit-ears antenna won't lose Oprah when the broadcasters decide to pull the plug on analog broadcasts (if she has bought a newer TV with a digital tuner). That would address one of the broadcasters' biggest complaints.

Congress should also make broadcasters pay for their valuable real estate by attaching a price tag to the spectrum they now occupy. When they approached Congress hat-in-hand, broadcasters promised something they have yet to deliver. Now that this has become abundantly clear, they shouldn't get a free ride on taxpayers' backs. What they should do is fork over the going rate for whatever airspace they occupy. That's what cell-phone companies are doing.

GET TOUGH. These prescriptions won't be popular. The broadcasters certainly don't want to surrender their spectrum or pay for their freebie. Telcos still interested in bidding might scream when the auction gets pulled. And the consumer-electronics lobby is digging in its heels, saying a TV-set mandate isn't necessary because the market for digital TV will eventually drive consumer demand.

FCC Chairman Powell doesn't approve of this confrontation: He calls the September auction a "train wreck" waiting to happen. Government is supposed to stop train wrecks. So the FCC and Congress should step in and keep the train on-track. Clear the spectrum space, make the TV-set manufacturers part of the solution, and force broadcasters pay if they insist on hanging onto their precious spectrum.