HDTV Seminar

Robert Hopkins

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Abstract: HDTV was first introduced in the United States in the early 1980s. Few technologies have stimulated as much enthusiasm and controversy. Virtually all the parameters, as first introduced by NHK, have been changed in the past twenty years. What began as an analog, widescreen, higher-resolution video system has become a digital worldwide standard, with a wider screen, operating at the 35mm motion picture frame rate, that has been used to make major motion pictures. This paper leads the reader through the twenty year period pointing out highlights along the way. Particular attention is paid to the HDTV production standard adopted by the ITU and the HDTV broadcasting standard adopted by the FCC.

In a ten day period in 1982, three separate events occurred that together represented a turning point in the development of modern television technology:

1. **Washington, D.C., February 1982** — High definition television was publicly demonstrated in the United States.

   Joe Flaherty, CBS, became the American leader of HDTV by bringing NHK's HDTV to Washington D.C., San Francisco, and New York. The new television system with 1,035 lines of resolution and a widescreen 5:3 aspect ratio was touted as the future of television.

2. **Geneva, Switzerland, February 1982** — The CCIR recommended a worldwide digital television studio format.

   The CCIR adopted Recommendation 601 specifying the digitization of conventional television systems, at a sampling rate of 13.5 MHz, into 720 samples per line.

3. **Washington, D.C., March 1982** — The FCC decided not to standardize AM stereo broadcasting.

   The FCC decided to let the marketplace sort out the standard, rather than pick one of three technologies as the winner.

These three events provoked a feeling of strong concern, generating the fear that the United States television industry would not be able to provide meaningful input into the development of advanced television (ATV) systems — the FCC was out of the standardization business, the CCIR was setting worldwide standards, and HDTV was coming.

The CCIR adoption of a worldwide standard was very significant because never before had there been worldwide agreement on a television standard. (CCIR was the radiocommunications standardization agency of the International Telecommunications Union, ITU.) NTSC was developed in the United States in the early 1950s. SECAM was developed in France in the 1960s. PAL was developed in Germany in the 1960s. For political reasons — domestic manufacturing and domestic control of the airwaves — different nations had wanted different television standards. A dozen variations of NTSC, SECAM, and PAL were, and still are, in use around the world. See **Figure 1**.

Conventional Wisdom, 1980s Style

At the beginning of the 1980s, it was conventional wisdom that:

1. **HDTV will be broadcast only by satellite.**
2. **HDTV cannot be broadcast in a 6 MHz channel.**
3. **Digital broadcasting will not be possible in the foreseeable future.**

All three rules would be broken within a decade.

More Technology News Flashes

Dubrovnik, Yugoslavia, May 1986 — The CCIR turned down a request by the United States, Canada, and Japan that the CCIR adopt the 1125/60 HDTV system as a single world standard. The European consumer electronics industry claimed victory. The standard would have provided 1,035 lines of resolution in a widescreen 16:9 aspect ratio with 1,920 pixels per line at 60 fields per second. The euphoria of adopting a worldwide television standard four years ago has been dashed as nations returned to their traditional roles demanding regional television standards.

Washington, D.C., Late 1986 — Land mobile radio petitioners were on the verge of convincing the FCC that large portions of the television broadcasting band should be taken away from TV broadcasters and given to mobile radio.

Washington, D.C., January 1987 —HDTV terrestrial broadcasting was demonstrated by NHK using two contiguous 6 MHz channels.

Conventional wisdom rule number 1 was in danger!

Washington, D.C., Late 1987 — The FCC established an Advisory Committee on Advanced Television Service to advise the FCC on issues relating to advanced television systems, and to recommend a standard if the Advisory Committee determined that the FCC should adopt a standard. The Advisory Committee chairman, Richard E. Wiley, a former chairman of the FCC, is a partner in the telecommunications law firm Wiley, Rein and Fielding.

Digression into Numerology

Several numbers have been mentioned thus far, and an explanation might be helpful — 1,035 lines of resolution, 5:3 aspect ratio, 13.5 MHz sampling, 720 samples per line, 16:9 aspect ratio, 1,920 pixels per line.

1. **1,035 lines of resolution**

   The original NHK proposal for HDTV used 1,125 total scanning lines with 1,035 scanning lines for the active picture area. NHK selected 1,125 and 1,035 because those number had ratios of integers for both 525 line systems and 625 line systems.

   1,125 = 5•5•5•3•3 = **525**•15/7 = **625**•9/5

   1,035 = 5•3•3•23 = **483**•15/7 = **576**•5•23/2•2•2•2•2•2

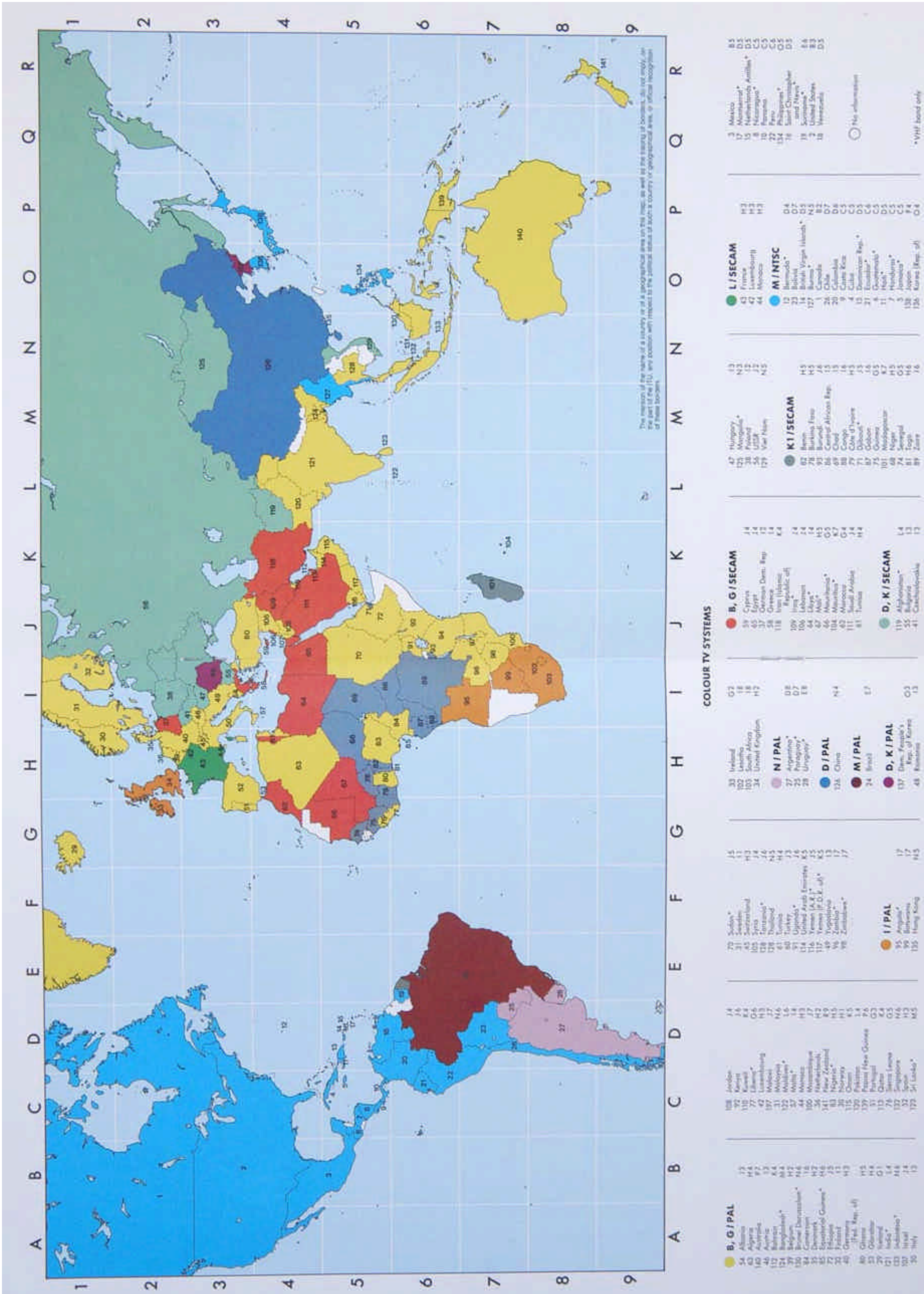

Figure 1. World map showing televison systems in use.

2. 5:3 aspect ratio

Original proposal by NHK for HDTV aspect ratio. NHK tests had shown that the optimum aspect ratio was between 5:3 and 2:1. NHK selected 5:3 because television receivers would cost less with the narrower aspect ratio.

3. 13.5 MHz sampling

13.5 MHz is a frequency related to both 525 and 625 line systems.

For PAL/SECAM, 864 times the horizontal scanning frequency is 13.5 MHz (625•50•864/2 = 13.5 MHz).

For NTSC, 858 times the horizontal scanning frequency is 13.5 MHz (525•59.94•858/2 = 13.5 MHz).

For NTSC, the sound subcarrier is 4.5 MHz (13.5/3) above the picture carrier; the color subcarrier is precisely 455/2 times the horizontal scanning frequency, the sound subcarrier is precisely 286 (572/2) times the horizontal scanning frequency. (By having the sound carrier be half an even multiple of the horizontal scanning frequency, and the color subcarrier be half an odd multiple, beats between the two carriers are minimized.)

4. 720 samples per line

With samples taken at a 13.5 MHz rate, 720 samples is sufficient to capture the full active line of 525 and 625 systems, plus 720 is a "nice" number (720=2•2•2•2•3•3•5).

With 858 (NTSC) and 864 (PAL/SECAM) total samples, and 720 active samples, there are 138 (NTSC) and 144 (PAL/SECAM) samples during the horizontal blanking interval.

5. 16:9 aspect ratio

Proposal by the United States for HDTV aspect ratio. The ratio is derived as the root mean square of 2.40:1, the aspect ratio of anamorphic movies, and 4:3, the aspect ratio of conventional television.

16:9 = 1.7778 sqrt (2.4 • 1.3333) = 1.7889

With this number, widescreen movies would fill the screen width and 75% of the screen height. Legacy television material, and old 4:3 movies, would fill the screen height and 75% of the screen width. See **Figure 2**. Material with aspect ratio greater than 4:3 and less than 2.4:1 would fill more than 75% of the screen area. For the case of movies with aspect ratio of 1.85:1, the movie would fill the screen width and 96% of the screen height.

6. 1,920 pixels per line

The CCIR had agreed that HDTV should be twice the resolution of conventional television systems. If the digital representation of conventional television systems had 720 pixels per line, then HDTV with an aspect ratio of 16:9 must have 1,920 pixels per line.

2 • 720 • 16/9 ÷ 4/3 = 1,920

Advisory Committee Activities

Within two years, more than 20 HDTV proposals were made to the Advisory Committee. All of the proposals were analog. The proposals were to make improvements to NTSC, to provide HDTV in a separate channel, or to use a second channel working with the NTSC channel to make high definition pictures.

For the proposals using NTSC in one channel, and an auxiliary signal in a second channel, older TV sets would pick up the NTSC signal only. New TV sets would pick up both signals, using the combination to make an HDTV picture. To visualize this, imagine that the second signal is providing pixels halfway between the NTSC pixels.

The proposals that used only the NTSC channel buried auxiliary signals in “holes” in the NTSC spectrum. These proposals were referred to as “enhanced NTSC” rather than HDTV.

The other type of proposals used a completely new, NTSC-incompatible, signal. In this way, the inefficient “baggage” of NTSC did not have to be propagated into the future. The concept, called simulcast, was that NTSC would continue to be broadcast for some time into the future, and HDTV would be broadcast on a second, unrelated channel. Once viewers had HDTV sets, the NTSC signals could be taken off-air.

Conventional wisdom rule number 2 was mortally wounded!

Only five of the proposals would survive the next year.

In June 1990, just days before the deadline on proposals to the Advisory Committee, General

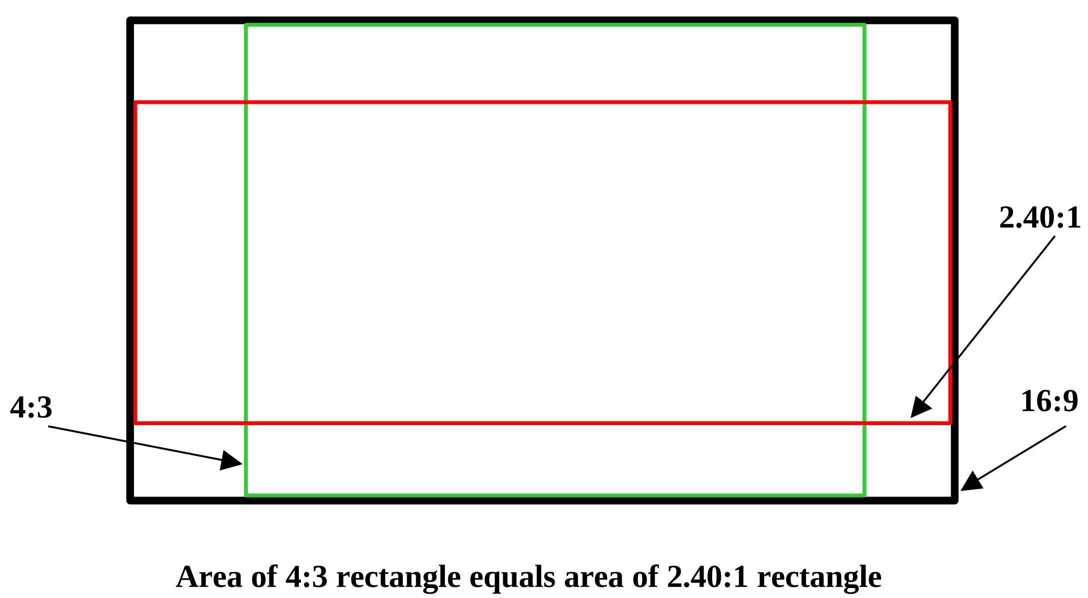

Figure 2. Origin of 16:9 aspect ratio. Area of 4:3 rectangle equals area of 2.40:1 rectangle. Rectangle which encloses both is 16:9.

Instrument proposed a 100% digital approach. Conventional wisdom rule number 3 was being challenged. Many engineers anxiously awaited a grueling examination of General Instrument engineers to determine if the proposal was smoke and mirrors, or real. After the examination, the engineers believed the proposal was real.

In less than a year, three of the analog HDTV proposals were modified to be digital proposals. One of the analog proponents dropped out. There were five proposals remaining (four digital and one analog), and testing began.

Conventional wisdom rule number 3 was dead!

All three conventional wisdom rules had been proven wrong!

International Activities

In the meantime, on the international front, Europeans were developing their 1250/50 HDTV system, Japan was perfecting their 1125/60 HDTV system, and Americans were thinking about computers and square pixels. There was a three-way battle in the CCIR. Europeans wanted the CCIR to adopt an HDTV system with 1,152 active lines (twice the 576 of PAL and SECAM) and a field frequency of 50 Hz, Japan wanted the CCIR to adopt an HDTV system with 1,035 active lines and a field frequency of 60 Hz, and Americans wanted the CCIR to adopt an HDTV system with 1,080 active lines (1,920 horizontal pixels in a 16:9 aspect ratio with square pixels would mean 1,080 vertical pixels) and allow any picture frequency. The American proposal was referred to as the “Common Image Format”.

In the early 1980s, Europeans decided to implement a multiplexed analog component system for satellite broadcasting. The system was known as C-MAC. After a couple years, some countries changed to D2-MAC, and some others to D-MAC. Then interest began in HD broadcasting, so the D2-MAC system was modified to be forward compatible with an HD-MAC system that was under development. Eventually the MAC systems began service, but by that time other satellite broadcasters were using PAL. The MAC system did not gather enough support to succeed. In addition, HD-MAC was considered a failure, proof that Europeans did not want HDTV. As digital standards were being developed for Europe in the 1990s, HD was not a factor, and was not included in the specifications.

Dusseldorf, Germany, May 1990 — The CCIR adopted Recommendation 709, a worldwide standard for HDTV. The Recommendation specified 1,920 horizontal pixels in a 16:9 aspect ratio, but left blank the number of active lines and the picture frequency.

HDTV Broadcasting Proposals

The five proposals before the Advisory Committee in 1991, all simulcast systems, were:

1. Narrow-Muse proposed by NHK
2. DigiCipher proposed by General Instrument and MIT
3. Digital Spectrum Compatible HDTV (DSC-HDTV) proposed by Zenith and AT&T
4. Advanced Digital HDTV (AD-HDTV) proposed by David Sarnoff Research Center, North American Philips, Thomson Consumer Electronics, NBC, and Compression Labs
5. Channel Compatible DigiCipher (CCDC) proposed by MIT and General Instrument

When the testing was complete, an Advisory Committee subcommittee, called the Special Panel, chaired by Robert Hopkins of ATSC, was convened for a week in February 1993 to debate the five systems, and pick one to be recommended to the FCC as the United States standard. Two charts used in that meeting show some of the differences of the systems.

Figure 3 shows the spectrum efficiency of the systems, specifically how many of the current 1,657 TV stations would be able to have a second channel with the same service area as their NTSC channel.

In the graph, the 1,657 current NTSC stations are placed in order of decreasing ATV to NTSC service area ratio. Examination of the graph reveals that, with any of the digital systems, about 200 of the ATV stations would have an ATV service area at least 20% larger than their companion NTSC service area, and more than 1,550 would have an ATV service area at least 80% of their companion NTSC service area. On the other hand, with the analog Narrow-Muse system, only 14 ATV stations would have an ATV service area at least 20% larger than their companion NTSC service area, and only 281 would have an ATV service area at least 80% of their companion NTSC service area.

The Narrow-Muse system clearly had spectrum problems. It caused greater interference in NTSC and other ATV channels, thus only a few stations would be able to have the same service area. The digital systems, on the other hand, would permit most stations to operate their second channel at a power level sufficient to match their NTSC service area. This difference comes from the analog versus digital characteristics of the data being broadcast. While the digital spectrum is

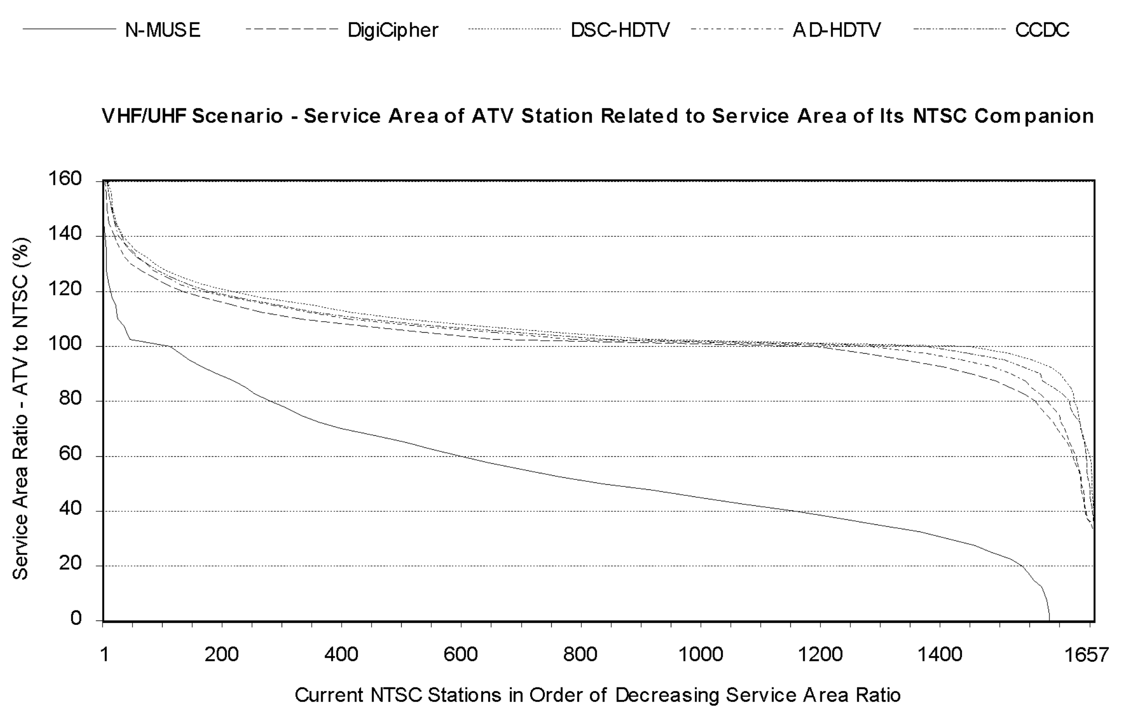

Figure 3. Interference-limited service area of each ATV station relative to the interference-limited service area of its companion NTSC station (co-channel and adjacent-channel constraints).

essentially flat, the analog spectrum has lots of spikes at much higher power density than the digital spectrum. These spikes are the primary contributors of interference to other stations.

Figure 4 shows the measured subjective quality of the tested systems.

Two of the digital systems fared better than any of the others, the DigiCipher system and the AD-HDTV system. Both were based on doubling the NTSC vertical scanning, retaining interlace. Narrow-Muse was based on 1,125 total lines, but with internal filtering that cut the resolution to about 700 lines, rather than Muse's 1,035 lines. The DSC-HDTV and CCDC systems were based on 720 progressive scanning.

At this time, the war between interlace scanning advocates and progressive scanning advocates was at an all-time high. Many observers referred to it as a religious war.

The Special Panel decided to eliminate the analog Narrow-Muse system, but not to pick any of the four digital systems, calling instead for improvements. The complete Special Panel report can be found at http://www.atsc.org/papers/atvreport/index_atvrpt.html.

More Activity in the CCIR

Recommendation 709 did not specify a specific number of lines, or any picture rate. Europeans were now demanding that their 1250/50 system be included in Recommendation 709. Likewise, Japan was demanding that their 1125/60 system also should be included in Recommendation 709. The United States opposed this action. In spite of the U.S. opposition, the CCIR (now called

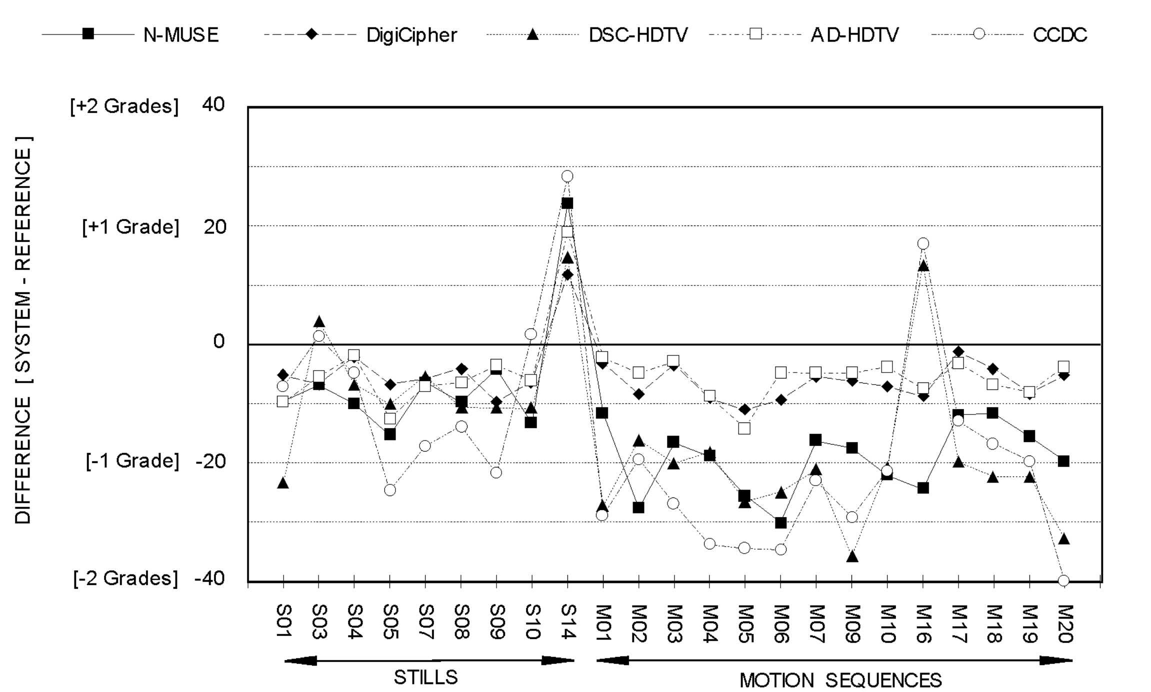

Figure 4. Average differences between quality judgments for the 1125-line studio quality reference and for each of the proposed ATV systems.

the ITU-R) decided to accommodate the European and Japanese wishes and modified Recommendation 709 to show two recommended systems. In a nod to worldwide standards, they showed in bold any values that were common between the 1250/50 and 1125/60 systems. The United States disapproved the action and took a "reservation" showing that the United States did not recognize the new Recommendation.

Grand Alliance Formed

The Advisory Committee went a step further than the Special Panel, calling for the four digital proponents to combine their systems to make a "best of the best" system. In May 1993, the proponents reached agreement to combine their efforts, calling their group the "Grand Alliance". There were seven members of the Grand Alliance: AT&T, David Sarnoff Research Center, General Instrument, MIT, North American Philips, Thomson Consumer Electronics, and Zenith. They proposed that the combined system have two resolution modes: 1,280 by 720 with progressive scanning and 1,408 (or 1,728) by 960 with interlaced scanning. The Grand Alliance did not pick one side in the religious war of scanning, they picked both sides! Also, the Grand Alliance proposed that the compression system would be based on MPEG-2 with Grand Alliance enhancements. They said that an audio system and a modulation system would be selected after Grand Alliance testing.

The Advisory Committee established a "Technical Subgroup" to work with the Grand Alliance in finalizing the system. The Technical Subgroup co-chairs were Joe Flaherty of CBS and Irwin Dorros of Bellcore. Two key issues were raised by the Technical Subgroup. One issue came from the Technical Subgroup's Expert Group on Scanning Formats, chaired by Robert Hopkins of ATSC, questioning whether the system should use 1,920 by 1,080 rather than 1,408/1,728 by 960. The second issue came from the Technical Subgroup's Expert Group on Video Compression, also chaired by Robert Hopkins, questioning whether the video compression system should deviate from the internationally adopted MPEG-2 standard. After further study, the Grand Alliance agreed to both points.

Over the next few months, following their tests, the Grand Alliance selected Dolby AC-3 as the audio system, and 8VSB as the modulation system. The Technical Subgroup agreed to these proposals.

After the Grand Alliance finished construction of their prototype system, it was tested by the Advisory Committee. **Figure 5** updates **Figure 3** with Grand Alliance prototype data on spectrum efficiency. Comparison of the Grand Alliance data with data from the four earlier digital systems shows that the Grand Alliance system provided a greater percentage of the ATV stations with service area matching their companion NTSC service area.

With regard to subjective picture quality, **Figure 6** updates **Figure 4** with Grand Alliance prototype data.

The Grand Alliance prototype, whether in the 720p mode or the 1080i mode, clearly demonstrated picture quality surpassing the individual digital systems. Because of concerns raised by many, from both sides of the progressive/interlaced scanning war, the picture quality of the two Grand Alliance modes was compared, and those results are shown in **Figure 7**.

The two modes compared quite closely, dispelling most concerns. The religious scanning war was fading from sight, but only temporarily. Another concern that had arisen was whether there

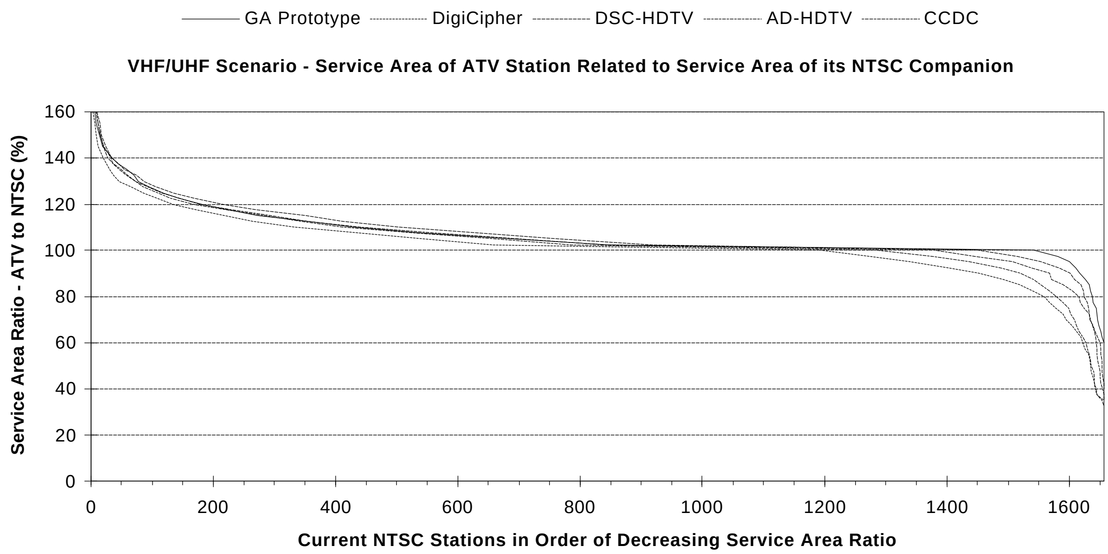

Figure 5. Interference-limited service area of each ATV station relative to the interference-limited service area of its companion NTSC station (VHF/UHF scenario, co-channel and adjacent-channel constraints).

would be quality losses if 720p images were displayed on a receiver with 1080i native display, or if 1080i images were displayed on a receiver with 720p native display. The expert observers characterized the conversions as only slightly poorer than when presented in the original format. They said the quality loss was manifested as a slight loss in resolution and a slight increase in noise. These results supported the view that any receiver should be able to receive and display either signal, regardless of the display device used in the specific receiver. Such a receiver was being called an "all-format" receiver.

Many in the television industry had been concerned that the FCC did not have the technical expertise to draft a standard for HDTV broadcasting. In 1992, one industry group, the Advanced Television Systems Committee (ATSC), offered to standardize the system the Advisory Committee selected as a United States voluntary standard, saying the FCC could then reference that standard in their rule-making process. ATSC had been organized a decade earlier as a private sector "committee" with the charter to develop voluntary technical standards for advanced television systems. The FCC had agreed to the ATSC proposal.

As the Grand Alliance and the Advisory Committee's Technical Subgroup were completing their system definition, the ATSC was busy documenting the system as a voluntary standard. ATSC adopted the standard in April 1995. It did not include any standard definition television options, only the 1,280 by 720 and 1,920 by 1,080 options. As this work was being completed, though, many in the industry were calling for the FCC to adopt a standard that would allow multiple standard definition programs, as well as HDTV, to be broadcast inside the 6 MHz channel. The Advisory Committee Chairman, Richard Wiley, asked ATSC's Robert Hopkins to reconvene his Expert Group on Scanning Formats to add standard definition modes.

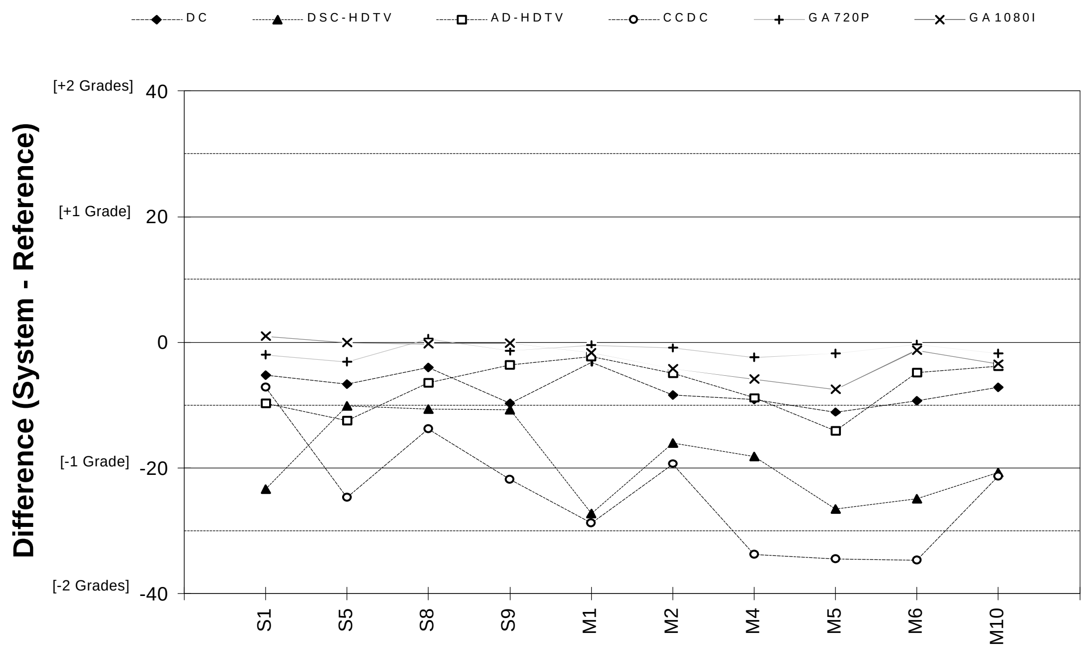

Figure 6. Quality of the Digital HDTV Grand Alliance system and the four original digital systems compared with the 1125-line studio quality reference.

The Expert Group met during the spring and summer of 1995 to decide which formats should be added. While some had proposed that the MPEG 320 by 240 format be included, there was no consensus to do so. Debate centered on the formats 720 by 480, 704 by 480, and 640 by 480. The first, 720 by 480, was the format from CCIR 601, the format that was used in professional digital video recorders. The format 704 by 480 was one that was being used by several companies for consumer digital video purposes. The format 640 by 480 corresponded to the computer industry's VGA standard. Ultimately the consensus was that the consumer format of 704 by 480 and the VGA format of 640 by 480 should be used. The 640 by 480 format would be available at various picture rates, but only in a 4:3 aspect ratio. The 704 by 480 format would be available at various picture rates in both 4:3 aspect ratio and 16:9 aspect ratio. The video modes appeared in Table 3 of Annex A of the ATSC Standard. The standard was updated in October 1995 to include the standard definition formats. ATSC's Table 3 is reproduced in **Figure 8**.

On October 31, 1995 the Technical Subgroup held its final meeting. They adopted their final report describing the Grand Alliance system, the test results, and the table of scanning formats that included standard definition modes. The Technical Subgroup report can be found at http://www.atsc.org/papers/tsreport.html.

On November 30, 1995 the Advisory Committee held its final meeting, agreeing to recommend that the FCC should adopt the Grand Alliance system, documented in ATSC Standard A/53, as the United States standard for digital broadcasting. The final report of the Advisory Committee can be found at http://www.atsc.org/papers/a_cats/finalrpt.html. ATSC standards can be found at http://www.atsc.org/standards.html.

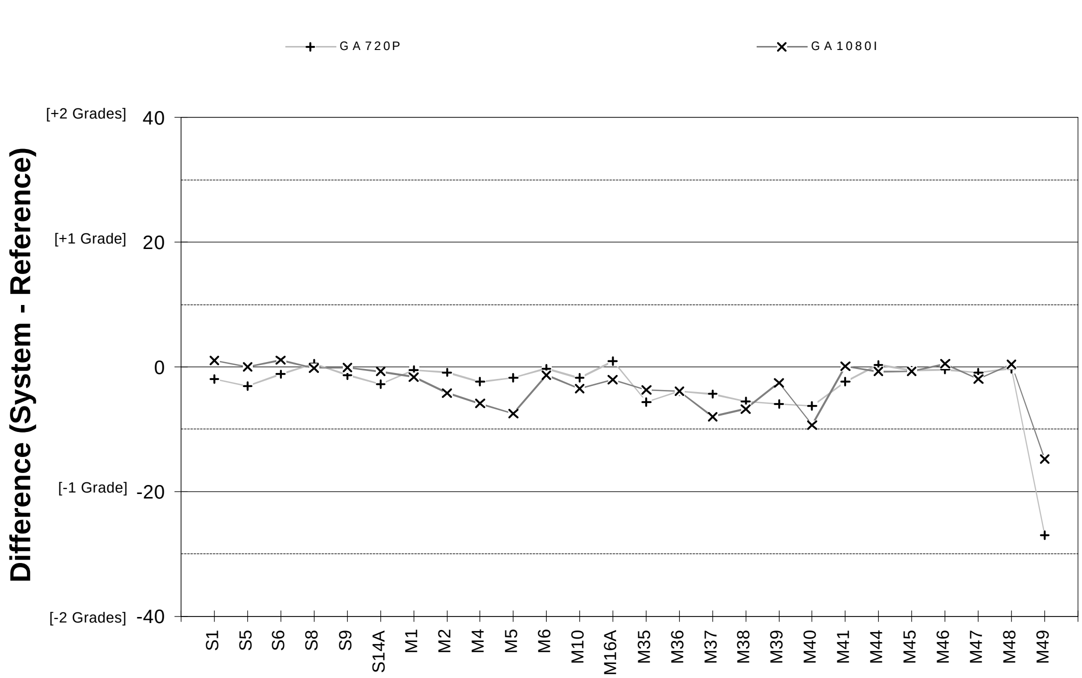

Figure 7. Quality of the Digital HDTV Grand Alliance system across all sequences compared with the 1125-line studio quality reference.

The current version of the ATSC Digital Television Standard can be found at http://www.atsc.org/standards/a_53b_with_amendment_1.pdf. The audio system, Dolby AC-3, also documented by ATSC, can be found at http://www.atsc.org/standards/a_52a.pdf. ATSC also wrote a tutorial, "Guide to the Use of the ATSC Digital Television Standard", which can be found at http://www.atsc.org/standards/a_54.pdf.

It took more than a year for the FCC to adopt the standard. During that time, the progressive/interlaced scanning war moved to a new front. This time, it was the computer industry versus the broadcasting and consumer electronics industries. Some people in Hollywood (Cinematographers and some Directors) joined the computer industry in the battle. Basically, the computer industry was demanding that the FCC forbid any interlaced scanning modes in the

Vertical Lines	Horizontal Pixels	Aspect Ratio		Picture Rates*			
1,080	1,920	16:9		60I		30P	24P
720	1,280	16:9			60P	30P	24P
480	704	16:9	4:3	60I	60P	30P	24P
480	640		4:3	60I	60P	30P	24P

* Picture rates also at 59.94, 29.97, and 23.98 Hz

Figure 8. ATSC's Table 3, the ATV system scanning formats.

digital standard. Cinematographers and Directors were demanding that the FCC forbid pan and scan. FCC Commissioner Susan Ness played a significant role in helping the industries find agreement. In November 1996, an agreement was reached that the FCC would adopt the ATSC Digital Television Standard, but would drop Table 3. This meant that the FCC standard would not have any specific picture format, meaning that any format would satisfy the FCC rules. The broadcasters and consumer electronics industry believed that ATSC's Table 3 would continue to prevail, though. Table 3 would not be dropped in the voluntary ATSC Digital Television Standard, only in the FCC rules.

The FCC Rulings

On December 24, 1996 the FCC adopted the ATSC Digital Television Standard. In April 1997 the FCC adopted the rules they would apply to digital broadcasting, and the channels they would assign to individual television stations. Every station would be given a second channel during a transition period. Under a voluntary agreement, the four primary networks (ABC, CBS, Fox, NBC) agreed to have selected digital stations in the top 10 markets on-air by November 1, 1998. Under the mandatory rules, the four networks would have all their digital stations in the top 10 markets on-air by May 1, 1999. They would have all their digital stations in the top 30 markets on-air by November 1, 1999. All other commercial stations would have their digital stations on-air by May 1, 2002. All non-commercial stations would have their digital stations on-air by May 1, 2003. All NTSC broadcasting would cease by 2006.

The FCC did not adopt any requirements for broadcasting HDTV. They adopted no requirements for receivers. They adopted no requirements for cable.

ITU Adopts Common Image Format

ITU again modified Recommendation 709. Worldwide agreement had been reached that 1,080 active lines was the right number. Recommendation 709 was modified to show 1,920 by 1,080, the Common Image Format, as the preferred HDTV format for 50 Hz or 60 Hz picture rates. The two previously approved standards, 1250/50 and 1125/60, were downgraded to a legacy status. Based on these changes, the United States removed its reservation on Recommendation 709.

Professional HD VTRs

While there was a European standard for HD production (1250/50), there was no manufacturing of professional VTRs in that format. Several prototype 1250/50 VTRs were made. There were professional VTRs for the 1125/60 format. The first digital HD-VTR was the Sony HDD-1000. It is an open reel, one inch machine that records 1,035 lines of uncompressed 8 bit YUV.

Panasonic developed a "black box" to compress HD about 4 or 5 to 1 so that the resulting bit stream would fit their standard definition D5. They called the machine the HD-D5. The black box was then added to the D5 making the HD-D5 a stand-alone machine. The original version recorded 8 bits. Later models recorded 10 bits using more compression to fit the same overall bit rate. Still later models added 720p and 24p formats.

Sony developed the HDCam format. Using modified digital betacam hardware, it records 8 bit filtered HD video (reducing Y from 1,920 pixels to 1,440 pixels, and U/V from 960 pixels to 480 pixels) while applying 4 to 1 compression. Sony later added 24p and 50i versions of the HDCam.

Toshiba developed the D6, subsequently marketed by Philips. This machine records uncompressed YUV with Y at 10 bits and U/V at 8 bits. It has a very low market share.

FCC Rulings Hold

Essentially, the FCC rulings have remained unchanged, with two notable exceptions. In the first exception, Congress ruled that NTSC broadcasting would not necessarily cease in 2006. NTSC would continue until 85% of viewers were able to receive digital signals.

In the second exception, the FCC ruled on August 8, 2002 that receivers must include digital tuners beginning with 50% of receivers 36” and above by July 1, 2004 and 100% by July 1, 2005; 50% of receivers 25” to 35” by July 1, 2005 and 100% by July 1, 2006; 100% of receivers 13” to 24” by July 1, 2007; and 100% of TV interface devices (e.g., VCRs) by July 1, 2007.

This ruling was somewhat unusual, but came about because the consumer electronics industry refused to agree to voluntarily manufacture TV sets with digital tuners. In early 2002, FCC Chairman Michael Powell asked various industries to help speed the adoption of digital television. He asked terrestrial broadcasters, cable casters, and satellite broadcasters to voluntarily increase their amount of high definition broadcasting, and for the consumer electronics industry to voluntarily increase the number of receivers with digital tuners. Only the consumer electronics industry failed to respond with acceptable proposals. Only the consumer electronics industry was hit with the August 8 ruling!

In retrospect, perhaps the greatest controversy surrounding the Grand Alliance system and the FCC ruling has been the choice of 8VSB. That selection was made in early 1994 when the Grand Alliance compared a QAM system with a VSB system. Shortly before the selection was made, it seemed that broadcasters were favoring QAM, and the cable industry was favoring VSB. The Grand Alliance tests showed VSB to be superior, thus that selection was made. Almost immediately, the cable industry favored QAM. It was almost as if there was an intention to be different!

At about the same time, European interests favored a system called COFDM (Coded Orthogonal Frequency Division Multiplex). You can look at COFDM as being a large number of QAM systems each with a narrow bandwidth. Its primary advantage is that the system “automatically” fixes multipath problems. Plus, you can select the individual carriers leaving “holes” where interference would be most prominent. Its primary disadvantage is that the C/N ratio is inferior to the single carrier systems, like QAM and VSB.

This VSB/COFDM issue became extraordinarily significant a couple years after the FCC adopted the standard. Sinclair Broadcast tried to persuade the industry, but especially the FCC, that VSB should be replaced by COFDM, or failing that, the FCC should allow individual broadcasters to decide on their own if they wished to use COFDM rather than VSB.

Many people believed that Sinclair was simply stalling the implementation of digital television. It was noted that many stations had already built their digital facility, but Sinclair, the company that owns the most stations in the country, had not built one single digital facility. It was also noted that Sinclair did not have the most healthy financial statements. Sinclair was making an issue of reception with “rabbit ears” in urban areas. It is well know that in the canyons of cities, multipath makes rabbit ear reception difficult, even with NTSC.

The FCC ran their own tests comparing VSB and COFDM, eventually finding that differences were slight, and turned down Sinclair's request.

ITU Adopts 24p

In the second half of the 1990s, Sony introduced a 24p production system for HDTV. This was well received. For years, it had been difficult dealing with 24 frame film in a 60 Hz video environment. With a 24p video system, this problem would be eliminated.

The United States proposed that the ITU add the 24p mode to Recommendation 709. This was agreed. With this change, Recommendation 709 truly became a worldwide standard. Pictures would be handled as 1,920 by 1,080 regardless of the picture taking rate. Plus, if material existed at the 24p rate, it could easily be converted to 50i for 50 Hz television by running the tape 4% fast, or to 60i for 60 Hz television by applying a 3:2 pulldown.

Finally, a true worldwide television standard!