

Comments on HDTV

ITS Lunch Meeting

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by Robert Hopkins

Introduction

Good afternoon ladies and gentlemen. I am pleased to be able to speak to you today on the topic of HDTV, a subject dear to my heart. I have been involved with HDTV, one way or another, for more than 15 years. For me it began in 1980 when I chaired the SMPTE's Committee on New Technology. In February and March of 1980, the Committee on New Technology's HDTV Study Group, under the able leadership of Donald Fink, who had served as secretary of both the black and white NTSC in the early 1940's and the color NTSC in the early 1950's, published its final report in the SMPTE Journal.

In those days, my participation was as a volunteer. My participation changed from volunteer to occupation in 1985 when I became the Executive Director of the Advanced Television Systems Committee, or ATSC. ATSC wrote the standard that the FCC will consider in its meeting tomorrow. Since the beginning of 1996, I have been the general manager of Sony Pictures High Definition Center.

Looks like I can't get enough of a good thing, or maybe I don't know when to quit.

You came today to hear the latest on HDTV. I was asked to speak on two topics – the standards work that has been done in Washington DC, and Sony Pictures outlook on HDTV. I will add one other topic on my own. Often, understanding where you have been helps to understand where you are going. So, if you will indulge me for a few minutes, I will first speak about the past.

HDTV History

Back in the early 1980's, when HDTV was first being discussed and demonstrated in the United States, everybody was wowed by the pictures, but nobody was sure what was going to come of it. A number of people did conclude, though, that it represented the future and that it was important to have a single worldwide electronic production standard. This, in fact, became the United States position in the international standards arena during the mid 1980's.

A single worldwide standard did not come to pass, though. The only HDTV system in existence at that time was a 60 Hz system, proposed by Japan, but that system did not gain sufficient acceptance in the 50 Hz regions of the world.

It is interesting, as a historical note, that "Hollywood" objected to the term "production standard." Film is the production standard, they said. This viewpoint was accommodated by using the term "electronic distribution standard." From that point, the United States position always referred to "HDTV studio standard" or "electronic distribution standard."

Early Agreement on Some Parameter Values

It was during that period, the mid 1980's, that some of the basic parameter values did get cast in stone, worldwide. One familiar value is the 16:9 aspect ratio. The Japanese had proposed 5:3. This did not gain wide acceptance in the United States and Europe. The value of 16:9, proposed in the United States, did find worldwide acceptance.

Let me make one comment on the 16:9 aspect ratio, and the reason it was proposed by SMPTE back in 1985. They wanted to choose an aspect ratio that would optimize the electronic display of the existing library of films while maintaining each film's aspect ratio. Specifically, the proposal came about by noting that the narrowest pictures were generally 4:3. The widest pictures were generally 2.35:1. If you made a display with width appropriate for 2.35:1 (but didn't use the full height) and height appropriate for 4:3 (but didn't use the full width) and presented both pictures with the same area on the display, the resulting display would have an overall aspect ratio of 16:9. If the picture was wider than 16:9, you would use the full width and whatever height was needed. If the picture was narrower than 16:9, you would use the full height and whatever width was needed. Notice that I am not talking about pan and scan – I am talking about preserving the original artistic choice of aspect ratio using a versatile electronic display.

The number of horizontal samples, 1,920, found worldwide acceptance rapidly. That number came directly from CCIR601 which was, itself, a worldwide standard. Everybody agreed that HDTV should have twice the resolution of conventional television systems. CCIR601 had 720 horizontal samples for both 525/60 and 625/50 systems. If you double that number, then increase it proportional to the wider aspect ratio, you get 1,920.

There was no agreement on a single value for the number of active vertical lines, however. And there still is no single worldwide agreed number today. Europeans like the number 1,152. Japan likes 1,035. The ATSC Standard is 1,080, which yields square pixels, which computer people like.

HDTV Demonstration in Washington DC

Not long after the failure to achieve a single worldwide HDTV studio standard, broadcasters in the United States concluded that it was imperative that they be able to broadcast HDTV. The broadcasters knew that the alternative media would be able to handle HDTV. If broadcasters could not, television broadcasting would become the "AM radio of television."

In 1987 the National Association of Broadcasters and the Association of Maximum Service Telecasters sponsored a demonstration in Washington DC using the Japanese MUSE equipment, an HDTV satellite system. For the demonstration, two adjacent UHF channels were used to handle the wider bandwidth. It worked.

At the same time, the FCC was on the verge of re-assigning some broadcast TV spectrum to mobile radio. It looked like the FCC was ready to give away much of the television broadcast spectrum – the same spectrum that broadcasters would need for HDTV broadcasting!

Almost immediately, some 55 broadcasters filed a petition with the FCC requesting that the FCC initiate a Notice of Inquiry. The big question they posed was what would happen to broadcasting when the alternative media began transmitting HDTV and terrestrial broadcasters could only broadcast NTSC.

Role of Federal Communications Commission in HDTV

Why, you might ask, did the FCC get involved in standards for HDTV? The reason is that the technical standard for terrestrial broadcasting is regulated by the FCC. Before broadcasters can switch to HDTV, it must be approved by the FCC. Note that the FCC does not regulate the technical standard for cable or DBS, but it does for terrestrial broadcasting.

The FCC responded in a positive way to the broadcasters' petition. The first NOI was released during the summer in 1987. An Advisory Committee was formed in late 1987. Over the intervening years the FCC has issued several items on the ATV docket. The items have been further NOIs, Notices of Proposed Rule Making, and Report and Orders.

ATV, advanced television. That's the first time I used that acronym. When the FCC issued that first NOI, questions were posed on all forms of advanced television, not just HDTV. The FCC also wanted to know about simple improvements to NTSC. As far as the FCC was concerned, the door was open to improvements ranging from improved NTSC all the way to HDTV. They simply called it ATV. It was about 1990 that the FCC really zeroed in on HDTV, not just the generic ATV. Then it was about 1994 that the focus was widened again to include also digital standard definition television, or SDTV.

FCC Advisory Committee

Initially, the Advisory Committee on Advanced Television Service was established with a two year life. There were 25 members named to the Committee, all from the private sector. Typically, they were Presidents, or Chairmen, of companies like CBS, NBC, PBS, Sony, Zenith, etc. The Committee finished its work in November 1995, eight years later. Seems like a long time, but a lot happened during that period.

The biggest change was that everything went digital. The first proposals were analog. With time, some proposals became hybrid analog and digital. But the broadcasting remained analog. Until 1990, that is, when General Instrument proposed a digital broadcasting solution.

About that time the computer industry became involved. Square pixels and progressive scan became important – no, critical – topics.

Five proposals survived. Tests were performed. Four of those five proposals were all-digital, one was analog. The analog proposal was rejected. The four digital proponents were asked to combine their proposals, to come up with a “Best of the Best” proposal.

Grand Alliance

And it happened. In 1993 the Grand Alliance was formed by the seven companies that were the proponents of the digital systems – AT&T, David Sarnoff Research Center, General Instrument, Massachusetts Institute of Technology, Philips, Thomson, and Zenith. All the digital proponents were members, and only the digital proponents were members. Sony was not a member because Sony was not one of the companies that proposed a digital system.

The Grand Alliance then proposed a system to the Advisory Committee. In some areas, the Grand Alliance was unable to reach consensus and proposed tests to make decisions. The

Advisory Committee agreed and assisted. The Grand Alliance constructed a prototype which was tested under the auspices of the Advisory Committee.

Development of ATSC Standard

During the period when there were several proponents, the ATSC proposed to the FCC that ATSC would document a standard for the “winning” system. The FCC endorsed the proposal. The primary reason for ATSC involvement was the concern that the standard must be open and not proprietary. Other manufacturers insisted on this approach. Furthermore, by documenting the standard in a public process, the likelihood of errors would be minimized.

In fact, during the documentation process one specific problem was uncovered. When the field tests were going on in North Carolina, one anonymous manufacturer had constructed a receiver using the ATSC documents. Unfortunately, the receiver did not work. Discussions between the chairman of the ATSC group responsible for that portion of the standard, the Grand Alliance member that had designed that portion of the system, and the anonymous manufacturer resolved the problem. The document was modified, the anonymous manufacturer modified the receiver, and the modified receiver worked! Keep in mind that the receiver was designed solely by reference to the ATSC documents. Helps build up trust in the standard, doesn't it!

Recommendation to FCC

After the ATSC documents were adopted as ATSC Standards, and after the Grand Alliance prototype was tested, and after the test results were analyzed by the Advisory Committee and found acceptable, the Advisory Committee met and recommended to the FCC that they adopt the standard for terrestrial broadcasting.

These documents – the ATSC Standard, the Final Technical Report of the Advisory Committee, and the Final Report of the Advisory Committee – are available on the Internet. Point your Web browser to “<http://www.atsc.org>” to find them.

I should take just a moment and list some of the fundamentals of the system. There are three picture sizes – 1080 active lines, 720 active lines, and 480 active lines. The 1080 and 720 line formats use 16:9 aspect ratio with square pixels. The 480 line format can be 4:3 or 16:9. It can have 640 horizontal pixels, to match the VGA format, or 704 horizontal pixels to match the CCIR601 format. Picture rates can be 60 Hz, 30 Hz, or 24 Hz. Both progressive and interlaced scanning are supported, depending on the specific format. Interlaced is used only in 60 Hz video formats. All 24 frame formats – that means film – are progressive scan only. The video is compressed using the MPEG-2 international standard. Audio is compressed using the Dolby AC-3 system which has been standardized by ATSC. The digital data is carried using the MPEG-2 transport packets. The RF is 8-level VSB. As I said, the full specification is available at the ATSC Web site, “<http://www.atsc.org>”.

Again, the Advisory Committee recommendation was given to the FCC in late November 1995. Almost six months ago.

Anticipated FCC Action

In the meantime, FCC Commissioners have been wrestling with a dilemma. Some want the standard adopted. One did not. It appears that they have found an answer to their dilemma. Tomorrow the FCC will meet and consider an NPRM. Rumor has it that the NPRM will be adopted, and that it will propose adoption of the standard. Perhaps in another four to six months, it will finally be complete. Nine years after the formation of the Advisory Committee!

Spectrum auctions have been an issue. The latest information seems to be that auctions will be held after the NTSC spectrum is reclaimed by the FCC, rather than auctions of the digital spectrum being held now. I believe it is best for the digital transition that auctions be held later, not now.

Sony Pictures High Definition Center

Now, what about Sony Pictures, and specifically the High Definition Center. The High Definition Center was formed about the same time the Advisory Committee began its work. It began solely as an R&D center. More recently it has been converted to a P&L center. We are continuing our R&D, and funding it completely on our own.

Sony Pictures is committed to digital technology. We want to be the leading experts. We want to be the first studio to be 100% digital. That's true whether we are talking about audio, or video, or computer graphics. We are preparing for the future.

Exploit HDTV Technology

Everything we do at the High Definition Center uses high definition technology as its centerpiece. At the same time, we are part of Sony Pictures. We live in the film world. We have anointed ourselves the gatekeepers between the traditional film world and the electronic cinematography world of the future. We like to believe we are learning how to do what all of you will be doing in the not too distant future, that we are paving that road so you won't have to.

HD Mastering of Films

Among our findings, actually not too surprising, is that a VHS tape of a film looks better if the video was derived from a high definition film to tape transfer rather than a standard definition film to tape transfer. I suppose that comes about because we initially over-sample giving a better MTF. We then have better control of the electronic filtering process in going from high definition to standard definition. I note that BTS introduced a new HD telecine at the recent NAB Convention. Perhaps they also believe this is a good thing to do.

Plus, we now have a high def master. Because of its higher quality, it can be used to make a 50 Hz standard definition tape. We don't have to re-scan the film. And, we have enhanced our library by already having a high def master. We will be ready to release in that format when the time comes.

We also believe pin registration is important in our transfers. Especially when the video is compressed for digital broadcasting, or for DVD. Why waste those precious bits removing weave.

Let's keep it out in the first place. Plus, the use of an area array CCD imager yields a higher signal-to-noise ratio which also will save bits when compressing the video.

We make two HD masters from each film. One will be down-converted to standard definition for display in the 4:3 format. The other will retain its original aspect ratio and be displayed letter-box on a 16:9 screen. Note that this maintains the original as the artist made it. We do not pan and scan to the 16:9 format.

HD Production for Film Exhibition

Some producers have decided they wish to test this new technology. Why not shoot an entire picture using high definition video, use digital techniques for post production, and then convert back to film for exhibition. With our electron beam recorder, we can do just that. One of our works, "Rainbow," is being shown in Europe as I speak.

I certainly am not taking the position that high definition video will replace film. It enhances, or complements, film. We want to find the things that can be done best with high definition video and the things that can be done best with film. What a combination. Exploit the two technologies separately, and together.

HD Center Exploring the Future

And that's what we are attempting to do. We are exploring the future. We want to learn when to use one technology, and when to use the other. And when to use both. And make it pay for itself. We want to make sure the manufacturers are designing the right equipment. That the workforce can easily move from today's equipment to the equipment of tomorrow. We want to make sure that the technology is right when the rest of you decide to take the step.

What an exciting technology. I have been a part of it for over 15 years. And this is not the time to quit. I know a good thing when I see it.

Thank you for your attention.