FACTS ENGINEERING WORKSHOP - HIGH DEFINITION TELEVISION

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USA POSITION

The Montreux Television Symposium in 1979 represented a turning point in the approach to television standards. In the United States and in Europe, working groups had been established to write standards for digital television studios. The EBU Specialist Group V1-VID had arranged a meeting with industry, during the Symposium, to inform those attending of the status of the work within the EBU and to solicit comments from industry. I was invited to the meeting because I was chairman of the SMPTE Working Group on Digital Video Standards. Two questions seemed paramount: What number should be selected for the sampling frequency and should the digital representation of the analog signal be in a composite format or a component format.

The debate in the United States had centered on the sampling frequency. There was support in some quarters for sampling at three times the color subcarrier frequency and support in other quarters for sampling at four times the color subcarrier frequency. The SMPTE group had clearly decided to select a composite format. However, the supporters of sampling at four times the color subcarrier frequency had arrived at that position because of the ease of decoding the digital signal into component form. European PAL countries had a distinct preference for composite coding with the sampling frequency locked to the PAL color subcarrier. The SECAM countries had a preference for component coding.

A clear message evolved from the V1-VID meeting. All countries should be working together and take a common approach.

Six months later, the 12:4:4 format emerged. After another six months, the 14:7:7 format was emerging. Finally, about 15 months after the V1-VID meeting, the 13.5:6.75:6.75 format emerged and eventually led to the CCIR Recommendation 601.

The impetus for this activity came from the realization that digital video equipment was going to play a much greater role in future television studios, that digital interconnection of the equipment would be desirable, and that it would be in the interest of all parties to have a common, standardized approach.

MAC was first appearing around the same time. The original concept was that an analog component format would solve the European PAL/SECAM problem. By using the time multiplexed signal format, the critical timing problems could be eliminated. MAC was conceived as a transmission system, not a production system. The digital component studio signal was seen as the input to the transmission system. Europe could say good-bye forever to the PAL/SECAM problem.

In this same time frame, interest was rapidly rising with high definition television. The SMPTE established a Study Group in 1977 "To examine present technology as applied to high definition television systems; to examine new technology applicable to the special needs of television broadcasting..." The Study Group retired after issuing a lengthy two part report in the

February and March, 1980, issues of the SMPTE Journal. The group was reactivated in 1981 because of the continually increasing interest in high definition television.

Two years later, in 1983, the United States Advanced Television Systems Committee (ATSC) was formed to develop national standards for advanced television systems and to propose national positions to the U.S. Department of State. The ATSC is composed of fifty member companies, all of which are major factors within the United States television industry. These members include broadcast networks and stations, cable television companies, program producers, professional and consumer equipment manufacturers, and satellite communications companies.

During the intervening years, one thing has become quite clear: Communications using electronic images is a worldwide phenomenon, one that will continue to grow in importance. Our basic television systems, PAL, SECAM, and NTSC, were developed as national transmission systems. Studios used the same format for convenience, unfortunately allowing no head room for processing prior to transmission. Worldwide communications did not seem to be a factor. Today, many homes have video tape recorders, are served by cable systems and receive satellite signals. The program producers in Hollywood will have greater revenue this year from video releases than they will from cinema releases. The continents are tied together with video via satellite. Yet there is no electronic equivalent to 35mm film. The highest technical quality productions are made using 35mm film, a worldwide standard which is convertible to all television standards. The technology is here today for an equivalent electronic image. The risk is that we will have, once again, national standards for high definition television rather than a world standard. We cannot let this happen.

There is a proposal for a CCIR Recommendation before us, the 1125/60/2:1/16:9 system [lines per frame/field rate/scanning format/aspect ratio]. The United States strongly supports the adoption of the proposed new Recommendation. This position is clearly stated in a document that has been submitted to the CCIR Plenary Assembly. The document has been distributed to this meeting. However, some countries say we need to do more study, that we should have taken a harder look at sequential scan. Others say the public doesn't want or need higher definition television, that the MAC enhancements will be sufficient. Still others say the 60 Hz field rate will be a problem in countries with 50 Hz mains and that we must establish transmission standards before we can agree to a production standard.

I would like to address each of these counter arguments.

The debate in the United States centered on the first of these points. The basic decision was taken on March 19, 1985, in a meeting of the ATSC Technology Group on High Definition Television. Several people had expressed interest in sequential scan. The arguments were quite varied. Some argued for a moderate increase (above 525) in the number of scanning lines but with the scanning system being sequential. They agreed that the static resolution would be less than the 1125/60/2:1 system but that the dynamic resolution would be greater. Others argued that the system should be 1125/60/1:1. Still others thought a proposed system should have at least 2000 lines with sequential scan.

The decision came about in the following way. The desire was very strong to achieve a worldwide standard. Unanimity clearly existed on this subject. A proposal was made to support the 1125/60/2:1/16:9 system as a worldwide standard. The only alternative that existed was to postpone the decision for four years. There were no other proven, tested, demonstrated,

alternative systems. There was a strong fear, however, that delay would simply produce multiple defacto standards. The time had arrived to fish or cut bait. A vote was taken and the proposal was passed by a 3 to 2 majority. I would note that such a majority in an American presidential election is called a landslide. An amendment was proposed and a unanimous vote followed. The amendment added a line stating that sequential scan studies should continue. This was seen as a way that the standard could be enhanced when future technology permitted, for example 1125/60/1:1. It was not viewed in the context of a lower number of lines, nor was it seen as an alternative standard. Two weeks later, the ATSC Executive Committee unanimously agreed to forward the proposal to the Department of State.

The overpowering argument throughout the debate on March 19 was that there should be worldwide agreement and that the decision had to be taken now. If you give a task to a group of engineers they will each come up with a different solution. In general, the solutions will have an equal balance. Each solution has its advantages and its disadvantages. But, on balance, they are usually similar. Given the time, one can generally find a better solution. This is always true. But, if you wait for the better solution, another better solution will be on the drawing board. It is a never ending scenario as technology advances.

CBS has recently prepared a document for the EBU V1-HDTV Specialist Group addressing EBU questions on sequential scan. A copy of the document has been distributed. CBS poses a very powerful argument. Consider 1125/1:1 vs. 2250/2:1. The bandwidths are the same. The dynamic resolution will be the same since both systems scan 1125 lines in one-sixtieth of a second. The 2250/2:1 system will clearly have greater static resolution. The appendix to the paper shows that the 2250/2:1 signal can be downconverted to 1125/1:1 resulting in a signal that is as good as an originally generated 1125/1:1 signal. The 2250/2:1 system would have interline twitter since it is an interlaced system. That is the trade-off, static resolution vs. interline twitter! For a given bandwidth, the interlaced system contains more information. The greatest value to be obtained from sequential scanning is enhancement of the display device in an interlaced system.

The next issue I want to address is the question, "Does the public need a higher definition television system?" This question is misdirected. What we are discussing in the CCIR is a production standard. Yes, we definitely need a better production standard than 625/50 or 525/60. There is such a film standard but there is no electronic equivalent for communications. When one asks if the public needs higher definition one is asking a question about the future. After electronic production exists, will the public want that capability in their homes? Many people think the public will want such quality, but this is an economic question for the future. If enough people want it, we engineers will find a way to deliver it!

The follow-up to the last question is, "Is not extended MAC sufficient if there is a need for higher definition?" It may be, it may not be. This, again, is a valid question for the future. The extended MAC proposals keep the same number of scan lines. A high definition production standard must have greater vertical resolution. There is general agreement that the equivalent resolution for 35mm film is in the 1000 line range. A film master will be more than 1000 lines; what is typically viewed in the cinema is less than 1000 lines.

Concerning the question of a 60 Hz field rate in a 50 Hz mains environment, I would point out that 35mm film, rather widely used, has a 24 Hz frame rate. I would also point out that Japan has both 50 Hz and 60 Hz mains. NTSC news crews often shoot in 50 Hz mains

environments and PAL/SECAM news crews often shoot in 60 Hz mains environments. Furthermore, there is significant interest in Hollywood for adopting a 30 Hz frame rate for film. It is obvious why Hollywood expresses interest in a 30 Hz frame rate. They anticipate that their revenue from television releases, much of it on videocassette, will continue to increase while revenue from cinema releases will remain somewhat constant as it has for several years. The only real problem that has come to our attention is single phase gas discharge lighting. It is reasonable to assume that this problem will go away with time. In the event the problem is faced, a flicker eliminator has been developed to process the signal to remove the flicker.

Attempting to establish transmission standards before establishing a production standard becomes an impossible problem. The production standard must produce the master copy. It must be of the highest quality. The production standard must be able to support the various television standards. It must have head room built into the standard. Many other factors, totally unrelated to production, become significant when transmission is introduced. What bandwidths are available and in what bands? Will some or all countries have terrestrial emission of HDTV? Will HDTV be available only via DBS? Will cable operators have different requirements? This will vary around the world and within different countries. We must first establish the production standard, then transmission can follow. If transmission standards were established first, they would tend to be the lowest common denominator, not the highest quality. The resulting standard would be unacceptable for production. Once the parameters for production are agreed, the experts can begin to assess the various needs for transmission.

Some people have raised fears that adoption of this HDTV Recommendation would cost a great deal of money because it would make all current equipment obsolete. This simply is not true. While the adoption of the Recommendation would be very valuable to those who intend to enter HDTV production, it would not oblige any program producer to do so. The use of HDTV immediately or in the future remains entirely at the discretion of each program producer or user. No one will be required to purchase or use HDTV equipment unless they so choose. The decision to import or export either television programs or studio equipment in the international marketplace is a voluntary individual decision that will be undertaken on the basis of economic and political factors.

There are some other papers which have been distributed to this meeting. There are two large booklets, referred to as the Blue Books and dated January 1986, that are being distributed by CBS. The first of these booklets consists of five chapters:

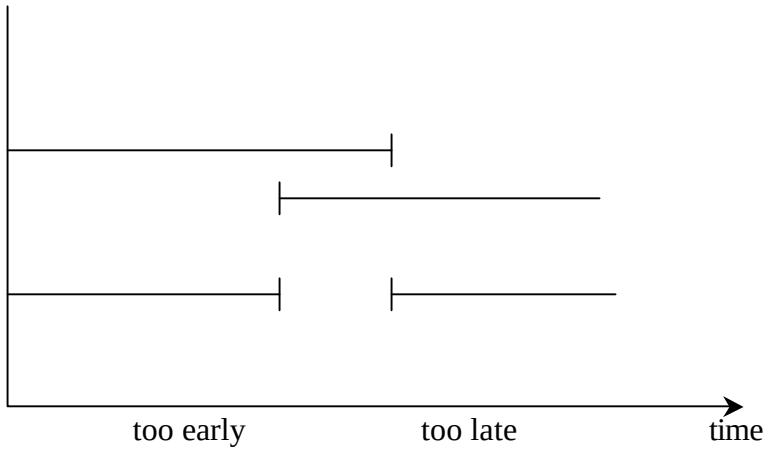
1. Executive Summary
2. Why HDTV?
3. A Short History of HDTV
4. Some Questions and Answers
5. Summary of Technical Issues and Appendices.

The second booklet contains 14 documents that have been written during the past few years by various organizations. One other paper, on an ATSC letterhead and dated January 29, 1986, contains several questions, with answers, that have been presented to the ATSC.

In closing, I would like to comment on a paper given by Howard Jones of the BBC Research Center to the International Broadcasting Convention in Brighton in 1980. Howard was

the chairman of V1-VID, the EBU Specialist Group that was struggling with the digital standard. Howard was giving a progress report for the Specialist Group. He began by showing a timing chart that had the words "too early" and "too late" along the x-axis. There were two sets of lines in the chart. In the first set, the period "too early" was shown ending after "too late" began, an overlap. In the second set, "too late" began after "too early" ended.

TIMING CHART FOR A STANDARD



Howard postulated that it is impossible to establish a standard in the first case. The engineers are still arguing that it is too early to establish a standard while the economic and political forces have already decided that it is too late because of vested interests. The second case can lead to a standard, but only in the window of time between the end of "too early" and the beginning of "too late." In his opinion, the timing related to a digital studio standard was just entering the window. He challenged the audience to quickly reach agreement.

In the case of high definition television, we, too, have entered the window. Four years from now will be too late.