United States General Accounting Office

GAO

Report to the Chairman, Subcommittee on Telecommunications and Finance, Committee on Energy and Commerce, House of Representatives

March 1990

HIGH DEFINITION TELEVISION

The Effects of Standards on U.S. Entertainment Industries

GAO/IMTEC-90-33

GAO

United States
General Accounting Office
Washington, D.C. 20548

Information Management and
Technology Division

B-237265

March 16, 1990

The Honorable Edward J. Markey
Chairman, Subcommittee on Telecommunications
and Finance
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

This report responds to your April 28, 1989, letter, which asked us to provide information on high definition television (HDTV) standards. In subsequent meetings with your office, we agreed to assess the effect that the selection of (1) a worldwide HDTV production standard would have on the U.S. motion picture and television industry's ability to market its movies and television programs internationally and (2) a domestic transmission standard would have on the ability of U.S. firms involved in television transmission and manufacturing to participate in HDTV. This report focuses on HDTV as an entertainment medium; a previous report discussed other potential applications for HDTV.[1] In this review, we obtained information primarily through interviews with officials representing the motion picture and television industry, academic and research organizations, and government agencies knowledgeable about HDTV. (App. I contains additional information on our objectives, scope, and methodology.)

Results in Brief

Although efforts to adopt a single worldwide HDTV production standard have been unsuccessful, the absence of such a standard will not negatively affect the U.S. entertainment industry's ability to successfully market its movies and television programs. The U.S. motion picture industry will continue to produce movies and television programs in 35 millimeter film and convert them to accommodate multiple HDTV standards. Additionally, manufacturers of production equipment—studio cameras, for example—will manufacture multiple lines of HDTV equipment to accommodate different standards, but believe they will otherwise be unaffected by the lack of a single standard.

However, the adoption of an over-the-air transmission standard—an area regulated by the Federal Communications Commission (FCC)—is

[1] High Definition Television: Applications for This New Technology (GAO/IMTEC-90-9FS, Dec. 11, 1989).

important to U.S. broadcasters and television manufacturers.[2] While Japan's and Europe's HDTV systems are designed for satellite transmission, the primary transmission medium in the United States is over-the-air broadcast. However, the technology to successfully transmit HDTV signals over-the-air, within current regulatory constraints, is still under development. Without a standard, broadcasters will be at a competitive disadvantage with cable and satellite companies because the technology is already available for them to transmit HDTV. However, broadcasters may not be able to transmit a television picture comparable to that of cable and satellite, even after the adoption of an over-the-air transmission standard, because of regulatory and technical constraints. Furthermore, because television design is closely linked to the transmission system, television manufacturers need to know what transmission system will be used in order to manufacture the appropriate sets.

Background

HDTV is a new video technology, pioneered by the Japanese, that has a wider and much sharper television picture, similar to the quality of films shown in theaters. HDTV significantly improves picture quality by increasing the number of scanning lines (horizontal lines that make up a television picture) from 525 to over 1,000. This improved picture quality can best be viewed on a large screen. In addition, HDTV has improved color and digital stereo sound. HDTV, however, is not compatible with current U.S. television technology, and as a result, consumers cannot view HDTV on existing television sets, and broadcasters cannot use current transmission equipment to transmit HDTV.

An HDTV system has three related parts: production, transmission, and display. The production part of the system creates the television program. It includes the camera used to convert an image into an electronic signal. During transmission the television program is transferred, in the form of an electronic signal, from a central distribution center to the television viewer. The display part of the system transforms the information transmitted into a viewable image.

There are currently two distinct but related HDTV standards at issue—production and transmission. A production standard is a set of technical specifications that determine how audio and visual information is created and recorded. Production standards determine the design and manufacture of production equipment, such as studio cameras and videotape

[2]Broadcasters, as used in this report, means over-the-air broadcasters, as distinguished from cable and satellite broadcast.

recorders. Transmission standards determine how the audio and visual information is converted to a signal format and transmitted to the viewer. Television pictures can be transmitted over-the-air, by cable, or by satellite. Transmission standards also affect the design and manufacture of television sets.

Presently, television programs are produced in two formats—35 millimeter film and video.[3] Currently, however, 35 millimeter film—the highest quality production format available—is the accepted worldwide production standard for the international exchange of movies and television programs. Although video production has some advantages over film, such as simplifying post production and creating special effects, current video production technology is inferior in quality to that of 35 millimeter film. HDTV, however, is a new video technology that offers both the advantages of video production and the quality of 35 millimeter film. As a result, some believe that HDTV may be an alternative production format for movies and television programs in the future.

Since the 1980s, the International Radio Consultative Committee (CCIR), an international voluntary standards setting body which is part of the United Nations, has been working toward the adoption of a single worldwide HDTV production standard—similar in quality to 35 millimeter film—to ease the international exchange of television programs and movies. At the 1986 CCIR Plenary meeting, the United States and Japan proposed the adoption of a modified Japanese production standard to be used by motion picture and television studios worldwide. At that time, it appeared that the Japanese standard would be adopted as the worldwide production standard. To realize the benefits of a single worldwide production standard, U.S. industry representatives supported this standard, even though some representatives had reservations about technical aspects of the Japanese standard. However, the European Community rejected the Japanese standard. The Japanese had developed an entire HDTV system—designed for satellite transmission—and were already manufacturing related equipment. Therefore, although the European Community objected to the standard for technical reasons, many believe that they rejected the standard because they believed Japan would get a marketing advantage for consumer equipment derived from its standard.

[3]Film is a chemical process; it requires a chemical to develop the images or pictures. Video is an electronic process; it electronically records images on videotape.

During the 1986 CCIR meeting, European objections to the Japanese standard and the subsequent announcement of Europe's intention to develop its own HDTV system—designed for satellite transmission—made it unlikely that CCIR participants would be able to agree on any worldwide production standard, at least in the short-term. As a result, U.S. industry consensus to adopt the Japanese standard dissolved. Although some U.S. industry representatives continued to work toward the adoption of a production standard, the emphasis in the United States shifted from production to transmission because neither Europe nor Japan was developing an over-the-air transmission standard—the United States' primary transmission medium—for HDTV. As a result, the FCC—a U.S. government agency that regulates over-the-air broadcast—began coordinating efforts to develop an HDTV over-the-air transmission standard. (App. II contains additional information on CCIR's efforts to adopt a worldwide HDTV production standard.)

Absence of a Worldwide HDTV Production Standard Will Not Negatively Affect U.S. Industry

A single worldwide HDTV production standard could benefit the motion picture and production equipment manufacturing industries by making the marketing of programs easier and reducing equipment manufacturing costs. However, the lack of such a standard will have little effect on these industries' ability to participate in the global HDTV market. The U.S. filmmaking community, currently the single largest producer of theater and television programs, is responsible for a trade surplus in excess of $1 billion. Representatives of this industry believe they will continue to be successful, even after HDTV is introduced, because they sell their programs primarily on content rather than picture quality. In addition, industry representatives believe they will continue to produce most motion pictures and television programs in 35 millimeter film—the currently accepted worldwide production standard—because (1) CCIR participants are not likely to reach agreement on a single worldwide HDTV production standard soon, (2) 35 millimeter film is the highest quality production format available, and (3) the motion picture industry prefers 35 millimeter film as a creative production medium.

35 Millimeter Film Will Continue as the Worldwide Production Standard

As a result of the controversy surrounding the adoption of an HDTV production standard, CCIR participants have been unable to agree to a single standard. The Japanese and the Europeans have made significant investments in their HDTV systems, and each would like its production standard adopted worldwide. Without a single HDTV production standard, there will be a need to convert among HDTV standards, just as there is a need to convert among the multiple current television standards. As

a result, most motion picture and television industry officials agree that 35 millimeter film will likely continue as the preferred production format for international program exchange.

According to motion picture and television industry officials, film is the highest quality production format currently available with about 2,000 lines of resolution. As a result, it converts well to all current television standards, and according to motion picture industry officials, will also convert well to HDTV standards.

Although most motion picture industry officials agree that there are advantages to producing on video, particularly in creating special effects, the majority of the filmmaking community prefers film as a creative medium at the present time. Film is supported by an entire industry of craftsmen, including cinematographers, who are accustomed to using film, like the way it looks, and can create moods with film that cannot be created with video. In addition, the quality of film continues to improve. Furthermore, a large U.S. filmmaking company has recently developed an electronic intermediate system that allows the filmmaking community to enjoy some of the benefits of video production—special effects, for example—while continuing to use 35 millimeter film as its primary production medium. With this system, film is converted to a high resolution video format, manipulated, and then transferred back to film while maintaining the high resolution imaging capabilities of film.

Production Equipment Firms Are Unaffected by the Lack of a Worldwide Standard

Equipment manufacturer representatives we interviewed stated that the lack of a single HDTV production standard will not affect their ability to compete in the world market. Currently, they manufacture to multiple standards and sell their equipment internationally. A single worldwide production standard, however, reduces manufacturing costs by eliminating the need for multiple production lines.

Transmission Standards Are Important to HDTV Participation

The adoption of an over-the-air transmission standard is needed to allow U.S. broadcasters and television manufacturers the opportunity to participate in HDTV. Whereas the Japanese and European HDTV systems are designed for satellite transmission, the primary transmission medium in the United States is over-the-air broadcast. However, the technology necessary to transmit HDTV signals over-the-air, within current regulatory constraints, has not been fully developed, and as a result, the selection of a standard is years away. Furthermore, without a transmission standard, U.S. broadcasters could be at a competitive disadvantage with

cable and satellite companies. They do not have the same regulatory and technical limitations as broadcasters and the technology is already available for them to transmit HDTV. Although cable companies can use the foreign technology and transmit HDTV, an over-the-air transmission standard is important because of their role in retransmitting broadcast programming. A transmission standard is also important to television manufacturers because it affects the design of television sets.

Broadcasters Could Be Disadvantaged Without a Transmission Standard

The FCC regulates over-the-air broadcasting and allocates spectrum—the continuous range of radio frequencies in which television signals are transmitted over-the-air. Spectrum, however, is limited and broadcasters must compete with other services, such as cellular phones, for additional spectrum. Currently, broadcasters are limited to transmitting television signals within 6 megahertz (MHz) of bandwidth.[4] HDTV, however, has about four to five times the information as current television and, as a result, transmitting an HDTV television signal requires a wider bandwidth than is available for current television.

In 1987, in response to broadcasters' concerns about transmitting HDTV, the FCC began coordinating efforts to develop an HDTV over-the-air transmission standard. In addition, the FCC established the Advisory Committee on Advanced Television to coordinate the development of the standard and to assist the FCC with the technical and policy issues surrounding over-the-air HDTV broadcasts.

The FCC issued a tentative decision, in September 1988, in which it concluded that existing service to viewers using current television sets must be continued, at least for a transition period, and that no more than an additional 6 MHz of bandwidth per channel would be allocated for HDTV transmission. The FCC further stated that this additional bandwidth would have to come from spectrum already dedicated to television. Although additional spectrum—outside of what had been allocated for television use—may be available for over-the-air broadcast of HDTV, the FCC has tentatively decided not to consider the use of any spectrum not already allocated for television use.

The FCC's requirement to continue existing television service to consumers provides continuity by ensuring that the 160 million television sets in the United States do not become obsolete with the introduction of

[4]Bandwidth is that portion of the spectrum available to transmit a single television signal, usually expressed in millions of cycles per second or megahertz (MHz).

HDTV. However, its requirement that broadcasters transmit an HDTV television signal—a signal that contains about four to five times the information of current television—within 6 MHz makes it difficult for broadcasters to transmit HDTV. The technology to transmit an HDTV signal within 6 MHz of bandwidth has not yet been fully developed.

As a result of the technical challenges associated with the over-the-air broadcast of HDTV, a number of organizations, including U.S. and foreign-based television manufacturers, are developing prototype HDTV systems to meet the FCC criteria, as outlined in the tentative decision. However, because the technology to transmit HDTV within 6 MHz is not yet fully developed, many of the prototype systems improve the current television picture, but do not have the same picture quality that can be transmitted by cable or satellite. The FCC will choose a standard from among these prototype systems. In addition, broadcasters have established the Advanced Television Testing Center to test these prototype systems. The first of these systems is scheduled to begin testing in the summer 1990 and testing is expected to be completed by 1992.

In contrast to over-the-air broadcast, satellite broadcast does not have the same bandwidth limitations, and as a result, can transmit a wider HDTV signal resulting in superior picture quality. Furthermore, not only is satellite capable of transmitting a wider HDTV signal, satellite transmission systems have already been developed and demonstrated. The Japanese—whose HDTV system is designed for satellite transmission—are already manufacturing equipment to transmit and receive an HDTV satellite signal. In addition, at least one U.S. company has successfully transmitted HDTV programming in the United States.

In addition to satellite, cable can also transmit a wider HDTV signal. Although many cable companies' channel capacity is near or at full capacity, unlike broadcasters, they are not dependent on the FCC for additional channels. To transmit a wider bandwidth HDTV signal, cable systems could expand their systems to add channels or drop existing channels to devote the additional bandwidth to HDTV. However, although cable companies can transmit a wider HDTV signal, an over-the-air transmission standard is important because of cable's role in retransmitting broadcast programming to the public. According to National Cable Television Association estimates, cable is the means by which 54 percent of U.S. households receive broadcast television. The average cable system includes 35 channels, and approximately 5 are broadcast channels. These 5 channels, however, account for 52 percent of the programming watched in cable households.

Even with the adoption of a transmission standard for over-the-air broadcast of HDTV, broadcasters may still be at a disadvantage when compared with cable and satellite. According to an Advisory Committee report,[5] in the present stage of technical development, channels of more than 6 MHz are necessary to transmit HDTV signals comparable in quality to those that will be offered by other transmission media.[6]

Transmission Standards Affect Television Design

Transmission standards will determine the design and manufacture of HDTV sets sold in the United States. Television manufacturing in the United States, however, is currently dominated by foreign firms; only one U.S.-owned firm remains. Both U.S. and foreign-based manufacturers have developed prototype over-the-air transmission systems. The manufacturer—whether U.S. or foreign-based—whose transmission system is selected as the standard, may economically gain from owning the technology and licensing other manufacturers. In addition, the owner of the selected system will have a short-term advantage in manufacturing the high definition televisions.

Conclusions

HDTV production standards will have little influence on the U.S. motion picture and production equipment manufacturing industries' ability to participate in the international market. With the CCIR unlikely to reach consensus on a worldwide production standard in the near-term, the motion picture industry will continue to produce in 35 millimeter film. Furthermore, because the use of 35 millimeter film seems to be firmly entrenched within the industry for artistic reasons, the motion picture industry may continue to use this medium, at least for some time, even after the adoption of an HDTV production standard. Conversion to any HDTV production standard does not present significant technical difficulties, and therefore, will not hamper the motion picture industry's ability to market its programs internationally. As with the motion picture industry, HDTV production standards will have little influence on production equipment manufacturers' ability to participate in the international market.

Transmission standards are critical to broadcasters', and to a lesser extent, television manufacturers' participation in the domestic HDTV market. Broadcasters have taken the lead in developing an over-the-air

[5]Interim Report of the FCC Advisory Committee on Advanced Television Service, June 16, 1988.

[6]Japanese technology is currently available to transmit an HDTV satellite signal within 9 MHz.

transmission standard and this medium is likely to drive initial HDTV development, and more specifically, television manufacturing in the United States. The FCC's decision to continue existing television service and limit the bandwidth available for HDTV transmission, however, has created a technical hurdle which will have to be overcome before broadcasters can transmit HDTV and a standard can be selected. Other media, such as cable and satellite, are not subject to the same regulatory and technical limitations and the technology is available to transmit HDTV. Although cable companies are unlikely to introduce HDTV in the near-term because of their role in the retransmission of broadcast programming, this situation may create an opportunity for satellite companies to compete with broadcasters by introducing HDTV.

Furthermore, HDTV and the FCC decision may ultimately lead to competitive and structural changes in the television media industry. Given current regulatory and technical constraints, even with adoption of an over-the-air transmission standard, broadcasters will not be technically capable of delivering a picture of comparable quality to that of cable and satellite. As a result, broadcasters may be at a long-term competitive disadvantage with these other media. Moreover, this situation could create the opportunity and incentive for cable and satellite companies to offer alternative programming that could ultimately challenge the broadcasters' current role as the dominant programming source.

We did not obtain official agency comments on this report, however, during our review we discussed our findings with cognizant industry and government officials. As agreed with your office, we plan no further distribution of this report for 30 days from the date of this letter, or until you publicly release it. We will also provide copies to the Secretary of Commerce; Secretary of Defense; Secretary of State; and the Commissioner, Federal Communications Commission. We will make copies available to other interested parties upon request.

This report was prepared under the direction of Jack L. Brock Jr., Director, Government Information and Financial Management, who can be reached at (202) 275-3195. Other major contributors to this report are listed in appendix III.

Sincerely yours,

Ralph V. Carlone

Ralph V. Carlone
Assistant Comptroller General

Contents

Abbreviations

ATSC	Advanced Television Systems Committee
CCIR	International Radio Consultative Committee
FCC	Federal Communications Commission
GAO	General Accounting Office
HDTV	High Definition Television
IMTEC	Information Management Technology Division
MHz	megahertz
SMPTE	Society of Motion Picture and Television Engineers

Objectives, Scope, and Methodology

The objectives of our review were to assess the effect the selection of (1) a single worldwide HDTV production standard would have on the motion picture and television industry's ability to market programs internationally and (2) a domestic transmission standard would have on the ability of U.S. firms involved in television transmission and manufacturing to participate in HDTV.

We obtained information primarily through interviews with production studios; television networks; cable companies; manufacturers of television sets, production equipment and film; industry associations; academic and research organizations; and government agencies knowledgeable about HDTV. We obtained this information from the following organizations:

- 20th Century Fox, Beverly Hills, California;
- Metro-Goldwyn Mayer/United Artists Telecommunications, Inc., Culver City, California;
- Paramount Pictures Corporation, Hollywood, California;
- Universal City Studios, Inc., Universal City, California;
- Walt Disney Studios, Burbank, California;
- Warner Brothers, New York, New York;
- Rebo High Definition Studio, Inc., New York, New York;
- American Broadcasting Companies, New York, New York;
- CBS, New York, New York;
- National Broadcasting Company, New York, New York;
- Public Broadcasting Service, Alexandria, Virginia;
- Tele-Communications, Inc., Denver, Colorado;
- Viacom International, New York, New York;
- Hubbard Broadcasting, St. Paul, Minnesota;
- North American Philips Corporation, Briarcliff Manor, New York;
- SONY Corporation of America, Teaneck, New Jersey;
- Thomson Consumer Electronics, Washington, D.C.;
- Zenith, Glenview, Illinois;
- Ampex, Redwood City, California;
- Tektronics, Beaverton, Oregon;
- Eastman-Kodak, Rochester, New York;
- American Electronics Association, Santa Clara, California;
- Association of Maximum Service Telecasters, Washington, D.C.;
- Electronics Industry Association, Washington, D.C.;
- Motion Picture Association of America, Washington, D.C.;
- Motion Picture Export Association, New York, New York;
- National Association of Broadcasters, Washington, D.C.;
- National Cable Television Association, Washington, D.C.;

- Society of Motion Picture and Television Engineers, White Plains, New York;
- Advanced Television Systems Committee, Washington, D.C.;
- Advanced Television Test Center, Alexandria, Virginia;
- Massachusetts Institute of Technology's Advanced Television Program, Cambridge, Massachusetts;
- Konnie Schaefer and Associates, Washington, D.C.;
- Department of State, Washington, D.C.;
- Federal Communications Commission, Washington, D.C.;
- National Telecommunications Information Administration, Washington, D.C.;
- National Institute of Standards and Technology, Gaithersburg, Maryland; and
- Defense Advanced Research Projects Agency, Arlington, Virginia.

Additionally, we reviewed State Department files and responses to the National Telecommunications Information Administration notice of inquiry to determine international activities in adopting a worldwide production standard and U.S. industries' position on the adoption of a single worldwide production standard. We also reviewed responses to the Federal Communications Commission's notice of inquiry to determine U.S. industries' position on the selection of a domestic transmission standard.

In assessing the impact of adopting production and transmission standards, we focused on the use of HDTV as an entertainment medium. We did not attempt to assess the effect that the adoption of a production standard could have on the U.S. computer industry, including the semiconductor industry.

Our work was conducted from June to December 1989, in accordance with generally accepted government auditing standards. Our work was conducted either at the locations cited above or the Washington, D.C. metropolitan area. We did not obtain official agency comments on this report, however, during our review we discussed our findings with cognizant industry and government officials. Their comments have been incorporated into this report where appropriate.

CCIR Efforts to Adopt a Worldwide HDTV Production Standard

The International Radio Consultative Committee (CCIR) is an international voluntary standards setting body. The CCIR's role is to study and adopt recommendations on technical and operating issues relating to radiocommunication. It is a permanent section of the International Telecommunications Union, a specialized agency of the United Nations. The CCIR is divided into 11 study groups that research radio and television broadcasting issues and make recommendations for adoption by the full CCIR membership. The full membership meets at the Plenary meetings, held once every 4 years, and votes to adopt the study group's recommendations. The CCIR represents about 160 countries. The State Department is the official U.S. representative to the CCIR.

The following sections describe (1) the CCIR's initial interest in HDTV as a result of Japanese research and development, (2) the U.S. position on a worldwide production standard,[1] (3) the CCIR's efforts to adopt a worldwide HDTV production standard, and (4) the current status of CCIR alternatives to a single worldwide production standard.

Early Research and Development

The Japanese—who have been involved in HDTV development for over 15 years—have developed an entire HDTV system, including production, transmission, and display and related equipment, such as studio cameras, videocassette recorders and television sets. The original Japanese HDTV system was based on a 1125/59.94 production standard. The standard was interlace scan[2] with 1125 scanning lines (the horizontal lines that make up a television picture), a 59.94 field rate (the number of times per second a field, or half the complete television picture, is refreshed), and a 5:3 aspect ratio (the width of the picture compared to its height).

The Japanese HDTV system generated a great deal of interest among members of the Society of Motion Picture and Television Engineers (SMPTE), an international professional organization that develops voluntary standards. They were interested in determining the technical viability of the Japanese production standard. SMPTE reviewed the Japanese standard and made two modifications. First, the field rate was changed

[1] A production standard is a set of technical specifications that determine how audio and visual information is created and recorded.

[2] Interlace scanning traces the lines of a television picture in two parts, or fields, and interweaves them to create an entire television picture.

from 59.94 to 60 to simplify editing.[3] Second, the aspect ratio was changed from 5:3 to 16:9 to accommodate Hollywood's preference for a wider screen. Japanese companies incorporated the changes and began manufacturing equipment for the 1125/60 production standard. Although the resulting standard, 1125/60, is officially called SMPTE 240M, it is often referred to as the Japanese standard.

Throughout their efforts to develop HDTV, the Japanese had continually submitted documents to the CCIR noting their progress. As a result, in the early 1980s, the CCIR became interested in HDTV and initiated efforts to adopt a worldwide HDTV production standard. The State Department, as part of its role as the U.S. representative to the CCIR, initiated action to develop a U.S. position on a worldwide production standard.

U.S. Position on a Worldwide Production Standard

In the United States, the Advanced Television Systems Committee (ATSC), was established to develop HDTV standards and to develop a U.S. position on a worldwide production standard for the State Department to propose to the CCIR. ATSC considered the 1125/60 standard as a worldwide standard because it had been approved by SMPTE as technically viable and because 1125/60 equipment was already available. Some members, however, expressed reservations about 1125/60 as the worldwide production standard because they preferred a progressive scan standard.[4] However, ATSC members agreed to support 1125/60 because it appeared that it would be adopted as the worldwide production standard. As a result, ATSC approved the 1125/60 standard and recommended that the State Department support it as a worldwide HDTV production standard at the 1986 CCIR Plenary meeting.

CCIR Efforts to Adopt a Worldwide Standard

At the CCIR's 1986 Plenary meeting, the United States and Japan proposed 1125/60 as a worldwide HDTV production standard. The European Community, however, opposed the 1125/60 production standard, primarily for political and economic reasons, rather than technical. Many believe that the European Community—in the interest of protecting European television manufacturers from Japanese competition—rejected the 1125/60 standard because they believed the adoption of the standard would provide the Japanese a marketing advantage in consumer equipment such as television sets and videocassette recorders. In

[3]The choice of 60 instead of 59.94 allows a perfect relationship between actual clock time and tape time.

[4]A progressive system scans the lines of a television picture sequentially.

addition, Europe wants to promote sales of its own programs and films. The U.S. motion picture industry supplies about 30 percent of the programs shown on European television and adoption of a worldwide production standard would make it easier for U.S. programming to be shown in Europe.

Officially, however, the European Community opposed 1125/60 as a worldwide production standard because of its field rate. They argued that programs produced using the 1125/60 standard would require conversion in European countries where the field rate is 50. Converters did not yet exist and concerns were raised about the degradation (loss of picture detail) and cost of converting 1125/60 programming to a field rate of 50.

At CCIR's request, the Japanese developed equipment to convert 1125/60 programs to a field rate of 50. The conversion process was acceptable to CCIR participants, including the European members. Despite the successful conversion, however, the European Community continued to reject the 1125/60 standard as a worldwide production standard, and began development of their own HDTV system, 1250/50 (1250 scanning lines and 50 fields per second). The European Community has recommended its standard to the CCIR for consideration as a worldwide HDTV production standard.

However, a field rate of 50 is unacceptable to the United States and Japan. A lower field rate updates the television picture less often. This results in inferior motion portrayal, such as blurring, and a flicker in the picture; a rapid visible change in brightness that occurs when the picture does not change often enough for the human eye. Conversions from a field rate of 50 to 59.94 are difficult. Although such conversions are technically possible, converting from a lower field rate is more difficult than converting in the other direction because additional fields have to be created.

When it became clear that 1125/60 would not be accepted as the worldwide production standard, U.S. industry consensus broke down. Many believed that without a single worldwide production standard, the United States should adopt an HDTV system compatible with its existing conventional television standards and equipment. Both proposed standards, 1125/60 and 1250/50, are designed for satellite transmission, but the primary transmission medium in the United States is over-the-air broadcast.

Several organizations, including television manufacturers, began developing HDTV prototype systems that could be transmitted over-the-air in the United States. One prototype has a 1050/59.94 production standard; 1050 scanning lines, 59.94 fields per second, 16:9 aspect ratio, and interlace scanning. This standard was suggested because of its relationship to our current television standard, 525/59.94. Some manufacturers believe that doubling the scanning lines from 525 to 1050 and maintaining the same field rate will simplify conversions. However, 1050/59.94 production equipment does not yet exist. In October 1988, the National Broadcasting Corporation asked SMPTE to approve the 1050/59.94 standard. SMPTE is currently reviewing the standard.

Zenith has been developing a prototype system, 785.5/59.94 which has 787.5 scanning lines, 59.94 fields per second, 16:9 aspect ratio, and progressive scanning. Progressive scanning provides high resolution because all the information is contained in one frame or television picture. However, a progressively scanned system requires more bandwidth (information capacity available to transmit a television signal) than an interlaced system. In addition, the field rate of 59.94 maintains compatibility with the current U.S. transmission system. Zenith has recently submitted its production standard to SMPTE for technical review.

Current Status of CCIR Activities

With the current controversy surrounding adoption of a worldwide production standard, it appears unlikely that CCIR participants will reach agreement in the near-term. As a result, the United States and other CCIR representatives proposed common image format as an interim step toward adopting a worldwide standard. Common image format is an effort to agree on common parameters that define the picture in a production standard. Such parameters include the number of scanning lines, aspect ratio, and color. The more parameters in common, the easier it is to convert between production standards. It is highly unlikely that CCIR members will agree to a common field rate because that appears to be the greatest technical obstacle to a worldwide standard.

As of October 1989, CCIR's Study Group 11 members have agreed to 23 of 34 parameters. They must unanimously agree to the individual parameters before they can present them to the full CCIR membership at the Plenary Meeting in May 1990. They are scheduled to meet again in March 1990 in an attempt to get agreement on the remaining parameters, but not field rate.

Another approach, common data rate, has been proposed for worldwide adoption by several European countries and other CCIR representatives. Common data rate is an agreement on the rate at which information flows through a tape recorder, however, it is not a substitute for a worldwide production standard. Common data rate could benefit tape recorder manufacturers by eliminating the need for several production lines. If the data rates of the production standards selected are similar, manufacturers could produce a recorder that could be used for two different production standards.

The effects of common image format and common data rate are unclear. It is unlikely that common image format or common data rate will result in the development of a single worldwide production standard. Since field rate will not be decided, there will be at least two production standards; a standard with a field rate of 60, and a standard with a field rate of 50. Common data rate controls only the flow of information contained in the production standard.

Some industry representatives suspect that common image format is an attempt to allow the United States time to develop its own HDTV production and transmission standards, while others acknowledge that it keeps CCIR countries negotiating and working toward a single worldwide production standard.

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