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AUTHOR Hongcharu, Boonchai
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ABSTRACT

The telecommunications industry has now entered the most critical period of evolution in television technology since the introduction of color television. The transition to high definition television (HDTV), with related technologies such as semiconductors and computers, would mean a multi-billion dollar business for the telecommunications industry. With its enormous economic impact, HDTV now becomes one of the most important policy issues of the nation. HDTV is both visual-and-audio-improved television with a wider aspect ratio. However, this advanced television requires a new transmission standard and more spectra. Currently, broadcasters, direct broadcast satellite operators, cable and telephone companies, as well as HDTV production equipment and videocassette recorder manufacturers, compete with one another to have a share in HDTV business. With its tremendous impact on the American economy, HDTV should be guided by the appropriate public policies from government and industry. Some suggestions for government policies are outlined under the following headings: government-industry cooperation; government funding; tax incentives; legislation; relief of the antitrust laws; and international cooperation and technology transfer. It is expected that the government will pay more attention to the rapid progress in the telecommunication industries and come up with appropriate policies and actions in the near future. HDTV represents a major policy and economic challenge to America at this time. (Twenty-eight references are appended.) (MS)

HIGH DEFINITION TELEVISION: A NEW CHALLENGE FOR TELECOMMUNICATION POLICY

BOONCHAI HONGCHARU

S.I. NEWHOUSE SCHOOL OF PUBLIC COMMUNICATIONS

SYRACUSE UNIVERSITY

SYRACUSE, NEW YORK

(Paper presented at the 1989 AEJMC Communication Technology and Policy division in Washington D.C.)

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High definition television is another challenge for telecommunication policy as it affects not only the telecommunication industries but also other industries that require high resolution visual imaging. With HDTV's strong impact on the economy, government officials must establish policies for this new technology, and many are urging the government to take a more cooperative role with industry in policy development. This study provides some suggestions and progress on these issues.

High definition television (HDTV) is both visual-and audio-improved television with a wider aspect ratio. However, this advanced television requires a new transmission standard and more spectrum. Currently, broadcasters, DBS operators, cable and telephone companies, as well as HDTV production equipment and videocassette recorder manufacturers, compete with one another to have a share in HDTV business. With its tremendous impact on the American economy, HDTV should be guided by the appropriate public policies from government and industry. Some suggestions of government policies are: government-industry cooperation, government funding, tax incentives, legislation, relief of the antitrust laws and international cooperation & technology transfer. The importance of policy issues on the new technology is also discussed.

HIGH DEFINITION TELEVISION: A NEW CHALLENGE FOR TELECOMMUNICATION POLICY

Telecommunications industry has now entered the most critical period of evolution in television technology since the introduction of color television. The transition to high definition television (HDTV), with related technologies such as semiconductors and computers, would mean a multi-billion dollar business for the telecommunications industry. With its enormous economic impact, HDTV now becomes one of the most important policy issues of the nation.

High Definition Television (HDTV) is an improved television which increases the sharpness of the electronic image to a point where it is comparable to 35mm film. It can display visual information five times more detailed than the current NTSC television and has the compact disc's audio quality. Moreover, HDTV has an aspect ratio of 5:3 or 16:9 (width-to-height) which is wider than the aspect ratio of an ordinary television (4:3).

In order to enlarge the picture screen of television so that the images will get larger, the space between the lines has to increase, and the lines become more evident, thus detail suffers. HDTV solves this problem by using more than 1,000 lines to enhance definition.

Definition is a direct function of the bandwidth. To get a high definition's picture quality, more bandwidth has to be used to transmit more information per unit of time. HDTV needs a 30 MHz

bandwidth if it were transmitted by the traditional broadcasting. Several projects have tried to compress the HDTV signals to fit into the traditional NTSC bandwidth of 6 MHz. Some proposed a 9 MHz system for HDTV. However, if any HDTV transmission system which needs more than 6 MHz bandwidth were adopted, the FCC would have to reallocate broadcast spectrum for the whole country. This problem is very difficult considering the spectrum scarcity in the VHF/UHF bands.

Last year, the FCC's tentative decision was that HDTV transmission standard should be NTSC compatible (Federal Communications Commission, 1988). That is, the signals should be able to be received by traditional NTSC color TV sets. Otherwise, HDTV would make obsolete approximately 160 million TV sets now in use in this country.

INTERNATIONAL COMPETITION.

Japanese HDTV System

HDTV was first developed by the NHK (Japanese Broadcasting Corporation) in 1964 and accomplished in 1968. This was a joint venture between industry and the Japanese government. Japanese Prime Minister Takeshita, the Ministry of International Trade and Industry (MITI) and the Ministry of Post and Telecommunications (MPT) and more than eleven manufacturers worked together to promote HDTV which the Japanese called "Hi-Vision" ("High Definition TV," 1988).

Japanese HDTV developed a system of 1,125 lines, 60 hz field

rate with an aspect ratio of 16:9. To transmit the signals, Japanese HDTV would need a 30 Mhz bandwidth, which is five times the 6 Mhz bandwidth used in the American NTSC standard. NHK then researched the MUSE system (Multiple Sub-Nyquist Encoding System) to compress the bandwidth to 8.1 Mhz ("Special Report," 1987).

Japan plans to transmit the HDTV signals via direct broadcast satellite (DBS) in 1990 using the MUSE-E system for compressing the bandwidth. This system is incompatible with the NTSC system. Therefore, a converter is needed for the NTSC receivers to receive the signals. NHK estimated that the converter would cost about $50.

European HDTV System

With the advent of high definition television, 18 European countries plus Iceland participated in the Eureka-95 project. This aimed at helping them compete with the U.S. and Japan in high technology and involved an investment of more than $180 million for HDTV. The four-year project began in 1986. Eureka, now led by Philips of the Netherlands, Thomson of France and Bosch of West Germany, has tried to establish the HDTV broadcasting standard so as to conform to the European 50 cycle broadcasting system. The European HDTV will use 1,250 lines of resolution, which is twice the current European standard of 625 on a 16:9 aspect ratio screen. Eureka-95 also developed the new DBS transmission standard called HD-MAC for the transmission of its HDTV system ("Eureka HDTV System," 1988).

NEW CHALLENGE IN TELECOMMUNICATIONS

HDTV & Broadcast Industry

Kalba Bowen Associates Inc. (1982) conducted a study of the future of High definition television in the U.S. to the year 2000 for CBS. The study projected that HDTV would be a significant part of the U.S. home video and information system. Kalba Bowen encouraged American broadcasters and manufacturers to enter the field as soon as possible although the changeover process to HDTV will be a long term one. In the same year, CBS tested over-the-air transmission of HDTV in the 12 Ghz DBS band via microwave.

NBC and the David Sarnoff Laboratories have developed the "Advanced Compatible Television (ACTV)" system. This system uses 1,050 lines interlace, which doubles the current NTSC 525 lines, with 59.94 hz. field rate.

In 1987, The National Association of Broadcasters (NAB) decided to establish a broadcast technology center specifically to assist in the development of HDTV. It supplied $700,000 for initiation and urged broadcasters to participate as limited partners ("NAB Forms," 1987).

As broadcasting in the U.S. is based on the principle of localism and the market of television sets in America is the largest of the world, the over-the-air transmission standard becomes one of the most critical and difficult issues of HDTV.

HDTV & Direct Broadcast Satellites (DBS)

So far, DBS has been plagued with marketing and programming problems. The same could happen with HDTV in the future unless

these two new technologies coexist. It appeared that there would not be sufficient programs to fully utilize the capacities of these two technologies. ("US DBS," 1988). European DBS was also hindered by marketing and programming problems caused by cable competition. In Japan, the policy of using DBS for HDTV transmission is firm partly because NHK, which is owned by the government, is the only active participant in the project, and DBS has been widely used by the Japanese for the past few years.

DBS has the unique ability in terms of power, bandwidth and spectrum to handle about 100 HDTV channels. This would be helpful for HDTV because HDTV needs much more bandwidth to transmit its signals and it appears that the VHF/UHF terrestrial bandwidth is too limited to allocate for HDTV. Moreover, the FCC has decided not to use above 1 Ghz spectrum for terrestrial broadcasting.

If the HDTV production standard is finally set in the U.S., plenty of HDTV programming in the form of 35mm film could provide DBS operators with the new type of product -- the one with high definition quality which is different from those being distributed in the present video market. In retrospect, the potential of DBS to handle HDTV transmission has given DBS operators the opportunity to recover from financial difficulties through the coexistence of both technologies ("The Road," 1988).

HDTV & Cable and Telephone Ccmpanies

Cable operators have been interested in HDTV business from the beginning. With the adjustments in the cable system to carry

signals over 6 MHz, cable can carry HDTV signals without any of the limitation from spectrum scarcity that broadcasters have. People in the cable industry follow the development of HDTV very closely, realizing that they might face the competition once HDTV VCR and compact disk technologies are fully developed before they can deliver HDTV signals to the subscribers. Cable operators have also reminded HDTV manufacturers to be sensitive to cable's need so that incompatibility problems which the cable industry now experiences (with e.g. cable-ready TVs and the delivery of BTSC-MTS stereo) will not happen with HDTV (Home Box Office, Inc., 1987). Furthermore, cable subscribers are more likely to purchase a newly improved television because they tend to be the heavier users of TV than any other consumer segment.

Meanwhile, the telephone companies are replacing copper wires with fiber optics which can bring videophones, push-button home shopping, news reports, movies and HDTV. The cable operators are trying their best to keep the telephone companies from entertainment and video information services. With fiber capability to handle better and more sophisticated cable TV services, cable and phone companies could cooperate to exploit this potential of fiber technology ("The Coming Battle," 1989).

HDTV Production Equipment & Videocassette Recorders

HDTV production techniques have been developed very rapidly. High Definition cameras, recorders and monitors have already been in use because they can produce the high picture quality of 35 mm

film with videotape convenience and less cost in creating special effects and animation. For example, in January, 1989, CBS produced and broadcast The Littlest Victims, the first HDTV movie made for commercial TV in the United States.

With the advancement of HDTV production, the Advanced Television Standards Committee (ATSC) and the Society of Motion Picture and Television Engineers (SMPTE) have approved the HDTV production standard using the parameters of 1,125 lines, 60 hertz field rate and 16:9 aspect ratio, based on the NHK system ("HDTV Production Standard Approved," 1988). The National Telecommunications and Information Administration (NTIA) (1989) has asked the industry to reconsider the production standard in terms of its relationship with transmission standard and equipment, because the new production standard might affect the sale of American programming all over the world.

Japanese electronic companies are now developing HDTV videocassette recorders. Sony and Matsushita exhibited their half-inch HDTV VCR in the NAB convention in Las Vegas, and Hitachi showed the same kind of VCR in the Consumer Electronics Show (CES) in Chicago earlier this year ("The HDTV Sight," 1989). Japanese HDTV VCR is expected to be ready for market in 1991. Since the U.S. market is bigger than the Japanese one, all aim at the American market as their top priority. However, the Japanese HDTV VCRs might face the problem of unavailable programming.

PROGRESS OF PUBLIC POLICY ISSUES ON HDTV

HDTV development affects the economy of other industries as well. For example, high definition television sets have to depend on semiconductors, and the semiconductor industry needs to have access to this market to survive. Many other industries that require high resolution visual imaging such as medicine, computers, printing, national security and motion picture are waiting for government actions on this new technology.

Some government actions which may help the advancement of high definition television technology include:

1. **Government-Industry cooperation.** In January, 1989, the American Electronics Association (AEA) signed with 17 companies, including IBM, Apple, AT&T, Hewlett-Packard, Motorola and Texas Instruments, to form a consortium for research and development (R&D) of HDTV technologies. The 17 companies hoped that the consortium for HDTV would be funded 49% by the government and 51% by the members (Business Week Jan. 30, 1989). However, Commerce Secretary Robert Mosbacher resisted this idea and encouraged the private sector to take action first.

Although the joint venture between government and industry may be impossible, the AEA has formed an intra-industry cooperation and followed the "industry-led strategy" to ask for support from the government. On the government side, President Bush appointed the Commerce Secretary to head an inter-agency task force on HDTV (Markey, 1989). The task force could establish a strong collaboration mechanism to coordinate resources among government agencies e.g. the Office of Science and Technology Policy (OSTP),

the Office of Technology Assessment (OTP), the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC).

2. **Government Funding.** The Defense Advanced Research Projects Agent (DARPA) has funded $30 million for research in HDTV display technologies. However, the AEA requested government funding of $1.35 billion for grants and loans on HDTV related projects. Recently, Senator Hollings has introduced a bill that would authorize $30 million for the National Institute of Standards and Technology (NIST) to help an industry-led consortium, $15 million in loan guarantees for consortia, and $7.5 million for NIST's laboratory on HDTV (S. 1191, 1989).

The government could provide R&D money for the electronic industry as does the Ministry of International Trade and Industry (MITI) of Japan. This is one of the major reasons why Japan is now leading America in electronic technologies. Moreover, the government could also fund more basic research at universities.

3. **Tax incentives.** The current U.S. tax policies seem to discourage companies to take the risk in R&D (NTIA, 1989). Nevertheless, at present, President Bush has announced that he would support federal funding for science and technology. The President may be extending R&D tax credit or reduce the capital gains tax to help HDTV industries if the government chose not to participate in the consortium. Recently, Jerry Pearlman, president and CEO of Zenith Corporation, proposed that the government fund HDTV research through an excise tax of $5 on every color television

sold for three or four years. The tax would accumulate $100 million a year and would be used to establish "HDTV trust fund". However, the excise tax idea was not acceptable to the rest of the consumer electronics industry because the tax would be passed along to the consumer eventually ("High Definition Gets," 1989).

4. **Legislation.** It is obvious that government actions, especially in terms of legislation, are necessary for HDTV development in America. Among HDTV legislative proposals are:

H.R. 1024 (1989) -- by Congressmen Boucher and Campbell, a bill that encourages cooperative research and commercialization.

H.R. 1025 (1989) -- by Congressman Edwards, a bill to amend the National Cooperative Research Act of 1984 so that companies may form joint ventures for production.

H.R. 2287 (1989) -- by Congressmen Levine and Ritter, a bill to provide for the establishment of an industry-led consortium for research, development and manufacturing activities of advanced television systems and for other purposes.

S. 952 (1989) -- by Senator Kerry, a bill to stimulate the design, development and manufacture of advanced television technology and for other purposes (High Definition Television Development Act).

S. 1191 (1989) -- by Senator Hollings, a bill to authorize appropriations for the Department of Commerce's Technology Administration, to speed the application and development of economically strategic technologies and for other purposes (Technology Administration Authorization Act).

These legislative proposals reveal Congress's awareness of the significant impact of HDTV on the American economy, especially its budget deficit and balance of payment problems.

Furthermore, an FCC task force on HDTV should be established in order to set the transmission standard as soon as possible. Telecommunications and electronic industries are now waiting for the FCC decision on this issue. The FCC task force should be able to provide personnel and resources to aid the transition to HDTV.

5. **Relief of the antitrust laws.** During the 1980s, many industries were unable to compete with foreign producers because the cost of R&D and manufacture of the new and complex products is often too high for one company to afford. Therefore, many companies have urged the government to relieve the antitrust laws so they can cooperate in research and development. In 1984, the National Cooperative Research Act was passed, allowing "joint research and development ventures" (National Cooperative Research Act of 1984). More than one hundred R&D consortia have been formed so far. The most distinguished one is Sematech, a consortium formed to develop semiconductors technology.

The AEA proposed that Congress relax the antitrust laws even further so that consortia can manufacture HDTV products. Since then, several bills (e.g. H.R. 1024, H.R. 1025, H.R. 2287 and S.952) have been introduced so U.S. companies can jointly produce advanced television products.

6. **International cooperation & Technology transfer.** More cooperation with international companies can be seen worldwide, as

the cost of inventing new technologies increased. Several companies that want to speed up new product development cooperate with their rivals. For instance, Motorola teamed up with Toshiba to produce memory chips and microprocessors.

Similarly, international cooperation would be a better way to develop HDTV technology. The competition in the world market hinders the progress of HDTV technology because each has to begin independent development instead of sharing the technology that has been discovered or tested. Moreover, because of the competition, there may be no single world standard for HDTV. A variety of color television standards in the world right now has not been an obstacle for any television manufacturers to sell their products. Broadcasters and viewers are those who have suffered from different types of equipment and programs they use to air or receive the signals.

DISCUSSION

Some in Congress now regard HDTV issues as the highest priority since HDTV means not only a $250 billion business in America but also involves the pride of America as world leader of the telecommunication technology. Much action has been proposed, but HDTV progress in the U.S is very slow when compared to Japan and Europe. The Japanese have been working on HDTV since 1970, and Europe since the early 1980's, with approximately $750 million and $250 million investment respectively.

The Japanese government has transferred HDTV technology to

the private sector at no cost and also provided tax incentives and government funding. In Europe, the Eureka-95 consortium followed the Japanese HDTV technology closely (NTIA, 1989). What has the U.S. government been doing on HDTV so far?

Several American telecommunication industries failed during the past 30 years. For instance, videocassette recorder technology was sold to Japan in 1972 because the Ampex company which developed it had financial problems. Had the government supported funding for this technology, it would have meant a $15 billion VCR market. Right now, there are no videocassette recorder manufacturers in America. Because of the natural marketing competition of the cable industry, and lack of programming, DBS developers have been unable to start up over the past decade. Moreover, delayed regulation by the FCC has slowed the progress of videotext, teletext and AM stereo.

Currently, the government hopes that the private sector will initiate the development of HDTV and suggest any government actions that would be appropriate to the American public. This industry-led strategy can be successful if the government also provides funding for R&D and basic research. Although the amount of money from extending R&D tax credits and lowering capital gains tax may not be very large, it is another direct means for the government to assist HDTV development.

The consortium approach is the way European electronic companies cooperate to compete with the Japanese HDTV manufacturers. This approach may be essential for the U.S.,

considering that there is only one television manufacturer, Zenith Electronics, left in the U.S. This would broaden the competitiveness of American electronics industry as a whole in the world market, since the development of HDTV affects many other industries as mentioned earlier.

Although the further relaxation of antitrust laws, so that such a consortium can manufacture HDTV products, sounds reasonable, many are afraid that the joint production of HDTV products could easily lead to monopoly. Some are also concerned that a consortium approach may not work in the U.S. because many companies do not want to share their research results.
("Spreading the Risks of R&D," 1989). Congressman Markey (1989) has warned that any reform of the antitrust laws "must be approached with extreme caution".

In the long run, international cooperation would be desirable since many consortia worldwide would find it unwise to spend money duplicating their rivals' technology. In fact, it would be more economical to join their effort to strive for more advanced technologies.

It is expected that the government will pay more attention to the rapid progress in the telecommunication industries and come up with appropriate policies and actions in the near future. High definition television represents a major policy and economic challenge to America at this time.

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