

Chapter 15

The Path from Analog HDTV to DTV in Japan

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Abstract: While Japanese broadcasters and manufacturers have been world pioneers in the development of high-definition television and digital production technologies, they have been slow to design a national system for digital television (DTV) transmission. Present plans call for the launching of a new satellite that will facilitate DTV transmissions by the year 2000. This paper examines the technological, political, and economic issues that have delayed the advent of digital broadcasting in Japan, especially compared to DTV broadcasting initiatives in Europe and the United States. The paper concludes that Japanese economic and political investment in the analog Hi-Vision HDTV format led to the promulgation of national industrial policies that inhibited the diffusion of alternative television technologies.

A significant event in the history of communication technology occurred in 1993 as the Federal Communications Commission (FCC) in the United States concluded its testing of several proponent advanced television systems. Through its Advisory Committee on Advanced Television Service (with another obligatory acronym, ACATS), the FCC had conducted thorough qualitative and quantitative tests of five competing advanced television (ATV) technologies. They were vying to be selected as the ATV standard to replace the NTSC analog broadcast system in the United States. It was a decision with multi-billion-dollar consequences not only for broadcasters and consumers, but especially for the companies that had made significant research and development investments in their competing systems. Beginning on February 8, 1993, a Special Panel of the FCC's Advisory Committee convened in a suburban Washington hotel meeting

room to select one of the competing systems as the U.S. transmission standard.¹ Four of the systems were based on newly-developed digital technologies, and one stood apart as the only analog entry in the competition. It was a “Narrow” MUSE system developed by Nippon Hoso Kyokai (NHK), the Japan Broadcasting Corporation, especially to meet the transmission bandwidth requirements of the FCC. NHK had perfected high-definition television as their chosen ATV system, and had actually been broadcasting throughout Japan from satellite for over four years at the time of the Special Panel meeting. However, it came as a rude shock to NHK’s engineers that Narrow MUSE had not tested well compared with the newer digital systems. On the fourth day of the Special Panel meeting, NHK saw the digital handwriting on the wall and withdrew MUSE as a competitor.² It was a stunning denouement for a technology that in 1986 was on the verge of *de facto* acceptance as a global standard for advanced television. Competitors trumpeted that the United States has regained its long-lost crown as an innovator in television technology. The Japanese juggernaut in consumer electronic technology had been dealt a major setback, or so it seemed at the time. The reality, in hindsight, is more complex than first appearances implied.

There is a myth that Japanese broadcasters and manufacturers are somehow “behind” in the global competition to develop digital communication technologies, but this chapter will explain that this only applies to the transmission aspect of the broadcast triad of production, transmission, and reception. In fact, Japanese companies lead the world in the development of digital television production systems.

There is no longer a question of whether or not Japan will make the conversion to digital television broadcasting -- the last unresolved question is *when* the transition would take place. On March 10, 1997, the Japanese government announced that the planned introduction of digital broadcasting was being moved up from an interval spanning the years 2000 - 2005 to the year 2000.³ The Japanese shift from analog HDTV broadcasting to a digital variant is an interesting subject of study due to the unique broadcast policymaking structure in Japan. The HDTV-DTV case study reveals much about this structure and the interplay of powerful government agencies, the national public broadcaster NHK, and multinational equipment manufacturers such as Sony and Matsushita.

1. THE DEVELOPMENT OF HDTV TECHNOLOGY

Japanese scientists and engineers at NHK were the first in the world to perfect a contemporary analog high-definition production standard in the

early 1980s that became the Hi-Vision system adopted by the Society of Motion Picture and Television Engineers (SMPTE) in the U.S. as their 240M standard.⁴ A MUSE⁵ compression scheme was developed for national satellite transmission of HDTV signals, and the first experimental broadcasts started for one hour each day in 1989.

It seemed that, after decades of conflict caused by three incompatible global television systems, that there might finally be a single advanced television system that would eliminate international transcoding requirements. However, when Japan attempted to have the 1125-line/60-Hz system adopted as a global production standard in 1986 by the International Telecommunications Union (ITU), they were rebuffed by European representatives. European manufacturers and governments were concerned about future Japanese domination of their consumer electronics markets, as they had done with VCR hardware. The Europeans then proceeded to develop an incompatible 1250-line/50-Hz HDTV system, while the FCC in the U.S. started an investigation into the creation of a unique American transmission standard. NHK entered the Narrow MUSE variant in the U.S. standardization competition as noted above, but it did not fare well against emergent digital technologies developed by other proponents.

2. THE BROADCAST TECHNOLOGY POLICYMAKING SYSTEM IN JAPAN

The technological superiority of digital transmission systems in the United States led European interests to phase out research in analog HDTV technologies in the early 1990s and shift to digital alternatives. With both U.S. and European television broadcasters deciding on massive and expensive conversions to digital technology, it begs the fundamental question as to why the Japanese stuck with their increasingly obsolete analog technology so far into the 1990s. The question takes on increased relevance due to the importance of both North America and Europe as prime markets for the export of Japanese electronic technology.

To comprehend this decision requires a brief explanation of the broadcast technology policymaking system in Japan using the analog-to-digital shift in HDTV as a case study. Figure One below outlines an HDTV policymaking model with four primary groups of actors. From the left and moving clockwise, they are broadcasters led by NHK, the Ministry of Posts and Telecommunications (MPT), the Ministry of International Trade and Industry (MITI), and multinational manufacturers such as Sony and Hitachi which have now become household names around the world. At the nexus of

this model is the Broadcasting Technology Association (BTA) and its High-Definition Television Committee (HDTC).

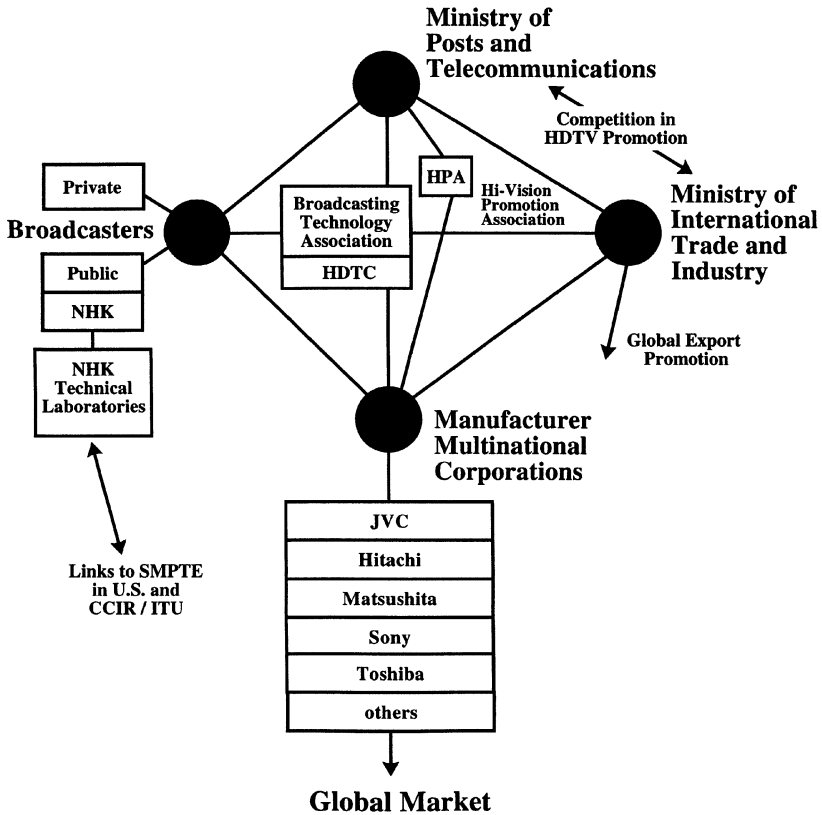


Figure 1 "Japanese HDTV Policymaking Model"

Source: Dupagne & Seel (1998). High-definition Television: A Global Perspective. © Iowa State University Press. Reprinted with permission.

Created by the MPT in 1985, the BTA was⁶ a government advisory organization dominated by broadcasters and manufacturers that was similar in function to the Advanced Television Systems Committee in the United States. NHK was first among equals on the Committee as the primary developer and promoter of HDTV technology. NHK had developed HDTV as part of its national mandate to investigate new broadcast technology, but

its R&D role was also motivated by the need to protect its public-broadcaster revenue provided by fees assessed on viewers. New broadcast services such as HDTV meant increased viewer fees. NHK also played a key role with the MPT in assigning the production of Hi-Vision/MUSE hardware amongst manufacturers who were part of the Association.⁷

In 1986, the BTA established a High-Definition Television Committee (HDTCC) specifically to investigate HDTV production and transmission standards. However, by this point the parameters of the Hi-Vision production standard were essentially locked-in by NHK's 15 years of R&D with the technology. The MUSE compression system for satellite transmission took longer to standardize, but the MPT adopted both standards as fundamental elements of the Japanese HDTV broadcast system in March 1991.⁸ The central role of NHK as the developer of both the production and transmission systems cannot be understated. It had such a significant financial and political stake in the future of analog Hi-Vision/MUSE that this was an important factor in the reluctance to consider digital HDTV options by Japanese decision-makers.

The MPT and the Ministry of International Trade and Industry also had significant bureaucratic interests in the success of Hi-Vision/MUSE, both internally and in potential export markets. In the late 1980s, the agencies actively competed with each other to become *the* champion of Hi-Vision technology. They each conducted massive public relations campaigns with the goal of diffusing the new systems throughout Japan. The MPT created a Hi-Vision Promotion Association (HPA) in association with television manufacturers to showcase the technology during special events such as the 1988 Seoul Olympics. MITI matched MPT's internal efforts almost campaign by campaign, but its ultimate objective was to support the development of HDTV technology for export throughout the world.

Last but not least, the multinational manufacturers involved in HDTV research and development had important stakes in the future of Hi-Vision/MUSE. Led by Sony, who had developed the world's first working HDTV production system, these manufacturers had varying financial investments in analog production and transmission hardware. They were reluctant to abandon the analog technology while they still had warehouses full of Hi-Vision cameras, VCRs, and television sets. However, they were hedging their bets by investing in digital research while still promoting Hi-Vision as the system of choice for HDTV broadcasting in Japan.

3. DIGITAL TELEVISION PRODUCTION FORMATS

In the mid-1980s, Japanese manufacturers developed a series of pioneering digital television production technologies. Starting with the 19mm D-1 format in 1986, through the advent of 1/4" DVCPro format in 1995, Sony and Matsushita (Panasonic) have dominated the global market for digital production systems. Table One lists the digital television production formats developed to date. It demonstrates that Japanese manufacturers were making extensive investments in digital R&D while simultaneously supporting the standardization of analog Hi-Vision during the period from 1986 to 1991.

Table 5. Digital Television Production Formats

Format	Tape Width	Source(s)	Manufacturer (s)	Introduction Year
D-1	19 mm	Japan	Sony	1986
D-2	19 mm	Japan, U.S.	Ampex, Hitachi, Sony	1988
D-3	1/2 inch	Japan	JVC, Panasonic	1991
D-5	1/2 inch	Japan ⁹	Panasonic	1992
DCT	19 mm	U.S.	Ampex	1992
Digital Betacam	1/2 inch	Japan	Sony	1992
D-6	1/2 inch	Europe	BTS (now Philips)	1993
DV	1/4 inch	Japan	Panasonic, Sony	1995
Digital-S	1/2 inch	Japan	JVC	1995
D-VHS	1/2 inch	Japan	JVC	1996

Source: J. C. Foust (1997)¹⁰

4. THE DIGITAL TELEVISION QUANDARY IN JAPAN

The DTV quandary in Japan was that NHK and electronics manufacturers had made a \$1.3 billion investment in analog HDTV technology and were reluctant to abandon it prematurely.¹¹ The handwriting was on the wall for analog technology when the Narrow MUSE transmission system did not test well against digital systems in the FCC's Special Panel deliberations in 1993. The impasse reached a critical point in 1994 when Akimasa Egawa, Director of MPT's Broadcasting Bureau said Japan would develop a digital HDTV system to replace Hi-Vision/MUSE.¹² Responding to a swell of protest from NHK and equipment manufacturers, he recanted the next day saying he "did not mean to imply the conversion to

digital is imminent.”¹³ Articles about the controversy at the time indicated that manufacturers with large investments in Hi-Vision were concerned about Mr. Egawa’s remarks.¹⁴ However, these same Japanese manufacturers were world leaders in DTV technology, and both Sony and Matsushita were busy perfecting new formats for digital HDTV production.

At the 1997 National Association of Broadcasters convention in Las Vegas, Sony introduced a new digital 1/2” HDCAM format with lightweight camcorder. This format brings digital HDTV recording into the weight and price range of their dominant Betacam system for electronic news gathering (ENG) and electronic field production (EFP) broadcast applications. Panasonic introduced a modified D-5 VTR with digital HDTV processor, and displayed their DVCPro system for 525-line EFP-ENG recording. Panasonic’s D-5 high-definition system was initially specified by the CBS television network for future HDTV program playback in the United States.

The problem in Japan is that Hi-Vision is still the “official” HDTV studio production standard, but this will likely change in the next 24 months. However, a standardization battle may ensue between Sony’s HDCAM and Panasonic’s D-5/DVCPro formats for acceptance in Japan.

5. DTV TRANSMISSION VIA DIRECT BROADCAST SATELLITE

Plans for Japanese DBS transmission conversion from analog to digital systems are underway. The BS4-I satellite was launched in early 1997 with three analog NTSC channels and one analog HDTV MUSE channel.¹⁵ A new BS4-II satellite will be launched by the year 2000 with up to 6 digital HDTV channels plus transponders for the digital simulcast of analog channels on the BS4-I satellite.¹⁶ The Japanese strategy for making the transition to digital broadcasting will mirror that in the United States by digitally multiplexing the four analog BS4-I channels as digital equivalents on one channel of the BS4-II satellite. In the year 2007, plans call for the replacement of the BS4-I system with a new BS5 satellite that will transmit either digital or analog channels based upon market penetration by digital television receivers in Japan.

The DTV broadcast conversion for Japan will be much simpler than for the United States. By relying on direct-broadcast satellites for HDTV and DTV transmissions, Japan can make the transition by simply putting an upgraded model in orbit. The United States will have to add 1,500 new DTV transmitters at stations throughout the nation to achieve its simulcast strategy.

On the reception side of the broadcast triad, analog MUSE HDTV programming is now transmitted 17 hours daily from the BS4-I satellite. There are over 400,000 Hi-Vision receivers in Japan and an additional one million homes have NTSC receivers with MUSE converters.¹⁷ A future potential problem is that the national transition to DTV broadcasting will require digital-to-analog converters for all analog HDTV and NTSC sets. The large installed base of analog widescreen sets in both NTSC (EDTV)¹⁸ and Hi-Vision (HDTV) formats indicates that there will be a significant market for these converters after the simulcast period ends.

Space is at a premium in many Japanese homes and apartments. A potential problem with large direct-view CRT displays may be solved by the advent of plasma flat-panel displays (FPDs) that are now on sale in Tokyo. If FPDs can be manufactured in large screen sizes at a reasonable cost, these displays could have a significant effect on HDTV diffusion throughout the world. Flat-panel displays would mean that large-screen HDTV sets could be embedded in the walls of rooms without taking up extensive floor space as do CRT models. Japan manufacturers lead the world in the development of FPD technology and have made significant R&D investments in this area.

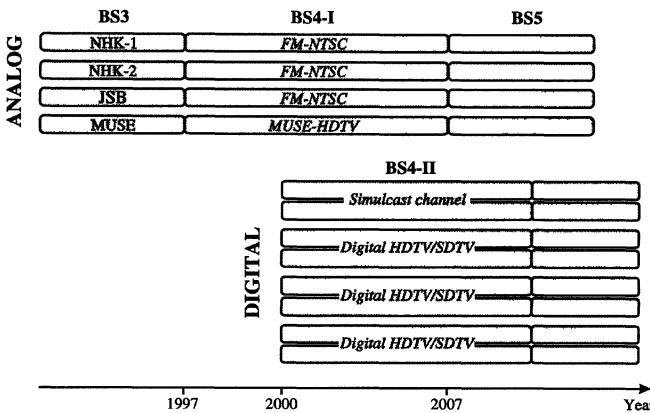


Figure 2 "Outline Scenario for Digital HDTV Broadcasting"

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6. CONCLUSIONS

While the nation of Japan may be somewhat of a comparative laggard in the development of digital television transmission systems, Japanese manufacturers lead the rest of the world in production and reception technology. Of the six “D” series DTV production formats, five were developed in Japan. No other broadcaster can match NHK’s 17 hours of daily HDTV programming, and only European broadcasters working in 16:9 formats have an equivalent level of experience with widescreen television production. The national investment in analog Hi-Vision/MUSE technology was high, but it laid the technical foundation for the implementation of digital television transmission in the year 2000.

The Japanese DTV case study demonstrates that there are drawbacks to being a pioneer in new communication technologies. The conventional wisdom is that innovators always have a competitive advantage in being first to market, and this might have been true for NHK if European competitors had not blocked the global standardization of Hi-Vision in 1986. The European Union then went on to demonstrate the flaws inherent in the creation of industrial policies designed to promote technological champions such as its analog HD-MAC system. The government-industry monolith known as Japan Inc. was a victim of its own industrial policies that coerced the promotion of analog Hi-Vision/MUSE even after it became clear in 1993 that digital technology was superior in almost all respects. The DTV transition case study demonstrates the perils of having government officials or corporate executives dictating industrial policies that anoint unique communication standards to protect native industries or to promote export markets. In a rapidly-evolving global market for digital communication technologies, promoters of distinctive national or regional standards may find that the rest of the world has past them by in efforts to forge global standards that promote, rather than inhibit, the international exchange of information. The development of international protocols concerning the Internet are a prime example of this.

Japanese broadcasting officials and manufacturers have now recognized the benefits of digital television transmission and have created a national transition plan. It remains to be seen if their transmission system more closely resembles the American ATSC¹⁹ standard or if they will model

it after the European DVB²⁰ digital broadcast standards. One trend that is emerging on a global basis is the acceptance of a digital HDTV Common Image Format (HD-CIF). The primary barrier to a global widescreen digital television standard (national industrial policies aside) is the 50-60 Hz variation in world electrical systems. One proposed solution is to allow time (frame rate) to vary from nation to nation while space (image size) remains constant. The HD Common Image Format based on a widescreen 1080 X 1920-pixel digital display has been proposed as a spatial constant to simplify international program exchange.²¹ The world may never have a single system for HDTV production and transmission, but the HD-CIF would be a positive first step toward a *lingua franca* for the global electronic exchange of television programs.

Note:

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- ¹. M. Dupagne and P. B. Seel, High-Definition Television: A Global Perspective. (Ames: Iowa State University Press, 1998), pp. 233-37.
- ². J. Brinkley, Defining Vision. (New York: Harcourt Brace, 1997), p. 231.
- ³. A. Pollack, 'Japan Says It Will Move Up Introduction of Digital television by a Few Years.' The New York Times, March 11, 1997, p. C6.
- ⁴. Dupagne & Seel. op. cit., pp. 69-93.
- ⁵. MUSE is an acronym for Multiple SUB-Nyquist Sampling Encoding.
- ⁶. The BTA was renamed the Association of Radio Industries and Businesses (ARIB) in 1995.
- ⁷. Dupagne & Seel. op. cit., p. 71.
- ⁸. Ibid., p. 85.
- ⁹. There is no D-4 digital format as the number "4" carries connotations of death in parts of Asia.
- ¹⁰. J. C. Foust, 'Videotape Formats,' in P.B. Seel and A.E. Grant (Eds.), Broadcast Technology Update. (Boston: Focal Press, 1997), pp. 86-90.
- ¹¹. B. Johnstone. 'Keeping an Eye Out.' Far Eastern Economic Review. (GET VOL # Mar. 25. 1993). pp. 59-62.
- ¹². B. Powell and K. Itoi. 'I Didn't Really Say That, Did I?' Newsweek (Mar. 7, 1994). p 47.
- ¹³. N. Kageki. 'HDTV Shift Stuns Industry.' The Nikkei Weekley. (Feb. 28, 1994). p. 1, 27.
- ¹⁴. Ibid.
- ¹⁵. J. Kumada. 'The Introduction of Digital HDTV in Japan.' Paper presented at the HDTV '97 Seminar, 1997, Montreux, Switzerland.
- ¹⁶. Ibid.
- ¹⁷. Hi-Vision Promotion Association (HPA. 1998). [Online]. Available: <http://www.hpa.or.jp/>.
- ¹⁸. EDTV stands for Enhanced- or Extended-Definition Television. These sets are typically analog systems that use line-doubling or image processing circuitry to provide a quasi-HDTV picture.
- ¹⁹. The ATSC is the Advanced Television Systems Committee which codified the DTV standard for the Federal Communications Commission in the United States.

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- ²⁰. DVB is an acronym for Digital Video Broadcasting, a primarily European consortium of broadcasters and manufacturers who have developed digital standards for cable, satellite, and terrestrial broadcasting. DVB is now competing with the ATSC standard for acceptance as a DTV transmission system in other nations.
- ²¹. International Telecommunications Union. 'Television Broadcasting Given a Major Boost with the Adoption of Two Landmark Standards.' *ITU News*, 7, 1997, pp. 27-9.