

DIGITAL BROADCASTING IN JAPAN

HDTV AND MOBILE RECEPTION AS KEY APPLICATIONS

Hiroshi ASAMI

**Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT),
JAPAN**

ABSTRACT

Japan began digital terrestrial television broadcasting (DTTB) in major metropolitan area in December 2003. The Japanese government has indicated that all analog TV will be discontinued in 2011 with national coverage of DTTB scheduled for the same year. The government adopted a strategic plan to ensure successful rollout of DTTB to enable shutdown of analog TV in 2011. This plan emphasizes that DTTB is obliged to provide additional value for consumers more than conventional analog TV. As part of this, DTTB broadcasters are required to ensure that more than 50% of their broadcasts are HDTV. Broadcasters are already equipped with HDTV programming facilities of the 1080i format. The ISDB-T system employed in Japan enables simulcast for small picture videos on cellular phones as well as HDTV transmission. The Mobile TV service will start in early 2005. HDTV and mobile reception are the merits of DTTB to attract consumers. Many TV manufacturers already provide all-in-one Digital TV sets, which can accommodate digital terrestrial and satellite tuners, and internet connections. As there are considerable merits to using DTTB, the system is expected to grow rapidly.

INTRODUCTION

Japan only began DTTB in December 2003, later than many other countries. Japan was also behind Europe, Hong Kong, and Singapore in the mid 1990's with respect to cellular phone penetration; however, now the penetrations ratio is one of the highest in the world with wealth of applications. Broadband access in Japan in 2000 was also behind Korea. Japan started the ADSL service in 2000; broadband access subscription numbers and price are now second to none. Digital broadcasting should follow a similar pattern. Within a few years, digital broadcasting in Japan will rank among the best.

TOWARD FULL DIGITAL BROADCASTING

Satellite broadcasting

The satellite digital TV service started early. There are two satellite platforms. One is SkyPerfectTV, which uses the Ku band satellite, and is broadcasting more than 200 SDTV programs with a subscription system, some programs are pay per view. Digital broadcasting began in 1996, and subscriber numbers are around 3.5 million.

The other platform is BS, NHK: the public terrestrial broadcaster started analog BS satellite broadcasting in 1989. The BS digital satellite service was initiated in December 2000; their services are mainly for HDTV programs. Currently 7 HDTV programs and 2 SDTV programs are provided;

the BS program operators are backed by major terrestrial broadcasters in Tokyo. More than 3 million digital receivers have already been sold. Analog BS programs will be discontinued in 2011.

Cable TV

Because of the high density of terrestrial stations coverage, cable TV penetration remains at 32% of household. Many people are subscribing for simply re-transmission of terrestrial TV. However, multi channel cable operators are increasing. They began digital broadcasting under a digital cable (256QAM) format recently.

Digital sound broadcasting

In addition to digital television, digital sound broadcasting is also available. The digital terrestrial sound broadcasting test service started from October 2003 in Tokyo and Osaka using VHF channels. Due to the lack of nationwide availability of the VHF band, its status will remain as a test broadcasting service until 2011. The format is ISDB-T_{SB}, which is part of ISDB-T; small sized moving pictures can be transmitted in addition to sound.

The 2.6GHz band is allocated for satellite sound broadcasting purposes in Asia. Korea and Japan will begin the digital sound satellite service from 2004, which allows for mobile reception. In addition to sound broadcasting, data and video broadcasting is available; hence it is called as DMB (digital multimedia broadcasting).

Japan will begin every kind of digital broadcasting by 2004, and all broadcasting will become fully digitalized by 2011.

DTTB AS FUNDAMENTAL MEDIA

DTTB History

Terrestrial TV stations are fundamental media in Japan. There are 48 million households and 100 million TV sets. The Broadcasting Law requires NHK to provide nationwide coverage. NHK is financed by household license fee. NHK and other terrestrial broadcasters have established many relay stations to provide maximum coverage throughout the mountainous archipelago. There are more than 3000 transmitter sites, and most of them have a less than 3W output. As a consequence, digitization of terrestrial broadcasting is a project of high importance to Japan.

MPHPT (Ministry of Public Management, Home Affairs, Post and Telecommunications) or former MPT (Ministry of Posts and Telecommunications) set up a policy study group in 1997 to deal with DTTB, and a report was made public in 1998. The report put forward the idea of giving one digital channel to existing analog stations, requesting simulcast programs during the transition period. All digital TV stations should use UHF channels. VHF and the upper portion of UHF TV channels are supposed to convert to other purposes such as mobile communication after discontinuation of analog TV.

The government initially tried to start DTTB early in 2001; however, due to heavy usage of UHF channels by existing analog relay stations, it became impossible to assign digital channels without migrating analog stations. Therefore, many analog TV channels were forced to shift to other UHF channels. The analog channel shift started from metropolitan areas of Tokyo, Nagoya and Osaka.

Test broadcast of DTTB began in 1999, and several experimental results were accumulated by 2003, including propagation features, mobile reception, data broadcasting and applications.

DTTB commenced on December 1st 2003 in Tokyo, Osaka, and Nagoya based on the preparations that had been made. Eight stations started digital broadcasting in Tokyo, Seven in Osaka and Nagoya. There are 12 million households in the digital service area; Tokyo 6.9 million, Nagoya 2.3 million, Osaka 2.8 million. The output power is kept low to avoid interference with existing analog TV relay stations nearby; however, with the progress of analog channel shift, this output power will be increased to full power by 2006, at this time the household coverage will expand from 12 million (25% coverage) to 23 million (50% coverage). Broadcasting stations in the remaining area will start digital broadcasting by 2006; followed by commencing digital relay stations network using SFN or MFN by 2011 to attain 48 million (100% coverage). The discontinuance of analog stations is scheduled for 2011, which is stipulated in the Radio Law.

DTTB Licensing Policy

The Government issued digital TV licenses to TV broadcasters in Tokyo, Osaka, and Nagoya in November 2003 with the following conditions and requirements.

- Over 2/3 simultaneous broadcasting with analog each day.
- Half of all broadcasting each week should be by HDTV.
- Broadcasters should consider handicapped and elderly viewers by using subtitles and commentary
- Expand digital broadcasting coverage in the same areas as analog broadcasting as soon as possible until the analog service is discontinued
- An engineering service which is providing information data to identify the TV programs and update the receiver's function must be possible within the license range.

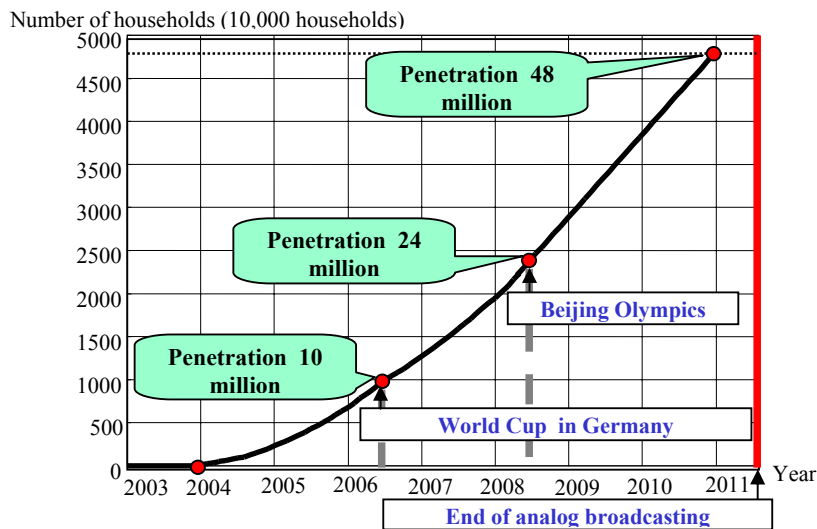


Figure 1 Objectives for the penetration of digital terrestrial television broadcasting receivers (households)

It is required that all analog TV sets be converted by 2011. Considering the importance of the task, the Ministry released the 'DTTB Promotion Strategic Plan' in 2003, with the participation of broadcasters, manufacturers, dealers, local governments, etc. The Plan includes the objectives for

the penetration of DTTB receivers including reception through cable TV. As an intermediate objective, 50% household penetration (24 million) should have DTTB sets in 2008 by the time of the Beijing Olympic Games.

SYSTEM FEATURES OF ISDB-T

Digital broadcasting systems adopted in Japan are called ISDB. ISDB is an abbreviation of Integrated Service Digital Broadcasting, and the concept behind it is to expand flexibility across the physical layer, the basic coding system such as MPEG2 are common regardless of whether it is applied to satellite or terrestrial broadcasting. These systems are standardized in ITU-R recommendations as follows, ISDB-T (terrestrial TV): ITU-R BT.1306-1, ISDB-S (satellite TV): ITU-R BO.1408-1, ISDB-T_{SB} (terrestrial sound) ITU-R BS.1114-4.

ISDB-T adopts OFDM modulation; it is effective for Single Frequency Networks, and robust for multipath interference. Because of heavy usage of TV frequency and ghost image interference by high rise buildings, OFDM is the reasonable choice for Japan. ISDB-T separates 6MHz into 13 segments. One segment is 429KHz. Using 13 segments flexibly, multi programming is possible. 1 HDTV (12 segments) + mobile service (1 segment) or 3 SDTV (3x4 segments) + mobile service (1 segment) is a typical service; however, other combinations are available. ISDB-T has the some commonality with DVB-T, such as the OFDM transmission system. However, segment structure, time interleaving, and TMCC (Transmission and Multiplexing Configuration Control) are unique features.

Systems	ISDB-T	DVB-T	ATSC
Transmission	Multiple carrier (OFDM)		Single carrier (8VSB)
Bandwidth	6/7/8 MHz		6/7/8 MHz
Modulation	DQPSK/QPSK/ 16QAM/64QAM	QPSK/16QAM/ 64QAM	8VSB
Error Control	Convolutional code/ RS		Trellis code + RS
Characteristic	SFN capability Effective against ghost Segmented OFDM Time interleaving	SFN capability	Analog based format
Proposing Country	Japan	Europe	U.S.A.

The DTTB systems are recommended in ITU-R Rec.BT.1306-1

TABLE 1 Comparison of ISDB-T, DVB-T, ATSC

The Telecommunications Technology Council which was charged by the Ministry initiated the study of DTTB in 1994, forming a special committee made up of broadcasters, manufacturers, private standard organizations and technical experts, and drafted the technical conditions and submitted these to the Ministry in 1999.

The details of the ISDB standards are set out in ARIB standards. ARIB: Association of Radio Industries and Businesses is the standardizing organization in Japan. ARIB standards are voluntary technical standards which supplement governmental regulations for telecommunications and broadcasting radio systems, and are set for the purpose of guaranteeing compatibility of radio

facilities and transmission quality as well as offering greater convenience to radio equipment manufacturers and users.

Technical standard for DTTB is as follows,

ARIB STD-B32: Image encoding, sound encoding and multiplexing formats

ARIB STD-B24: Data broadcasting encoding formats and transmission formats

ARIB STD-B23: Data broadcasting application execution environment

ARIB STD-B25 Restricted reception formats

ARIB STD-B10 Program line-up information

ARIB STDB31 Transmission formats

ARIB STD-B21 Receiver device

ARIB TR-B14 Terrestrial TV operation specification

In order to promote the concept and the systems of ISDB worldwide, the digital Broadcasting Experts Group (DiBEG) was founded in 1997 as one committee of ARIB. DiBEG has participated in DTTB trials in Singapore, Hong Kong, Beijing and Brazil. DiBEG also participated and organized digital broadcasting seminars and conferences.

KEY APPLICATIONS FOR SUCCESSFUL DTTB ROLLOUT

1080i HDTV

As mentioned, the government requires broadcasters to ensure that more than 50% of programs are in HDTV. As multi channel programs are already provided by satellite broadcasting, DTTB should have some additional values other than multi channels: However, DTTB operators are required to simulcast analog programming. If the programs are SDTV quality, they do not attract consumers. HDTV should be one of the key features to attract consumers to migrate from analog to digital. Broadcasters have already invested heavily in HDTV programming production facilities utilizing the 1080i format.

Although technical standards include 720p as one of HDTV, the choice of Japanese broadcasters is 1080i. The NHK-G channel is already providing pure HDTV programming in 80% of all programs, and the other broadcasters are increasing pure HDTV programming to 50% within 2004. Pure HDTV means programs which are recorded by HDTV camera, and televised in HDTV format. While licensing requirements allow the up-converted program which is recorded by SDTV camera.

China has already announced that it will utilize HDTV programming for the 2008 Beijing Olympic Games, by that time more and more programs will be broadcast as HDTV. Korea is also promoting HDTV. The Korean government requires broadcasters to provide at least 13 hours of pure HDTV programs per a week.

Market availability of HDTV receivers

TV manufacturers started shipment of HDTV sets with DTTB tuners from December 2003. STB is also available; however, only the users who already have HDTV displays can enjoy HDTV quality with STB; therefore, the main stream is HDTV sets with DTTB tuners. These HDTV sets also are accommodating digital satellite tuners, thus they are 'all-in-one digital HDTV' sets. As of February 2004, 80 DTTB products from 13 manufactures are being provided. All of those models are equipped with 10Base-T interface for interactive service. A model of PC with DTTB tuner was put

on the market in January 2004, and a model of DVD/HDD recorder with DTTB tuner was on sale in February 2004.

0.5 million sets of 'all-in-one digital HDTV' were shipped in Japan by the end of 2003, and 2.5 million DTTB ready HDTV sets, which have HDTV display and DTTB STB interface, are on the market. The flat display panel (FDP) is becoming popular; the sale of LCD and PDP TV sets already surpass conventional CRT HDTV receivers. The demand for flat display panels will enhance the demand for DTTB, and the penetration speed will be accelerated.



Figure 2 Status of Sale of Digital TV Products

Mobile reception

Mobile reception is the one of the definitive strengths of the ISDB-T system. Using one segment which is allocated in the center of 6 MHz, mobile receivers just receive the narrow band information only. With 16QAM modulation, 630 kbps data is transmitted. This size is enough for small video for cellular phones or PDA adopting MPEG4 video compression.

Cellular phones with the television make it possible for people to view television programs anywhere anytime with stable reception quality, which is a significant marketing tool for TV advertising, considering many people are commuting by train in metropolitan areas. A few companies already released prototypes of cellular phones cum digital television. Broadcasters are planning to begin the TV programming for mobile reception in 2005.

Cellular phones and PDA are not the only solution for mobile reception. Coaches and trains need wider screens which are beyond cellular type resolution. For this purpose, research is being conducted to receive HDTV in 12 segments of 64QAM signal. The HDTV reception in a vehicle travelling below 60km/h is attained by using active array antenna on the window of the vehicle. Experiments are examined on the Doppler equivalent technique against the multi-path Doppler frequency shift while moving at the 100km high speed. The demonstration of HDTV reception on coaches will be provided at the ITS World Conference in October 2004 in Nagoya, Japan.



Figure 3 Broadcasting to Portable Terminals (sample)

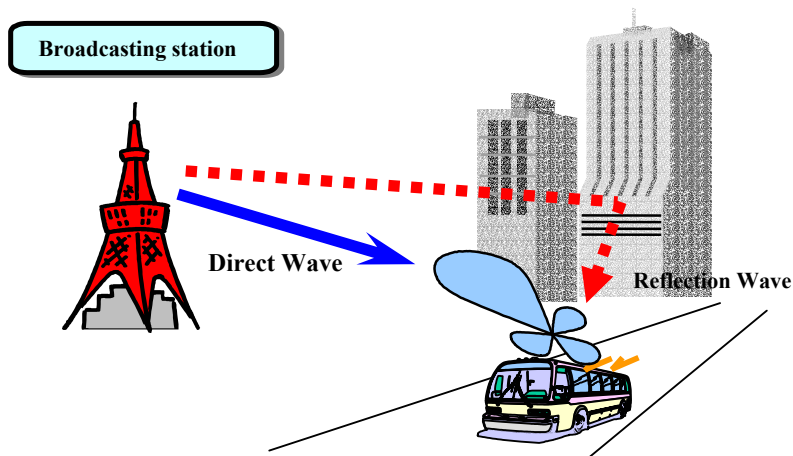


Figure 4 Mobile reception for HDTV using active array antenna

Copy right protection

Copy right protection is an important tool to secure the program rights. The copy control signal to secure a one-time only copy will be inserted into DTTB from April 2004, which is the same format as digital BS. DTTB receivers are sold with CAS (Conditional Access System) cards. The viewer should insert the card into the receiver at the time of purchase.

CONCLUSION

DTTB is the fundamental broadcasting media in Japan. The digitalization of television broadcasting is inevitable considering the widespread use of digital ICT services. The DTTB receivers are appropriate tool for home information terminals. The year 2004 is the start of full scale digital television. DTTB should have unique merits of digital broadcasting among several broadband media. HDTV and mobile reception are the vehicle to drive fast penetration of DTTB and the elements for the successful business model of DTTB.