ISDB-T Seminar

Presentation 5

ISDB-T Fixed & One-Seg Receivers /Broadcasting Station Facility

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Caracas, Venezuela
DiBEG JAPAN
Rafael Perez Cruz
(TOSHIBA)
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1. Service Configuration of ISDB-T

As explained in forward seminar, ISDBT has a priority for service variation by making use of its hierarchical transmission technology. At first, show a relations between service type and hierarchical transmission system.
*13 segments are divided into layers, maximum number of layers is 3.

*Any number of segment for each layers can be selected (totally 13 segment)

*Transmission parameter sets of each layer can be set independently (In above example, modulation index of each layer are different)
Examples of Hierarchical transmission system

- Hierarchical transmission

As shown above, ISDB-T transmission system supports maximally 3 reception style. Therefore, any of transmission system can be arranged according to the service concept in one frequency channel and one transmitter.
Examples of Service Configuration of ISDB-T

(1) Single layer multi-program for stationary reception

TV program 1
...
TV program N

(1 transmitter)

Select any program

(2) 2 layers for HDTV and portable reception (same program)

HDTV program

QVGA

(You can enjoy same TV program in any place)

(3) 3 layers for HDTV, SDTV and portable reception (same program)

HDTV program

SDTV

QVGA

Current service in Japan is case (2) shown above.
Service lineup of ISDB-T in Japan

**ISDB-T has powerful applications**

- **HDTV**
  - High quality image on wide screen and CD quality sound.

- **Data broadcasting**
  - Local news and weather forecast for viewers at any time.

- **Mobile accesses**
  - Transmission service to Mobile accesses

- **Multi-channel program**
  - Standard quality multi-channel service

- **Interactive TV**
  - Offers Interactive service
2. ISDB-T Receivers

As described in section 1., ISDB-T gives various kinds of broadcast service. According to service type, many kinds of receiver are now on market in Japan. ISDB-T receivers in Japanese market are categorized as follows:

(1) Receivers for fixed reception
(2) Receivers for mobile reception
(3) Receivers for portable reception (note)

(note) To save power dissipation, One-Seg receivers are main trend.
Part 1  Examples of receivers for Fixed Reception (Full Segment)

As described section 1., Digital Broadcasting service in Japan is mainly “HDTV(12 segment)+One-Seg(1 segment)”.

Fixed reception type receivers are mainly for HDTV reception, categorized as shown below.

(1) Wide flat panel TV (including tuner)
(2) STB, DVD type (not include Display panel)
(3) PC type (note)
   (note) some kinds of mobile PC has only One-Seg tuner to save power consumption.
Between a Full-Seg receiver and a One-Seg receiver, the basic configurations are about the same, though there are some differences such as a tuner, video decoder, resolution of display and so on.

**Key**
- **Command**: Phone Line, LAN, etc.
- **IF**: Intermediate Frequency
- **RF**: Radio Frequency
- **TS**: Transport Stream
- **Demux**: Demultiplexer
- **NVRAM**: Non-volatile RAM
Fixed Receivers

PDP TV

- VIERA TH-42PZ700SK Panasonic
- Wooo P42-HR01 HITACHI
- PDP-A427HX Pioneer

LCD TV

- REGZA 42H3000 TOSHIBA
- AQUOS LC-42RX1W SHARP
- VIERA TH-20LX70 Panasonic
- BRAVIA KDL-40V2500 SONY
- LCD-32HR100 SANYO
- AQUOS LC-16E1 SHARP
- VIERA TH-15LD70 Panasonic

SDTV

- AQUOS LC-13SX7 SHARP
### Fixed Receivers (Cont.)

<table>
<thead>
<tr>
<th>HDD/DVD Recorder</th>
<th></th>
<th>Blu-ray</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDZ-D800 SONY</td>
<td></td>
<td>BDZ-V9 SONY</td>
</tr>
<tr>
<td>VARDIA RD-S600 TOSHIBA</td>
<td></td>
<td>DIGA DMR-BW200 Panasonic</td>
</tr>
<tr>
<td>DIGA DMR-XW51 Panasonic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DVR-DV635 MITSUBISHI</td>
<td></td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>STB</th>
<th></th>
<th>STB-Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>TU-MHD600 Panasonic</td>
<td></td>
<td>TZ-DCH1800 Panasonic</td>
</tr>
<tr>
<td>DT400 MASPRO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Fixed Receivers (Cont.)

### Desktop PC

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Screen Size</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC</td>
<td>VALUESTAR S VS770/JG</td>
<td>20 inch</td>
<td>(1680x1050)</td>
</tr>
<tr>
<td>NEC</td>
<td>FMV-DESKPOWER LX70W/D</td>
<td>20.1 inch</td>
<td>(1680x1050)</td>
</tr>
<tr>
<td>HITACHI</td>
<td>Prius One type W AW37W5U</td>
<td>20.1 inch</td>
<td>(1680x1050)</td>
</tr>
</tbody>
</table>

### Notebook PC

**(medium-large size)**

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Screen Size</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC</td>
<td>LaVie L LL970/HG</td>
<td>15.4 inch</td>
<td>(1280x800)</td>
</tr>
<tr>
<td>NEC</td>
<td>FMV-BIBLO NX95W/D</td>
<td>17 inch</td>
<td>(1440x900)</td>
</tr>
<tr>
<td>TOSHIBA</td>
<td>Qosmio G40/95C</td>
<td>17 inch</td>
<td>(1920x1200)</td>
</tr>
</tbody>
</table>
Part 2  Examples of In Car Receiver

Because of following reasons, ISDB-T receiver are able to be used under mobile and portable condition.
(1) “Time Interleave function” (ISDB-T only).
(2) Diversity reception Technology

Many kinds of “In car receiver” are now on market in Japan.
Mobile Reception Environment

1. Lower electric field strength because of low antenna height (Approx. 10dB down)
2. Smaller antenna gain because of a nondirectional antenna (Approx. 10dB down)
3. Greatly affected by multipath fading because of mobile reception
4. Doppler shift because of high-speed movement
Improvement of Reception Performance

Improvement of a reception sensitivity with a single antenna almost reaches the limit.

Diversity reception techniques are expected to improve total reception sensitivity.

In fixed reception, diversity effect is 3dB at maximum. But in mobile reception, e.g. in-car TVs or cell phone TVs in a car or train, the effect reaches 6 - 8 dB.
Overview of Diversity System

Ripples are generated because of multipath reception.

Direct wave

Reflected wave (Multipath)

RF Tuner → FFT → Channel Estimation and Equalization → Selecting or Combining → Demapping

Note; this figure shows 2 input diversity reception, but, recently, 4 input type diversity receiver is now commercialized.
In-car Receivers

Navigation System
Full-Seg/One-Seg

- Strada CN-HDS965TD
  - Panasonic
  - All-in-one model
- AVIC-VH099G
  - Pioneer
  - Tuner separated model

Portable Navigation Device
One-Seg Only

- Mini GORILLA NV-SD10DT
  - SANYO

Portable Navigation Device
One-Seg Only

- In-Car TV
  - One-Seg Only

- GORILLA NV-HD830DT
  - SANYO
- CAV-TD85D1
  - SANYO

※Full-Seg is Optional
Part 3  Examples of receivers for Portable Reception (One-Seg)

As described in forward seminar, “One-Seg” is very unique service in ISDB-T. This service enables following advantages;
(1) Plural types of service in one channel (fixed/portable); it saves both frequency resource and Transmitter cost.
(2) Low power consumption terminal (note)
    (note) Partial reception technology is used to save power consumption, this technology is unique for ISDB-T

In this part, show several kinds of portable receiver.
Worldwide Trend of Mobile Digital TV Reception

Importance of mobile reception is recognized worldwide. Europe and U.S.A developed additional system for mobile reception. Broadcasters need additional investment for mobile TV reception except in the case of Japan’s system.

**EUROPE**
- Mobile Reception: DVB-H
- Fixed Reception: DVB-T
  - DVB-H was established for mobile reception as series of DVB, European DTTB system.
  - Trial Services have been provided in some countries, such as Finland, France, Spain, and Denmark.
  - MPEG-4 AVC/ITU-T H.264 will be adopted for video encoding.

**JAPAN**
- Mobile Reception: ISDB-T
- Fixed Reception: ISDB-T
  - MPEG-4 AVC/ITU-T H.264 was adopted for video encoding.
  - Launched on 1 April 2006.
  - Federative Republic of Brazil also adopted Japan’s system on-Jun 2006.
  - MPEG-4 AVC/ITU-T H.264 was adopted for video encoding.
  - Launch on 1 April 2006.
  - Federative Republic of Brazil also adopted Japan’s system on-Jun 2006.

**U.S.A**
- Mobile Reception: Under Consideration
- Fixed Reception: ATSC
  - Stream distribution services using mobile networks instead of terrestrial broadcasting have been started.
  - In addition to DVB-H, new technologies such as Media-FLO are being considered.

**KOREA**
- Mobile Reception: T-DMB
- Fixed Reception: ATSC
  - T-DMB based on European Digital Audio Broadcasting (DAB) was adopted for mobile reception systems unlike fixed reception.
  - Launched in Dec. 2005
  - ※ MPEG-4 AVC/ITU-T H.264 will be adopted for video encoding.

※ MPEG-4 AVC/ITU-T H.264 will be adopted for video encoding.
### Comparison of Mobile Reception Systems

<table>
<thead>
<tr>
<th></th>
<th>Japan</th>
<th>Other Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission system</td>
<td>ISDB-T (One-segment)</td>
<td>- T-DMB (KOR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- DVB-H (EU)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Media-FLO (U.S.A)</td>
</tr>
<tr>
<td>Service application</td>
<td>Video/Audio/Data</td>
<td>Video/Audio/Data</td>
</tr>
<tr>
<td>Assignment of new</td>
<td>Not necessary</td>
<td>Necessary</td>
</tr>
<tr>
<td>frequency bandwidth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional license</td>
<td>Not necessary</td>
<td>Necessary</td>
</tr>
<tr>
<td>Service provider</td>
<td>Broadcaster (Free Service)</td>
<td>Broadcaster/Carrier/ Other company (Pay Service)</td>
</tr>
<tr>
<td>Emergency Warning</td>
<td>Implementable</td>
<td>Cannot implement</td>
</tr>
<tr>
<td>Broadcasting System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thrifty Power Consumption</td>
<td>Excellent</td>
<td>Depend on systems</td>
</tr>
</tbody>
</table>

Obviously ISDB-T is excellent system for mobile reception.
One-Seg Receiver Market

- **One-Seg is abbreviation for “one segment service”**.
- **One-Seg launched on April 1, 2006**.
- **More than 7 million cell phones with One-Seg service have been sold in the market according to JEITA statistics of End of April, 2007.**

![Graph showing the growth of One-Seg Mobile Phones and In-Car One-Seg Receivers from 2006 to 2010.](source: Nomura Research Institute)
Portable Receivers

Cell Phone  One-Seg Only

- au
  - W51SA
  - W52T

- NTT DoCoMo
  - P903iTV
  - D903iTV

- Softbank
  - 911SH
  - 911T

**au**
14 models are available at the end of May, 2007

**NTT DoCoMo**
4 models are available at the end of May, 2007

**Softbank**
3 models are available at the end of May, 2007
### Portable Receivers (Cont.)

**One-Seg Only**

<table>
<thead>
<tr>
<th><strong>DVD Player</strong></th>
<th><strong>Laptop</strong></th>
<th><strong>Adapters (USB, etc.)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>DVD-LX87 Panasonic</td>
<td>DVD-HP700ND SANYO</td>
<td>VAIO type T SONY</td>
</tr>
<tr>
<td>Many products are on sale. BUFFALO, I・O DATA, etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Audio Player**

- gigabeat V30E TOSHIBA

**Dictionary**

- Papyrus PW-TC900 SHARP

**Portable TV**

- XDV-100 SONY
Diversity Reception System for Cell Phones

Diversity systems are applicable to cell phones as well as in-car receivers. Now, only one product, P903iTV, is equipped with diversity system. It has two antennas for One-Seg, a whip antenna and an internal antenna.
4. Facilities of Broadcaster in Japan

Digital Terrestrial Broadcasting has started from Dec., 2003 in 3 metropolitan areas.

And from Dec. 2006, Digital Terrestrial Broadcasting has been in service in all prefectures.

In this section, show the several examples of Broadcaster’s facilities, both studio system and transmission system.
Current situation in Japan

Digital Broadcasting Service

- Begun by Oct. 2006
- Begun by Dec. 2006
- Begun by end of 2006

As shown below, Digital Terrestrial Broadcasting has started in all Prefecture.
Analog to Digital

Differences Between Analog and Digital Broadcasting

Analog broadcasting

Vision
Sound

Master

Analogue STL

Analogue transmitter

Digital broadcasting

MPEG Coding/Multiplexing

Key technologies

OFDM transmission

Digital STL

Digital transmitter

Vision

Digitalization

Coding

Multiplexing

Sound

Digitalization

Coding

Data

Coding
Applications

Segments: 12

Segments: 1

8:00
9:00
10:00

Time

SDTV1
Supplemental broadcast

SDTV2
Supplemental broadcast

SDTV3
Supplemental broadcast

HDTV

Supplemental broadcast

Supplemental broadcast

1 segment service for mobile phone
Block diagram of ENC/MUX

Data Server

Ether-Net LAN

Automation

Matrix Switcher

Source Input

SI/EPG

Data Service

Video

Audio

HD-ENC

SD1-ENC

SD2-ENC

1-SEG ENC

ISDB MUX

System Change

TS Splicer

SI/EPG Data Service

Total Control of Base Band and ENC/MUX

Transmission Control Data

Multiplex TS

STL TX

System Control of Base Band and ENC/MUX

Primary TS

Transmission Control Data

Reference SYNC/MUX/SFN

ENC/MUX SG

DiBEG Digital Broadcasting Experts Group
Example of Master system
(TV Tokyo)

- Operation by few clues
- Efficient positioning
- Multi-view and/or selection on wide screen LCD, PDP
- Use touch panel for operation
- Monitoring another line at monitoring booth
Example of Master system (TV-asahi)
Examples of Transmission System

(1) High Power Digital Transmitter System
(2) Micro-wave Links of Digital Terrestrial Broadcasting
(3) Trans-poser of Digital Terrestrial Broadcasting
(1) High Power Digital Transmitter system

(a) An Example of Conceptual block diagram (Full redundant system)

(b) Power Line-up in Japan

<table>
<thead>
<tr>
<th>Area</th>
<th>Digital TX</th>
<th>Analog TX</th>
<th>note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo</td>
<td>UHF 10 kW</td>
<td>VHF 50 kW</td>
<td>wide area key station</td>
</tr>
<tr>
<td>Osaka</td>
<td>UHF 3 kW</td>
<td>VHF 10 kW</td>
<td>same as above</td>
</tr>
<tr>
<td>Nagoya</td>
<td>UHF 3 kW</td>
<td>VHF 10 kW</td>
<td>same as above</td>
</tr>
</tbody>
</table>

(c) Examples of Hardware; see following pages
Examples of High Power Digital Transmitter (Toshiba)

10 kW digital Transmitter(2/3 type)
3 kW digital transmitter rack
1 kW digital transmitter rack

Output power series;
-10kW(2/3) type; for Kanto area
-3kW dual type; for Kansai and Chukyo
-1kW dual type; for medium cover area

Feature;
-Any of cooling type (water or air)
-Equipped high performance non-linear distortion compensator
Examples of Digital Transmitter (NEC)

Features

1) Both liquid cooling / air cooling available
2) Compact size / Minimized footprint
3) Adaptive Digital Corrector to maintain optimal signal quality
4) Color LCD to monitor detailed parameters

3kW Air Cooled UHF Digital TV Transmitter
(in operation at Osaka & Nagoya stations)

10kW Water Cooled UHF Digital TV Transmitter
(in operation at Tokyo station)
Antennas(1)

A number of analog TV antennas were already mounted on the optimum position of Tokyo Tower.
Vacancy zone is around 250m of Tokyo tower. There are no appropriate space except there. Digital antennas were designed, compact size, 6 meters in width and 12 meters in height.
(2) Micro-wave Transmission Link

(a) STL (studio transmitter link) and TTL (transmitter transmitter link)

2 transmission types described below are available (can be applied to fiber transmission)

1. TS transmission type

2. IF transmission type

(b) FPU (Field Pick Up)

Field Pick Up is the outside program transmission system for news gathering and sports relay system, etc. Recently, digital modulation system such as single carrier QAM and OFDM are introduced.

(c) Examples of Hardware; see following pages
An Image of transmission network chain

Main Transmitter

Micro TS-TTL

Micro TS-STL

Micro IF-TTL

Broadcast wave relay

Transposer

Broadcast wave relay

Transposer

Transposer

Transposer

Studio

DiBEG
Digital Broadcasting Experts Group
Example of Wide KANTO area Network

DiBEG
Digital Broadcasting Experts Group

Tokyo Tower

Transposer

Transposer

FX

FX

Studio

Transmitter

TS TTL

IF TTL

300WTX

3WTX

10WTX

: 10WTX

: 3WTX

: 300WTX

: IF TTL

: TS TTL

0 10 20 30 40 50km
Examples of Microwave STL/TTL (Toshiba)

- Dual type, seamless switching
- DVB-ASI digital interface
- Equipped automatic multi-path equalizer

TS STL/TTL TX  TS STL/TTL RX

- Dual type, TX/RX are installed in 1 rack
- OFDM IF signal interface
- Phase noise compensation technology with pilot signal

IF TTL TX/RX
Examples of Digital Studio to Transmitter Link for TS Signal Transmission
(Hitachi KokusaiElectric)

- Seamless SHF Output Signal Switching
- DVB-ASI Digital Signal Interface
- High-performance automatic equalizer diminishes multi-path distortion

2 channels dual system
Examples of Digital Transposer (NEC)

30W x 3-channels common amplification System

Features

1) Excellent IM (less than -50dB) using Feed-forward technology.

2) MCPA (Multi Channel Power Amplifier) is available.
   No required of Channel combiner, especially, in the case of adjacent channel transmitting.

3) END (Equivalent Noise Degradation) improving equipment for on air receiving system is provided.
   - Loop canceller
   - Diversity receiver
   - Noise reduction (Re-mapping) Equipment.
Examples of Digital Transposer (Toshiba)

TS-TTL 3W TX

TS-TTL 50W TX
END of Seminar #5

Thank you for your attention