"ISDB-T Receiver"

27th - 28th February, 2008
Manila, Philippines
DiBEG JAPAN
Hirohiko SAKASHITA
(Matsushita Electric Industrial Co., Ltd.)
Contents

- Reception types of ISDB-T
- Introduction of some Japanese ISDB-T receivers
  - Fixed receivers
  - In-car receivers
  - Portable receivers
- Shipments and diffusion prediction of ISDB-T receivers
- Merits of One-Seg
- Configuration of a basic receiver
- Improvement of reception performance
  - Introduction of diversity system
  - Experiments of One-Seg diversity reception
- Trends in Price of Japanese ISDB-T receivers
One channel of ISDB-T is divided into 13 segments. One segment of them is used for mobile and handheld TVs.
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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, LCD-70
- AQUOS LC-16E1, SHARP
- AQUOS LC-13SX7, SHARP

SDTV
- VIERA TH-15LD70, Panasonic

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Fixed Receivers (Cont.)

HDD/DVD Recorder

- RDZ-D800
  - SONY
- DIGA DMR-XW51
  - Panasonic
- VARDIA RD-S600
  - TOSHIBA
- DVR-DV635
  - MITSUBISHI

Blu-ray

- BDZ-V9
  - SONY
- DIGA DMR-BW200
  - Panasonic

STB

- TU-MHD600
  - Panasonic
- DT400
  - MASPRO

Cable STB

- TZ-DCH1800
  - Panasonic

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### Fixed Receivers (Cont.)

#### Desktop PC

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

#### Notebook PC (medium-large size)

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Display Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC</td>
<td>LaVie L LL970/HG</td>
<td>15.4 inch (1280x800)</td>
</tr>
<tr>
<td>FMV-DESKPOWER</td>
<td>NX95W/D</td>
<td>17 inch (1440x900)</td>
</tr>
<tr>
<td>TOSHIBA</td>
<td>Qosmio G40/95C</td>
<td>17 inch (1920x1200)</td>
</tr>
</tbody>
</table>
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**In-car Receivers**

**Navigation System**

- **Full-Seg/One-Seg**
  - Strada CN-HDS965TD
  - Panasonic
  - AVIC-VH099G
  - Pioneer

- **Tuner separated model**
  - All-in-one model
  - HS706D-A
  - NISSAN/SANYO

- **One-Seg Only**
  - GORILLA NV-HD830DT
  - SANYO

- **In-Car TV**
  - One-Seg Only
    - ※Full-Seg is Optional
  - CAV-TD85D1
  - SANYO

**Portable Navigation Device**

- **One-Seg Only**
  - Mini GORILLA NV-SD10DT
  - SANYO

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### Portable Receivers

<table>
<thead>
<tr>
<th>Cell Phone</th>
<th>One-Seg Only</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>au</strong></td>
<td></td>
</tr>
<tr>
<td>W51SA</td>
<td>P903iTV</td>
</tr>
<tr>
<td>W52T</td>
<td>D903iTV</td>
</tr>
<tr>
<td>911SH</td>
<td></td>
</tr>
<tr>
<td>911T</td>
<td></td>
</tr>
</tbody>
</table>

**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.)

#### DVD Player
- DVD-LX87
  - Panasonic
- DVD-HP700ND
  - SANYO

#### Laptop
- VAIO type T
  - SONY

#### Adapters (USB, etc.)
- Many products are on sale.
  - BUFFALO, I・O DATA, etc.

#### Audio Player
- gigabeat V30E
  - TOSHIBA

#### Dictionary
- Papyrus PW-TC900
  - SHARP

#### Portable TV
- XDV-100
  - SONY
Shipment Volume of ISDB-T Receivers

Total until April, 2007
21,287 (thousand units)

<table>
<thead>
<tr>
<th>Product</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC</td>
<td>701</td>
</tr>
<tr>
<td>Cable STB</td>
<td>3,926</td>
</tr>
<tr>
<td>STB</td>
<td>326</td>
</tr>
<tr>
<td>Recorder</td>
<td>3,528</td>
</tr>
<tr>
<td>LCD TV</td>
<td>10,230</td>
</tr>
<tr>
<td>PDP TV</td>
<td>1,854</td>
</tr>
<tr>
<td>CRT TV</td>
<td>722</td>
</tr>
</tbody>
</table>

※Receivers only for One-Seg and in-car receivers are not included.

Source: Japan Electronics and Information Technology Association (JEITA)
Diffusion Prediction of ISDB-T Receivers

The cumulative total of sales until 2011 will be 117 million units.

※Receivers only for One-Seg and in-car receivers are not included.

Source: Japan Electronics and Information Technology Association (JEITA)
Diffusion Prediction of One-Seg Cell Phones

A certain research institute has reported diffusion prediction of One-Seg cell phones. About 30% of cell phone users will have One-Seg cell phones in 2010.

Source: Yano Research Institute Ltd., Japan
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Merits of One-Seg

- High quality video & audio in a mobile environment
  - Robustness to noise and multipath

Stable reception in a mobile environment

- Easy to put the function on portable terminals
  - One-seg receivers need lower cost, smaller devices, lower power consumption, and lower CPU power than Full-seg receivers.

Various portable terminals get possible to have TV function.

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### Tuner Modules for One-Seg

<table>
<thead>
<tr>
<th>Maker</th>
<th>ALPS</th>
<th>ALPS</th>
<th>MURATA</th>
<th>SHARP</th>
<th>MITSUMI</th>
<th>Panasonic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model/Type</strong></td>
<td>TDPJ</td>
<td>TSL</td>
<td>SUMUDDJ-LS101</td>
<td>VA35JZ9910</td>
<td>DVT7-J11D</td>
<td>CTMW02</td>
</tr>
<tr>
<td><strong>Feature</strong></td>
<td>Small size</td>
<td>High durability for automobile environments</td>
<td>Small size</td>
<td>Low power consumption</td>
<td>Small size</td>
<td>Diversity reception</td>
</tr>
<tr>
<td><strong>Size (mm)</strong></td>
<td>9.5x9.5x1.7</td>
<td>25.0x15.2x2.1</td>
<td>8.7x9.6x1.55</td>
<td>9.0x9.0x1.5</td>
<td>8.9x8.9x1.5</td>
<td>12.5x16.5x1.95</td>
</tr>
<tr>
<td><strong>Power consumption (mW)</strong></td>
<td>180</td>
<td>-</td>
<td>-</td>
<td>95</td>
<td>140</td>
<td>100(low power mode) /115(normal mode) ※single mode</td>
</tr>
<tr>
<td><strong>Minimum input sensitivity (dBm, 1 segment bandwidth, QPSK1/2)</strong></td>
<td>-109</td>
<td>-107.5</td>
<td>-110</td>
<td>-109</td>
<td>-109</td>
<td>-109(single mode) / -112(diversity mode)</td>
</tr>
</tbody>
</table>
### Improvement of One-Seg Cell Phones

<table>
<thead>
<tr>
<th>Model</th>
<th>Released date</th>
<th>Size(mm) (when closed)</th>
<th>Weight(g) (with battery)</th>
<th>Display</th>
<th>International Roaming</th>
<th>Continues Call time(min)</th>
<th>Continuous watch time for “One-Seg”</th>
</tr>
</thead>
<tbody>
<tr>
<td>P901iTV</td>
<td>Mar. 2006</td>
<td>110x51x27</td>
<td>150</td>
<td>2.5inch QVGA (240x320)</td>
<td>3G</td>
<td>145</td>
<td>3 h</td>
</tr>
<tr>
<td>P903iTV</td>
<td>Feb. 2007</td>
<td>110x50x22</td>
<td>139</td>
<td>2.8inch Wide QVGA (240x400)</td>
<td>3G</td>
<td>195</td>
<td>7h</td>
</tr>
<tr>
<td>P905</td>
<td>Nov. 2007</td>
<td>106x49x18.5</td>
<td>137</td>
<td>3.0inch Wide VGA (480x854)</td>
<td>3G / GSM</td>
<td>200</td>
<td>6 h</td>
</tr>
</tbody>
</table>

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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.

RF : Radio Frequency
IF : Intermediate Frequency
TS : Transport Stream
Demux : Demultiplexer
NVRAM : Non-volatile RAM
Functional Block Diagram of the Front-end

- RF Signal
- Down Conversion
- A/D Conversion
- FFT
- Channel Estimation and Equalization
- Frequency De-interleave
- Time De-interleave
- Demapping
- Bit De-interleave
- Viterbi Decoding
- Byte De-interleave
- Energy Dispersal
- Reed-Solomon Decoding
- Frame Synchronization
- TMCC Decoding
- Symbol Synchronization
- Clock Regeneration

FFT: Fast Fourier Transform
TMCC: Transmission and Multiplexing Configuration Control
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**Functional Block Diagram of the Back-end**

- **PID filter**
- **Section filter**
- **DSM-CC Data carousel processing**
- **Application Execution Engine (MHP/ARIB-J)**
- **Presentation Engine (BML Browser)**
- **Blending**

**Key Components**:
- **PID** : Packet Identifier
- **PES** : Packetized Elementary Stream
- **PCR** : Program Clock Reference
- **PSI/SI** : Program Specific Information/Service Information
- **DSM-CC** : Digital Storage Media - Command and Control
- **BML** : Broadcast Markup Language

Not currently operated in Japan
Basic Applications on ISDB-T Receivers

- Frequency scanning / Channel list
- Channel selecting
- Audio/Video playing back
- EPG (Electronic Program Guide)
- Closed Caption / Subtitle
- Data Broadcasting (BML)
- Interactive service
etc.
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
2-Diversity System (4 Antennas and 2 Tuners)

Less complex than 4-tuner diversity system.
Higher-sensitive than conventional 2 antenna-diversity system
4-Diversity System (4 Antennas and 4 Tuners)

4-diversity system improves the reception performance more than conventional 2-diversity system, though the process becomes more complex.
Experiments of One-Seg Diversity Reception

Experiment 1 : Field test
   A) The upper terminal is using single antenna reception system.
   B) The middle terminal is using diversity reception system of SANYO.
   C) The lower terminal is using diversity reception system of a certain company.
Experiments of One-Seg Diversity Reception

Experiment 2: Laboratory test
A) The left terminal is using diversity reception system of SANYO.
B) The right terminal is using diversity reception system of a certain company.
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.
Launched digital terrestrial television

Change in Price of Major Flat Panel Displays (FPD)

- LCD 37-inch
- PDP 42-inch
- CRT 32-inch

Price (US$)

- 6,203 U.S.$
- 5,743 U.S.$
- 1,565 U.S.$
- 1,113 U.S.$

Launch dates:
- PDP 42-inch: Sep. 2004
- CRT 32-inch: Mar. 2005
Distribution of LCD Price

Price (U.S.$)

Prices are going down!
## Varied LCD Digital Receivers

<table>
<thead>
<tr>
<th>PHOTO</th>
<th>TYPE</th>
<th>PRICE</th>
<th>URL</th>
</tr>
</thead>
</table>
Distribution of PDP Price
Price (U.S.$)

Prices are going down!
## Varied PDP Digital Receivers

<table>
<thead>
<tr>
<th>PHOTO</th>
<th>TYPE</th>
<th>PRICE</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="37V.png" alt="Image" /></td>
<td>HITACHI P37-H01 (37-inch)</td>
<td>123,900 JPY (≈1,072 U.S.$)</td>
<td><a href="http://av.hitachi.co.jp/tv/plasma/01/index.html">http://av.hitachi.co.jp/tv/plasma/01/index.html</a></td>
</tr>
<tr>
<td><img src="50-inch.png" alt="Image" /></td>
<td>bydsign PH-5000DFK (50-inch)</td>
<td>239,800 JPY (≈2,074 U.S.$)</td>
<td><a href="http://www.bydsign.jp/Form/Product/ProductDetail.aspx?shop=0&amp;cat=101&amp;swrd=&amp;pid=PH-5000DFK&amp;vid=">http://www.bydsign.jp/Form/Product/ProductDetail.aspx?shop=0&amp;cat=101&amp;swrd=&amp;pid=PH-5000DFK&amp;vid=</a></td>
</tr>
</tbody>
</table>
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### High-Performance Set Top Box

<table>
<thead>
<tr>
<th>PHOTO</th>
<th>TYPE</th>
<th>PRICE</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TU-MHD600</td>
<td>(≒396 U.S.$)</td>
<td></td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>SONY</td>
<td>42,987 JPY</td>
<td><a href="http://www.ecat.sony.co.jp/vaio/acc/acc.cfm?PD=26654">http://www.ecat.sony.co.jp/vaio/acc/acc.cfm?PD=26654</a></td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>VGF-DT1</td>
<td>(≒372 U.S.$)</td>
<td></td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>SHARP</td>
<td>28,489 JPY</td>
<td><a href="http://www.uniden.jp/support/manualdl.html">http://www.uniden.jp/support/manualdl.html</a></td>
</tr>
<tr>
<td><img src="image4.png" alt="Image" /></td>
<td>TU-HD200</td>
<td>(≒246 U.S.$)</td>
<td></td>
</tr>
<tr>
<td><img src="image5.png" alt="Image" /></td>
<td>MASPRO</td>
<td>27,842 JPY</td>
<td><a href="http://www.maspro.co.jp/new_prod/dt400/dt400.html">http://www.maspro.co.jp/new_prod/dt400/dt400.html</a></td>
</tr>
<tr>
<td><img src="image6.png" alt="Image" /></td>
<td>DT400</td>
<td>(≒241 U.S.$)</td>
<td></td>
</tr>
</tbody>
</table>

These products also correspond to BS and CS digital broadcasting services.
### Low-Price Set Top Box

<table>
<thead>
<tr>
<th>PHOTO</th>
<th>TYPE</th>
<th>PRICE</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="AVOX YDIT-10" /></td>
<td>AVOX YDIT-10</td>
<td>15,213 JPY (≒132 U.S.$)</td>
<td><a href="http://www.cmex.co.jp/tuner.html">http://www.cmex.co.jp/tuner.html</a></td>
</tr>
<tr>
<td><img src="image2.png" alt="YAGI DTC10" /></td>
<td>YAGI DTC10</td>
<td>16,097 JPY (≒139 U.S.$)</td>
<td><a href="http://www.yagi-antenna.co.jp/products/home/tuner/index.html">http://www.yagi-antenna.co.jp/products/home/tuner/index.html</a></td>
</tr>
<tr>
<td><img src="image3.png" alt="MASPRO DT610" /></td>
<td>MASPRO DT610</td>
<td>17,444 JPY (≒151 U.S.$)</td>
<td><a href="http://www.maspro.co.jp/products/dt610/tokuyo.html">http://www.maspro.co.jp/products/dt610/tokuyo.html</a></td>
</tr>
</tbody>
</table>

**Digital broadcasting experts group**
About 35 million analog TVs will be persisted in Japan by 2011, when transition of analog to digital broadcasting will be completed, especially in the field of public institution (e.g. schools, hospitals, and nursing homes etc..).
Conclusions

✓ Since 2003 various ISDB-T products, fixed, in-car and portable receivers have been launched in Japan.

✓ Consumer adoption of ISDB-T receiver is growing at a rapid pace for 2011 when analogue TV broadcasting will end in Japan.

✓ About 30% of cell phone users will have One-Seg cell phones in 2010 in Japan.

✓ For mobile reception, diversity techniques are very effective to improve the reception performance.
Thank you for your attention.

Digital Broadcasting Expert Group

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