Presentation 6

ISDB-T / One-Seg Receivers

13th - 14th June, 2007

Bangkok, Thailand

DiBEG JAPAN

Masahiro SATA
(SANYO Electric 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
One channel of ISDB-T is divided into 13 segments. One segment of them is used for mobile and handheld TVs.
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

SDTV
- VIERA TH-15LD70 Panasonic
- AQUOS LC-13SX7 SHARP
### 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
## Fixed Receivers (Cont.)

<table>
<thead>
<tr>
<th>Desktop PC</th>
<th></th>
<th>Notebook PC (medium-large size)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VALUESTAR S VS770/JG</strong></td>
<td>NEC</td>
<td><strong>LaVie L LL970/HG</strong></td>
<td>NEC</td>
</tr>
<tr>
<td><strong>20 inch</strong> (1680x1050)</td>
<td></td>
<td><strong>15.4 inch</strong> (1280x800)</td>
<td></td>
</tr>
<tr>
<td><strong>FMV-DESKPOWER LX70W/D</strong></td>
<td>FUJITSU</td>
<td><strong>FMV-BIBLO NX95W/D</strong></td>
<td>FUJITSU</td>
</tr>
<tr>
<td><strong>20.1 inch</strong> (1680x1050)</td>
<td></td>
<td><strong>17 inch</strong> (1440x900)</td>
<td></td>
</tr>
<tr>
<td><strong>Prius One type W AW37W5U</strong></td>
<td>HITACHI</td>
<td><strong>Qosmio G40/95C</strong></td>
<td>TOSHIBA</td>
</tr>
<tr>
<td><strong>20.1 inch</strong> (1680x1050)</td>
<td></td>
<td><strong>17 inch</strong> (1920x1200)</td>
<td></td>
</tr>
</tbody>
</table>
## In-car Receivers

### Navigation System

<table>
<thead>
<tr>
<th>Full-Seg/One-Seg</th>
<th>Tuner separated model</th>
<th>All-in-one model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strada CN-HDS965TD</strong></td>
<td>Panasonic</td>
<td><strong>AVIC-VH099G</strong></td>
</tr>
<tr>
<td><strong>HS706D-A</strong></td>
<td><strong>NISSAN/SANYO</strong></td>
<td><strong>GORILLA NV-HD830DT</strong></td>
</tr>
</tbody>
</table>

### Portable Navigation Device

<table>
<thead>
<tr>
<th>One-Seg Only</th>
<th><strong>Mini GORILLA NV-SD10DT</strong></th>
<th><strong>SANYO</strong></th>
</tr>
</thead>
</table>

### In-Car TV

<table>
<thead>
<tr>
<th>One-Seg Only</th>
<th><strong>CAV-TD85D1</strong></th>
<th><strong>SANYO</strong></th>
</tr>
</thead>
</table>

※Full-Seg is Optional
### 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></td>
</tr>
<tr>
<td>W52T</td>
<td></td>
</tr>
<tr>
<td>P903iTV</td>
<td></td>
</tr>
<tr>
<td>D903iTV</td>
<td></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.)

One-Seg Only

- **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

※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)
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
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.
### 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>Model/Type</td>
<td>TDPJ</td>
<td>TSL</td>
<td>SUMUDDJ-LS101</td>
<td>VA35JZ9910</td>
<td>DVT7-J11D</td>
<td>CTMW02</td>
</tr>
<tr>
<td>Feature</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>Size(mm)</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>Power consumption (mW)</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>Minimum input sensitivity (dBm,1segment bandwidth, QPSK1/2)</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>W33SA (The first One-Seg receiver)</th>
<th>W43SA</th>
<th>W51SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size(mm) (when closed)</td>
<td>105x50x27</td>
<td>102x50x22</td>
<td>105x51x21</td>
</tr>
<tr>
<td>Weight(g) (with battery)</td>
<td>150</td>
<td>133</td>
<td>146</td>
</tr>
<tr>
<td>Display</td>
<td>2.4inch QVGA (240x320)</td>
<td>2.4inch QVGA (240x320)</td>
<td>2.6inch QVGA (240x320)</td>
</tr>
<tr>
<td>Battery capacity(mAh)</td>
<td>830</td>
<td>840</td>
<td>840</td>
</tr>
<tr>
<td>Continuous watch time for “One-Seg”</td>
<td>2 h 45 m</td>
<td>&lt; 4 h 40 m</td>
<td>&lt; 5 h 5 m</td>
</tr>
</tbody>
</table>

Duration time has become longer mainly thanks to lower power consumption of a tuner and a chipset.
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**
- **AAC**: Advanced Audio Coding
- **MPEG2**: Moving Picture Experts Group 2
- **H.264**: High Efficiency Video Coding
- **Caption Data Carousel**: Data used for closed captioning
- **NVRAM**: Non-volatile RAM

**Abbreviations**
- **RF**: Radio Frequency
- **IF**: Intermediate Frequency
- **TS**: Transport Stream
- **Demux**: Demultiplexer
- **NVRAM**: Non-volatile RAM

**Diagram Notes**
- Flows of signal and data
- System Bus
- Audio Output
- Video Output
- Communication I/F
- Phone Line, LAN, etc.
Functional Block Diagram of the Front-end

- RF Signal
- 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
Functional Block Diagram of the Back-end

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

**TS**

- **PID filter**
- **PES processing**
- **PCR**
- **Caption Decoder**
- **Video Decoder**
- **Scaling**
- **Audio Decoder**

**Definitions**
- 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
Functional Block Diagram of BML Browser

Event Manager / Total Management

- Presentation Manager
- Document Manager (DOM / CSS)
- ECMAScript Compiler
- Content Manager (Broadcasting Content / Communication Content)
- External Functions (Data Carousel, Communications, NVRAM, Key, Graphics, Fonts, Sound, etc.)

- Still Image Decoder
- XML Parser
- CSS Parser
- ECMAScript Interpreter
- Built-in Objects (Basic / Extended)
- Browser Pseudo Objects

External Events
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.
Ripples are generated because of multipath reception.

Overview of Diversity System

Direct wave

Reflected wave (Multipath)

RF Tuner → FFT

Channel Estimation and Equalization

Selecting or Combining

Demapping

DiBEG
Digital Broadcasting Experts Group
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 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.
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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