Features of ISDB-T
and
Activities to spread watching DTV in Japan

October 20, 2003
Jakarta, Indonesia

Atsumi SUGIMOTO
DiBEG
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• Features of ISDB-T
• Activities to spread watching DTV in Japan
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  – Targets of Diffusion of Digital Terrestrial TV receiver units
  – Analogue Channel Re-arrangement
  – DTTV License Policy
  – National Organizations for Promoting
• Recently announced DTTV products
• The Development of New Services
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The Digital Broadcasting Experts Group (DiBEG) was founded in September 1997 for the key forces to promote the Japanese Digital Terrestrial Broadcasting System ISDB-T and ISDB-TSB into the world.

Today, DiBEG has 25 members, including broadcasters, broadcast equipment manufacturers and consumer electronics manufacturers etc.

DiBEG is now one committee of ARIB (Association of Radio Industries and Businesses)
Features of ISDB-T
ISDB-T is 

- ISDB-T system was developed by the Association of Radio Industries and Businesses (ARIB) in Japan.
- ISDB (Integrated Digital Services Digital Broadcasting) is a new type of broadcasting intended to provide audio, video, and multimedia services. T is Terrestrial.
- ISDB-T is one of ISDB family.
- ISDB-T uses a modulation method referred to as Band Segmented Transmission (BST) OFDM
Market Requirements for ISDB-T

- HDTV
- Multi SDTV
- Mobility
- Portability
- Data Broadcasting
- Effective Spectrum Utilization
- Flexibility
The Correct Design of the System

**Technical Specifications**

- **OFDM**
  - Robustness, SFN (Single Frequency Network)
- **Segmented Structure**
  - Extensible, Partial Reception
- **Time Interleaving**
  - Mobile Reception, Indoor Reception
- **TMCC (Transmission and Multiplexing Configuration Control)**
  - Flexible, Versatile
Transmission Scheme

- Band Segmented Transmission OFDM
  - Bandwidth of an OFDM-Segment:
    - 6/14MHz (428.6kHz) or 8/14MHz (571.4kHz)
  - Number of OFDM Segments: 13
Segmented Structure and Partial Reception

6MHz or 8MHz
Transmission Scheme

• Band Segmented Transmission OFDM
  • Bandwidth of an OFDM-Segment:
    • 6/14MHz (428.6kHz) or 8/14MHz (571.4kHz)
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• Partial Reception
  – One-segment ISDB-T receiver can receive a centered segment of ISDB-T signal.
Segmented Structure and Partial Reception
Transmission Scheme

- **Band Segmented Transmission OFDM**
  - Bandwidth of an OFDM-Segment:
    - 6/14MHz (428.6kHz) or 8/14MHz (571.4kHz)
  - Number of OFDM Segments: 13

- **Partial Reception**
  - One-segment ISDB-T receiver can receive a centered segment of ISDB-T signal.

- **Hierarchical Transmission**
  - Three layers
  - Modulation, Coding rates, Length of Time interleaving
An Example of Hierarchical Multiplexing

Segmented Structure and Partial Reception

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sound / Data</th>
<th>HDTV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Layer A</td>
<td>Layer B</td>
</tr>
<tr>
<td>Parameter</td>
<td>64QAM 3/4 12 segments</td>
<td>16QAM 1/2 1 segment</td>
</tr>
<tr>
<td>Bit rate</td>
<td>16.9 Mbps</td>
<td>630 kbps</td>
</tr>
</tbody>
</table>
Three Mode of ISDB-T

<table>
<thead>
<tr>
<th></th>
<th>Mode1(2K)</th>
<th>Mode2(4K)</th>
<th>Mode3(8K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DQPSK</td>
<td>Mobile SDTV</td>
<td>Mobile &amp; Fixed HDTV/SDTV</td>
<td>Fixed HDTV/SDTV</td>
</tr>
<tr>
<td>QPSK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16QAM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>64QAM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TMCC can change the mode any time to any combination.
### Parameters of ISDB-T

(6MHz Bandwidth)

<table>
<thead>
<tr>
<th>ISDB-T Mode</th>
<th>Mode 1</th>
<th>Mode 2</th>
<th>Mode 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of OFDM Segment</td>
<td></td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Useful Bandwidth</td>
<td>5.575MHz</td>
<td>5.573MHz</td>
<td>5.572MHz</td>
</tr>
<tr>
<td>Carrier Spacing</td>
<td>3.968kHz</td>
<td>1.984kHz</td>
<td>0.992kHz</td>
</tr>
<tr>
<td>Total Carriers</td>
<td>1405</td>
<td>2809</td>
<td>4992</td>
</tr>
<tr>
<td>Modulation</td>
<td>DQPSK, QPSK, 16QAM, 64QAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active Symbol Duration</td>
<td>252 ÷ sec</td>
<td>504 ÷ sec</td>
<td>1,008 ÷ sec</td>
</tr>
<tr>
<td>Guard Interval Duration</td>
<td>1/4, 1/8, 1/16, 1/32 of Active Symbol Duration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Symbols per Frame</td>
<td>204</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Interleaving</td>
<td>0, 0.125, 0.25, 0.5sec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inner Coding</td>
<td>Convolutional Code (1/2, 2/3, 3/4, 5/6, 7/8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outer Coding</td>
<td>RS(204, 188)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Useable Bit Rate</td>
<td>3.65Mbps ¬ 23.23Mbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hierarchical Transmission</td>
<td>up to Three Layers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Parameters of ISDB-T

(8MHz Bandwidth)

<table>
<thead>
<tr>
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<th>Mode 1</th>
<th>Mode 2</th>
<th>Mode 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of OFDM Segment</td>
<td></td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Useful Bandwidth</td>
<td>7.434MHz</td>
<td>7.431MHz</td>
<td>7.430MHz</td>
</tr>
<tr>
<td>Carrier Spacing</td>
<td>5.291kHz</td>
<td>2.645kHz</td>
<td>1.322kHz</td>
</tr>
<tr>
<td>Total Carriers</td>
<td>1405</td>
<td>2809</td>
<td>4992</td>
</tr>
<tr>
<td>Modulation</td>
<td>DQPSK, QPSK, 16QAM, 64QAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active Symbol Duration</td>
<td>189 µsec</td>
<td>378 µsec</td>
<td>756 µsec</td>
</tr>
<tr>
<td>Guard Interval Duration</td>
<td>1/4, 1/8, 1/16, 1/32 of Active Symbol Duration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Symbols per Frame</td>
<td>204</td>
<td></td>
<td></td>
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<tr>
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<td>Convolutional Code (1/2, 2/3, 3/4, 5/6, 7/8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outer Coding</td>
<td>RS(204, 188)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Useful Bit Rate</td>
<td>4.87Mbps ~ 30.98Mbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hierarchical Transmission</td>
<td>up to Three Layers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Any improvement of digital receiver was not considered to make the table below.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>System conform to requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum bit rate under Gaussian noise environment</td>
<td>ATSC</td>
</tr>
<tr>
<td>Resistivity against multi-path distortion</td>
<td>DVB-T, ISDB-T</td>
</tr>
<tr>
<td>Resistivity against impulse noise</td>
<td>ISDB-T</td>
</tr>
<tr>
<td>Wide area single frequency network (SFN) operation</td>
<td>DVB-T, ISDB-T</td>
</tr>
<tr>
<td>Mobility and Portability</td>
<td>ISDB-T &gt;&gt; DVB-T</td>
</tr>
<tr>
<td>Hierarchical transmission (Multiple modulation systems simultaneously in the same channel is possible)</td>
<td>ISDB-T&gt;&gt; DVB-T</td>
</tr>
<tr>
<td>System commonality with digital terrestrial sound broadcasting (One segment receiver is available)</td>
<td>ISDB-T</td>
</tr>
</tbody>
</table>
Activities to spread watching DTV in Japan
Schedule of Digital Broadcasting in Japan

- **Satellite (CS):**
  - **1996:**
  - **110CS:**
  - **The end of 2000**

- **Satellite (BS):**
  - **1998~2003 Pilot trial**
  - **2003:**
  - **Others:**
  - **2006:**
  - **End of Analog HDTV**
  - **End of Analog SDTV?**
  - **2011?**

- **Terrestrial:**
  - **1996:**
  - **2003:**
  - **Tokyo, Osaka, Nagoya**
  - **2006:**
  - **Others**
  - **2011**
  - **Target of end**

- **Cable:**
  - **1996:**
  - **Analog/Digital**
  - **Fully digital**
Cumulative Total of shipments of BS Digital Receiver

As of Aug 31, 2003
Total: 2,238Kset
- Set Top Box: 834Kset
- Integrated TV (CRT): 1,124Kset
- Integrated TV (Plasma): 280Kset

BS broadcasting launched

The World Cup

The accumulative Total of Shipments (Ksets)
The volume of Shipments (Millions)

Source: JEITA Electronics and Statistics Committee AV Forecast Working Group
Roundtable Conference on the Future Aspects of Broadcasting in the Broadband Age formulated the Targets of diffusion of terrestrial digital TV receiver units on April 15.
Roundtable Conference on the Future Aspects of Broadcasting in the Broadband Age formulated the Targets of diffusion of terrestrial digital TV receiver units on April 15.
• Digital terrestrial broadcasting will begin in the three major metropolitan areas of Tokyo, Osaka, and Nagoya in **December 2003**.

• The government's plan describes a schedule for broadcasting to have started in all major cities by the **end of 2006**, and for current analog broadcasts to have been completely replaced with digital broadcasting by **July 2011**.

• In view of the launch of digital terrestrial broadcasting, **an analog-to-analog shift (Re-arrangement of analogue TV channels)** has already started last February. This shift changes the frequencies used by analog terrestrial broadcasting to secure the channels needed for digital broadcasting.

Frequency Circumstance in Japan and Analogue Channel Re-arrangement

The number of transmission stations for analogue TV

- **VHF**
- **UHF**

**UHF lower channels basically**

**Re-arrangement of analogue channels except major transmitters**

**ISDB-T channels**
Programme

- 2/3 of DTTV programs are same with programs of analog TV broadcasting a day.
- HDTV programs should be televised at more than 50% of broadcasting hours a week.
- Broadcasters must televise more than 10% educational programs and more than 20% cultural programs a week.

Further requirements

- Broadcasters build relay stations without hesitating.
- Broadcasters positively televise programs for sight and hearing handicapped persons.
- Broadcasters are able to make engineering services.
<table>
<thead>
<tr>
<th>Organization</th>
<th>Setup</th>
<th>Representative</th>
<th>Members</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrestrial Digital Broadcasting Promotion Headquarters, MPHPT</td>
<td>Aug 2003</td>
<td>Mr. Katayama Minister, MPHPT (Head)</td>
<td>Minister, MPHPT, Vice-Minister, MPHPT, Secretary General, MPHPT, Executives, MPHPT</td>
<td>The smooth implementation of DTTB</td>
</tr>
<tr>
<td>The association for promotion of digital broadcasting (D-PA)</td>
<td>Aug 2003</td>
<td>Mr. Kitagawa (Chairman)</td>
<td>NHK, 127 commercial TV broadcasters, 153 Receiver - Manufacturers etc.</td>
<td>Enforcement of RX/TX std. Operation of ES RMP</td>
</tr>
<tr>
<td>National Conference for promotion of terrestrial digital broadcasting</td>
<td>May 2003</td>
<td>Mr. Yamaguchi (Chairman)</td>
<td>NHK, 127 commercial TV broadcasters, Government (MPHPT), Manufacturers, Retailers, Consumers society</td>
<td>Follow-up of the action plan for digital migration</td>
</tr>
<tr>
<td>National Council for Promotion of digital terrestrial broadcasting</td>
<td>July 2001</td>
<td>Mr. Kitagawa (President)</td>
<td>NHK, 127 Commercial TV broadcasters, Government (MPHPT)</td>
<td>Analogue channel shifts &amp; publicity</td>
</tr>
</tbody>
</table>
Recently announced DTTV products
Toshiba Launched the Sale of New TV Sets

- Four tuners (ISDB-T, ISDB-S for BS, ISDB-S for CS110, Analog terrestrial) are installed.
- Equips LAN terminal for interactive TV
- Upgraded software can be installed by a customer.

Sharp Launched the Sales of New LCD TV Sets on July 9

• **LC-37AD1 and LC-37AD2**
  - 37” LCD display
  - For HDTV (1366 ~ 768 pix)
  - Separated tuner (NTSC analog, ISDB-S and ISDB-T)

• **LC-30AD1 and LC-30AD2**
  - 30” LCD display
  - For HDTV (1280 ~ 768 pix)
  - Display is provided with tuner

• **LC-22AA1**
  - 22” LCD display
  - For wide TV (854 ~ 480 pix)
Sanyo Announced the sales of New TV Sets

- PDP (42”, 37”) and LCD (30”)
- Four tuners (ISDB-T, ISDB-S for BS, ISDB-S for CS110, Analog terrestrial) are installed.
- Pixel
  - PDP 1024 ¥ 1024
  - LCD 1280 ¥ 768
- Sanyo will launch the sales on Oct. 1

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- LC-30AD1 and LC-30AD2
  - 30” LCD display
  - For HDTV (1280 × 768 pix)
  - Display is provided with tuner
- LC-22AA1
  - 22” LCD display
  - For wide TV (854 × 480 pix)
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- Four tuners (ISDB-T, ISDB-S for BS, ISDB-S for CS110, Analog terrestrial) are installed.
- Pixel
  - PDP 1024 × 1024
  - LCD 1280 × 768
- Sanyo will launch the sales on Oct. 1

Sony announced ISDB-T STB

- For ISDB-T and ISDB-S (BS +CS110)
- Though open-priced, the STB is likely to be sold for about 600$.
- Sony will launch the delivery on October 21.
Panasonic Launched the Sale of New TV Sets on Sep. 1

- Three types: TH-36D50 (36”), and TH-32D50 (32”) and TH-28D50 (28”)
- Four tuners (ISDB-T, ISDB-S for BS, ISDB-S for CS110, Analog terrestrial) are installed.
- Equips LAN terminal (10BASE-T) for Tnavi
- Browser for Tnavi is installed.
- EPG for all tuners is installed.
Panasonic Announced the Sale of New PDP and LCD TV Sets

- ISDB-T tuner are installed in 37”, 42”, 50” PDP TV and 32”, 26”, 22” LCD TV.
- Panasonic will launch the sales from Sep. to Oct.
Hitachi Announced the Sale of New PDP and LCD TV Sets

- ISDB-T tuner are installed in 37”, 42”, 50” PDP TV and 32”, 26”, 22” LCD TV.
- Hitachi will launch the sales on Sep 25.
Sony Announced the Sale of New Digital TV Sets

- **New models**
  - PDP 61”, 50”, 42” 9 models
  - LCD 42”, 37”, 32” 3 models
  - CRT 28”, 32”, 28” 3 models

- **Sony will launch the sales of the digital TV sets next Oct. And next Nov.**
The Development of New Services
Toyota Central Lab demonstrated HDTV Mobile Reception using Adaptive Array Antenna

- Pole type antenna (conventional)
- Adaptive Array Antenna attached on wind shield

UHF 15ch (whole segment reception)
Mode 3, 64QAM, 3/4
Guard interval: 1/8 (128 η s)
Threshold C/N = 20.1 dB

Reference: http://ne.nikkeibp.co.jp/DTV/2003/01/1000016922.html
Segmented Structure and Partial Reception

An Example of Hierarchical Multiplexing

Layer A

Layer B

Sound / Data

HDTV
Prototype of Cellular Phone with a ISDB-T one-segment receiver

- One-segment demodulator LSI announced last Oct. is installed in 3G cellular phone.

- Specifications:
  - UHF13~62ch
  - Multiplexing; MPEG-2 TS
  - Video coding; MPEG-4 simple profile *
  - Video resolution; SQVGA 4:3(160x120pix), 16:9(160x90), 15f/s
  - Audio coding; MPEG-2 AAC LC profile
  - Software for EPG and data broadcasting is not installed yet.

- NEC demonstrated at Telecom2003.

* Video coding system for ISDB-T one-segment broadcasting has not been decided yet. NEC temporarily used MPEG-4 SP for this demonstration.
Sanyo announced one-segment receiver installed in cellular phone.

Specifications:
- Diversity reception
- UHF13〜53ch
- Multiplexing; MPEG-2 TS
- Video coding; MPEG-4 Simple profile L1*, QVGA 15f/s
- Audio coding; MPEG-2 AAC LC profile
- Display; 176x200pix organic LE panel
- Recordable on flash memory 128MB=30min
- Weight; 150g
- 960mAh lithium ion battery;
  - 420hours stand-by mode or 90minutes TV reception

Sanyo demonstrated at CEATEC JAPN2003.

* Video coding system for ISDB-T one-segment broadcasting has not been decided yet. Sanyo temporally used MPEG-4 SP for this demonstration.
Panasonic announced ISDB-T one-segment front-end module for cellular phone and PDA etc.

RF tuner circuit and OFDM demodulator are installed in this module.

Specifications:
- Size: 20mm × 28mm × 2mm
- VHF 7ch, UHF13—53ch
- Power Consumption: 200mW
- Length of the antenna: 50mm
- Modulation: DQPSK and QPSK and 16QAM

Product sample will be shipped from this autumn.
Sony announced ISDB-T one-segment tuner module for cellular phone and PDA etc.

RF tuner circuit and OFDM demodulator are installed in this module.

Specifications:
- Size: 20mm × 16mm × 2mm
- VHF 7ch, UHF 13~62ch
- Power Consumption: <150mW
- Output: MPEG2 TS

Product sample will be shipped from Dec. 2003.
Front End Module will be installed in all kinds of Portable Devices

Thickness < 1.4mm
Conclusions

- **ISDB-T** showed the best results in Brazil’s comparison tests. The similar results were obtained in Singapore and Hong Kong trials.
- The system flexibility and the reliable mobile reception of ISDB-T make broadcasters more competent in the new wireless world.
- **ISDB-T** is the most flexible system of the three DTTV standards. And so it will adapt to different circumstances of all countries.
- The sales of Digital TV receivers reached more than two millions and will increase rapidly around 2006 in Japan.
- Digital TV promotion is now operated jointly by governments and private sectors.
- The analog channel re-arrangement is first big challenge.
- All of consumer-manufacturers announced the sale of new TV sets.
- Developments of ISDB-T one-segment receiver were announced recently in Japan. Mobile TV will be launched in the end of 2005.
Thank you for your attention!