Emergency Warning Broadcast System

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Manila, Philippines
DiBEG JAPAN
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(NHK Science & Technical Research Lab)
Contents

- Outline of the Emergency Warning Broadcast System (EWS)
- EWS for analog broadcasting
- EWS for digital broadcasting “ISDB-T”
- Automatic activation of One-Seg handheld receivers by EWS
- Conclusion
1. Outline of the Emergency Warning Broadcast System (EWS)
The emergency warning broadcast system is • • •

• EWS is a remote activation system for Radio & TV.
• EWS transmits alert/warning information to viewers and listeners about disasters.
• EWS has been operating since September 1985 in Japan.
• Test signals/programs are broadcast monthly in Japan (every 1st day)
• EWS is operated in response to large-scale earthquake warnings, Tsunami Alerts and broadcast requests from local governors
What’s the EWS? (II)

- Is it possible to do remote activation by not only broadcasting but also communication?
  - Yes, it is. However, they both have merits and demerits, and the system should be designed to make the best use of these merits.

- **Remote activation by communication (telephone)**
  - Merits: possible to control individual receivers
  - Demerits: In case of a large scale disaster, traffic congestion is very likely.

- **Remote activation by broadcasting**
  - Merits: possible to quickly activate many receivers simultaneously
  - Demerits: difficult to customize activation control for individual receivers
Remote activation by communication (email, etc.)

- **Reliability**
  In case of disasters, congestion is very likely.

- **Speed**
  Need more time to inform a huge number of people

- **Locality**
  Possible to control activation in local area

1. Remote activation by mail
2. Remote activation by Emergency warning broadcast
Remote activation by EWS

- Reliability
  No traffic congestion, anybody can receive it in the broadcasting area. Broadcasters offer reliable news by filtering information.

- Speed
  Possible to inform an extremely large number of people simultaneously.

- Locality
  The system used in Japan is controlled by prefectural area.

**Broadcasting is an ideal media to deliver disaster information**

Remote activation and emergency warning broadcast reception by EWS
The history of EWB

EWB: Emergency Warning Broadcast

- Around 1980  NHK STRL launched EWS study
- Sep. 1,1985  EWB operation start in Japan
- Mar.18,1987  First EWB operation for tsunami alert
- Jan.13,2007  Most recent EWB operation for tsunami alert
- Up to now   EWB has operated 15 times during 21 years
- Test broadcasting takes place on 1\textsuperscript{st} of every month at noon
- shipment of receivers : about 550,000

*reference:
On Sep.1\textsuperscript{st},1923, a large scale earthquake attacked Tokyo area and more than 100,000 people died. It became a trigger to start radio broadcasting in Japan. Sep.1\textsuperscript{st} is the day of disaster prevention in Japan.
Operation records of EWB
(Every case was Tsunami warning by earthquake)

- Miyazaki prefecture offshore earthquake (March 18th, 1988)
- Sanriku offshore earthquake (November 2nd, 1989)
- Hokkaido south-west offshore earthquake (July 12th, 1993)
- Hokkaido east offshore earthquake (April 10th, 1994)
- Sanriku far offshore earthquake (December 28th, 1994)
- Amami Oshima near offshore earthquake (October 19th, 1995)
- New Guinea earthquake (February 17th, 1996)
- The Sea of Hyuga earthquake (October 19th, 1996)
- Okinawa-Ishigaki south offshore earthquake (May 4th, 1998) (March 26th, 2002)
- An earthquake at Taiwan (March 31th, 2002)
- Hokkaido Kushiro offshore earthquake (September 26th, 2003)

**ISDB-T commenced in Japan (December 1st, 2003)**

- Tokai offshore earthquake (September 5th, 2004)

NHK broadcasts EWS test program every month.
### List of Recent Significant Earthquakes (from December 2004)

<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>Fatalities</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec. 26, 2004</td>
<td>Off northwest coast of Sumatra, Indonesia</td>
<td>300,000</td>
<td>9.3</td>
</tr>
<tr>
<td>Feb. 22, 2005</td>
<td>Zarand, Iran</td>
<td>Over 500</td>
<td>6.4</td>
</tr>
<tr>
<td>Mar. 28, 2005</td>
<td>Northern Sumatra, Indonesia</td>
<td>1,000-2,000</td>
<td>8.7</td>
</tr>
<tr>
<td>Oct. 8, 2005</td>
<td>Kashmir, Pakistan</td>
<td>100,000 (estimated)</td>
<td>7.6</td>
</tr>
<tr>
<td>May. 26, 2006</td>
<td>Java, Indonesia</td>
<td>Over 6,000</td>
<td>6.3</td>
</tr>
<tr>
<td>July. 17, 2006</td>
<td>Java, Indonesia</td>
<td>Over 500</td>
<td>7.7</td>
</tr>
</tbody>
</table>
Conditions for operation of EWB in Japan

• In Japan, EWB broadcasts only in three cases where there is great risk to human lives and property,

1. When a precautionary declaration of a large-scale earthquake such as the Tokai earthquake is issued, (First-class nationwide)

2. When a Tsunami (tidal wave) alert is given, (Second-class nationwide, prefecture wide)

3. When the local governor requests an emergency warning broadcast (First-class nationwide)
2. Analog EWS
Analog EWS transmission and reception block diagram

Program signal

Switch

Transmitter

Control signal generator

Program signal reception

Control signal reception

Broadcasting station

Receiver with warning function

Radio

TV

Alarming sound, followed by announcement
Connection of Emergency Information

Earthquake

Japan Meteorological Agency

Emergency database

Automatic Earthquake/tsunami visual production systems

Automatic earthquake/tsunami announcement Script display system (in the studios)

Expected tsunami arrival times

Robot camera monitoring system

Robot camera

IP-VPN network

206 points all over Japan
Analog EWS Control signal

A start sign and end sign are transmitted by an FSK 640Hz/1024Hz signal combined with a warning sound.

- **Start sign**
- **End sign**

<table>
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<tr>
<th>Usual Program</th>
<th>Emergency warning broadcasting program</th>
<th>Usual Program</th>
</tr>
</thead>
</table>

**time**
Analog EWB conventional receivers

Receiver with a Clock

Portable AM/FM Receiver

Receiver with Power on switch
Analog EWB New Receivers (New development)

(1) New receiver for EWS

(2) Onboard EWS decoder

A new algorithm capable of running on a multi-purpose processor IC integrated in home electronics has been developed
3. Digital EWS and ISDB-T
ISDB-T (Integrated service digital broadcasting terrestrial)

- **Dec. 2003 commenced**: Supports 3 reception types on one channel
- **One-Seg**: 2006.4 commenced

**Fixed reception**
- 13 segments

**Mobile reception**
- 13 segments
- 1 segment

**Home receiver**
- HDTV

**Mobile receiver**
- 13 segments
- 1 segment

**Diversity Reception**
- Automatic Activation By EWS!!

**TV station**
- 6MHz
- 13 segments

**Handheld receiver**
- Audio
- Visual
- Data
- contents

**One-Seg**
- Receiver in vehicle

**DiBEG**
Digital broadcasting experts group
ISDB-T, the Digital Television for the Philippines

ISDB-T services example

ISDB-T

Fixed receiver (Multi SD, HDTV)

Handheld receiver

Mobile receiver

6 MHz

Internet

HDTV

or

SDTV x 2

or

SDTV x 3

One-Seg: Mobile & handheld
Data bit-rate: 416Kbps
Modulation: QPSK (2/3)
Features: Robustness for mobile reception

12 segments: Fixed (multi SD or HDTV)
Data bit-rate: 16.9Mbps
Modulation: 64QAM (fec:3/4)
Features: HDTV & 5.1ch surround sound or Multi SD serviced

Automatic Activation By EWS!!
Features of ISDB-T system

- **HDTV or multi-SD and mobile service** can be transmitted **simultaneously** by BST-OFDM, economical system.
  - One-Seg service for handheld receivers
- ISDB-T has technological **advantages in mobile reception** because of time interleaving technology
- ISDB-T promises **flexible** broadcasting services through hierarchical transmission
- Multimedia Services
  - Data broadcasting: Regional information service
  - Interaction: Quizzes, questionnaires, requests, voting
  - Combined with communication services
- **Automotive HDTV system** using diversity reception technology
  - The same HDTV broadcasted for fixed receiver can be viewed in motor vehicle
- **EWS** (Emergency Warning System)
  - Handheld receivers woken up by EWS signal alerts the user quickly of earthquake and tsunami warnings
- **SFN** for effective frequency utilization
## Outline of ISDB-T transmission scheme

<table>
<thead>
<tr>
<th>Item</th>
<th>Contents</th>
<th>ARIB Standards</th>
<th>ITU-R Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video coding</td>
<td>MPEG-2 Video (ISO/IEC 13818-2)</td>
<td>STD-B32</td>
<td>BT.1208</td>
</tr>
<tr>
<td>Audio coding</td>
<td>MPEG-2 AAC (ISO/IEC 13818-7)</td>
<td>STD-B33</td>
<td>BS.1115</td>
</tr>
<tr>
<td>Data broadcasting</td>
<td>BML(XHTML), ECMA Script</td>
<td>STD-B24</td>
<td>BT.1699</td>
</tr>
<tr>
<td>Multiplex</td>
<td>MPEG-2 Systems (ISO/IEC 13818-1)</td>
<td>STD-B10,</td>
<td>BT.1300,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STD-B32</td>
<td></td>
</tr>
<tr>
<td>Conditional access</td>
<td>Multi 2</td>
<td>STD-B25</td>
<td></td>
</tr>
<tr>
<td>Transmission</td>
<td>ISDB-T transmission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel Bandwidth</td>
<td>6MHz, 7MHz, 8MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modulation</td>
<td>Segmented OFDM (13 segment/ch)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode,</td>
<td>Mode: 1, 2, 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guard</td>
<td>Guard Interval Ratio: 1/4, 1/8, 1/16, 1/32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrier Modulation</td>
<td>QPSK, 16QAM, 64QAM, DQPSK</td>
<td>STD-B31</td>
<td>BT.1306 System C</td>
</tr>
<tr>
<td>Error correction</td>
<td>Inner Convolutional code</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Coding rate: 1/2, 2/3, 3/4, 5/6, 7/8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outer (204, 188) Reed–Solomon code</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interleave</td>
<td>Frequency and Time Interleave</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time Interleave : 0 – 0.5 sec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information bit rate</td>
<td>6MHz : 3.7 – 23.2 Mbit/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(depend on parameters)</td>
<td>7MHz : 4.3 – 27.1 Mbit/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8MHz : 4.9 – 31.0 Mbit/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiver</td>
<td>ISDB-T receiver</td>
<td>STD-B21</td>
<td></td>
</tr>
<tr>
<td>Operational guideline</td>
<td>ISDB-T broadcasting operation</td>
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</table>
ISDB-T, the Digital Television for the Philippines

ISDB-T One-Seg receivers

Number of shipments as of Jul 2008: Over 39,000,000 (JEITA statistics)

- **au by KDDI** W33SA
- **SoftBank 905SH**
- **Laptop Computer**
- **Portable DVD player**
- **FOMA P901iTV**
- **Antenna for One-Seg receiver**
ISDB-T, the Digital Television for the Philippines

ISDB-T mobile receivers

Number of shipments as of Aug 2008: about 1,860,000 (JEITA statistics)

- Panasonic
  - CN-HDS960TD
  - CN-HDS635TD

- SANYO
  - NV-HD870DT
  - NVA-HD1500DT

- Pioneer
  - AVIC-VH009MDG

- Fujitsu ten
  - AVN7406HD

- ALPINE
  - VIE-XO7B1/S1

- Toyota
  - TDT-H56

From each company’s web site
Shipments of ISDB-T Home-use (Stationary) Receivers in Japan

(Source: JEITA)
Shipments of ISDB-T One-Seg cellular phones in Japan

Monthly and Total shipments (× 1,000)

- Monthly shipments
- Total shipments

Service launched (Jul. 2008)

Total sum (39.71 million)

(Source: JEITA)
ISDB-T Transmitter block diagram

Service

Video
Audio
Data

MPEG-2
Source coding

Coding

Coding

Coding

Multiplexer

Channel coding

Hierarchical parallel processing
- Error correction
- Mapping
- Interleaving

OFDM Frame

TMCC add.

Addition of Activation signal for EWB

TMCC : Transmission and Multiplexing Configuration Control
EWB Descriptor (ISDB-T)

Digital broadcasting experts group
Arrangement of TMCC in mode 3

TMCC
(204 bits/frame)

Header

Time axis

Frequency axis

Activation signal for EWB

Seg. #0 (429 kHz)

Seg. #1 (429 kHz)

Seg. #2 (429 kHz)

Seg. #3 (429 kHz)

Seg. #4 (429 kHz)

Seg. #5 (429 kHz)

Seg. #6 (429 kHz)

Seg. #7 (429 kHz)

Seg. #8 (429 kHz)

Seg. #9 (429 kHz)

Seg. #10 (429 kHz)

Seg. #11 (429 kHz)

Seg. #12 (429 kHz)

Freq.

BW : 5.6MHz
4. Automatic activation of One-Seg handheld receivers by EWS
Possibility of EWS and One-Seg service

- One-Seg service commenced on April 2006
  - One-Seg service is capable of transmitting EWS
  - Most people carry mobile phones in Japan

A huge number of people can get disaster information quickly in the field if the One-Seg receiver can receive EWB
Automatic activation of One-Seg receivers

receiver Stand-by with low power consumption

Automatic reception of emergency warning broadcasting

Tsunami disaster information...

We have news of an earthquake...

Automatic activation of One-Seg receiver circuit by EWB activation signal
To automatically activate One-Seg receivers by EWS

- EWS receivers need to monitor the EWB activation signal on the TMCC carriers continuously

- Continuous operation of the receiver circuit causes wasting of the battery

  **Power-saving of receiver circuit is indispensable!**

- The characteristics of a trial receiver circuit have been tested which demodulates only four TMCC carriers and uses diversity combining technologies

- The activation signal is received intermittently in synchronization with the timing of the activation signal transmission format
Arrangement of TMCC Carriers (Mode 3)

Band Width: 5.6MHz

One-Seg Band Width (=429kHz)

Demodulate only four carriers
When the handheld receiver is in stand-by mode, only the One-Seg tuner and activation signal detector are working.

The activation signal detector uses a simple circuit without FFT.

When the activation signal is active, the demodulator and display are started, the One-Seg tuner operates continuously and the emergency warning broadcast is displayed.
Control power switching interval of One-Seg tuner

Control power switching intermittently to save the power consumption
Activation signal detector for One-Seg

Prototype activation signal detector

The Activation signal detector connected to a cellular phone
Usage for EWS

Not only
- Earthquake forecast
- Tsunami forecast

But also
- Hurricane forecast
- Flood warning
- Eruption warning
- Fire warning
- Other warning
Conclusion

- Broadcasting is an ideal media to deliver disaster information
- EWS is a broadcasting system which remotely activates radio & TV in the case of emergency alerts.
- EWS for analog AM/FM radio, analog and digital TV has already commenced operation in Japan
- Research and development of an EWB receiver for One-Seg
  - Automatic activation of handheld receiver by EWS is very effective
  - Power consumption saving is required while EWB is in stand-by
EWS introduction DVD
Please visit the EWS demonstration!
ISDB-T, the Digital Television for the Philippines
Thank you for your attention!

NHK STRL
http://www.nhk.or.jp/strl/english/index.html
ISDB-T, the Digital Television for the Philippines

References
ISDB-T, the Digital Television for the Philippines

Fixed and mobile receivers examples

**Sony’s products “Bravia”**
X7000 series, X5050 series, X5000 series and W5000 series

**Panasonic’s Car Navigation & AV System “Strada”**

The screen changes when EWS is detected!!