#### **ISDB-T Seminar**

#### Presentation 4

## Broadcasting Station Facility of ISDB-T

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**Bangkok**, Thailand

**Dibeg Japan** 

Takeshi SAWADA

(Toshiba)



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## 1. What is ISDB-T?

- -What is ISDB-T?
- -What kinds of technologies are used?
- -What is Segmented OFDM?



## 1.What is ISDB-T?

#### •ISDB-T is;

#### ➡ Integrated Service Digital Broadcasting - Terrestrial

•This system was developed by ARIB(note) in Japan, and ISDTV in Brazil has been developed based on ISDB-T. (note) Association of Radio Industries and Business

• ISDB-T is the newest system among 3 DTT systems(ATSC, DVB-T, ISDB-T).

• Therefore, ISDB-T adopts any better new technologies compare to other DTT systems.

#### ⇒Developed for following features

•Flexibility of Service,

•Flexibility of reception style within same band(stationary, mobile and portable)

•Robustness against any disturbance

•Harmonization with Communication , & Interactive service

#### 2. What kinds of technologies are used?

#### Transmission system; Segmented OFDM with Time interleave



\*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)

#### 3. What is Segmented OFDM? (1/2)





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 Broadcasting service by using Hierarchical transmission**

(1) Single layer multi-program for stationary reception





## 2. Comparison of three DTTB systems

- -Comparison of three DTTV systems
- -Results of comparison test in Brazil
- -Summary of comparison



## **Comparison of DTTV Systems**

System Item	ATSC	DVB-T	ISDB-T
HDTV/ SDTV Fixed reception	HDTV ©	SDTVMulti-ch ⊚	HDTV&SDTV Multi-ch ©
Data broadcasting	In operation	In operation ©	In operation
SFN	Field traial underway ×	In operation ©	In operation
HDTV Mobile reception	Under study ×	Possible for SDTV O	Practical even for HDTV ©
Portable reception with cellular phone	Under study ×	Field traial Underway (DVB-H) ム	In Operation (One-seg) ©
Internet access	-	-	In operation

## **Technical Details of DTTV Systems**

Sy	vstem	ATSC	DVB-T	ISDB-T
Мос	lulation	8VSB	COFDM (QPSK, 16QAM,64QAM)	Segmented COFDM (DQPSK,QPSK, 16QAM,64QAM)
later	Bit/Symbol	Yes	Yes	Yes
Inter- leaving	Frequency	-	Yes	Yes
	time	-	-	0s, 0.1s, 0.25s, 0.5s
Guard	d Interval	-	1/4,1/8,1/16,1/32	1/4, 1/8,1/16,1/32
ТІ	MCC	-	-	Yes
Information	tion bit rate	19.39 Mbps	3.69 -23.5Mbps	3.65 -23.2 Mbps
Channel	bandwidth	6/7/8 MHz	6/7/8 MHz	6/7/8 MHz

## **Results of Brazilian Tests**

- Comparison testing of three DTTB systems

   ATSC, DVB-T, ISDB-T
- Carried out from Aug. 1999 to April 2000
- Laboratories tests
  - Impulse noise, Mobile reception
- Field tests
  - Coverage, Indoor reception

ISDB-T shows superior performances especially for following items
(1) Robustness against impulse noise (urban noise)
(2) Coverage; robustness of ISDB-T system leads wide cover area
(3) Indoor reception; Robustness against impulse noise and fading leads good performance of indoor reception



## Laboratory Tests Basic Configurations

	ATSC	DVB-2K	DVB-8K	ISDB-4K
PAYLOAD (Mbps)	19.39	19.75	18.09	19.33
Configurations	1	Many		Lots

\* 2K, FEC ¾, GI 1/16 (18,67us) \* 8K, FEC 2/3, GI 1/32 (37,33us) \* 4K, FEC ¾, GI 1/16 (31,5us), 0,1s Time Interleaving



## Laboratory Tests - Results Impulse Noise



## Laboratory Tests - Results Mobile Reception Simulation



- ATSC did not work at 1.8 Km/h
- Number of carriers is a key factor
- ISDB 8K has similar performance to the DVB 2K
- DVB 8K only for portable Rx.

## Field Test – Results

#### Coverage



- DVB 8k similar to ISDB 4k
- ATSC similar to DVB 2k (inadequate)
- ISDB 4k Higher Payload (+1.2 Mbps)

# Field Test – Results Indoor Reception



- Only in sites with a good outdoor Rx. margin
- ISDB similar to DVB 8k
- ATSC Inadequate

## Summary of Comparison(1/2)

Any improvement of digital receiver was not considered to make the table below.

Requirements	System conform to requirements	
Maximum bit rate under Gaussian noise environment	ATSC	
Robustness against multi-path distortion	ISDB-T >> DVB-T note1)	
Robustness against impulse noise	ISDB-T	
Wide area single frequency network (SFN) operation	DVB-T, <b>ISDB-T</b>	
Mobility and Portability	DVB-T, <b>ISDB-T</b>	

(note1) Indoor reception can be available, its reduce reception cost



## Summary of Comparison(2/2)

Any improvement of digital receiver was not considered to make the table below.

Requirements	System conform to requirements
Hierarchical transmission (Multiple modulation systems simultaneously in the same channel is possible)	ISDB-T>> DVB-T
Both portable/fixed reception service by one channel and one transmitter	ISDB-T(note1)
System commonality with digital terrestrial sound broadcasting (One segment receiver is available)	ISDB-T(note2)

(note1) Save both frequency resource and Infrastructure cost

(note2) Multi purpose portable receiver is available

## 3. Broadcasters Infrastructure (Studio System)

- -Analog to Digital
- -System Block Diagram
- -Example of Master System



#### **Analog to Digital**

**Differences Between Analog and Digital Broadcasting** 



**Applications** 





## **Overall Block Diagram**



ENC/MUX: Encoder / Multiplexer



## Block diagram of ENC/MUX



## 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)





## 4. Broadcasters Infrastructure (Transmission System)

(1) High Power Digital Transmitter System

- (2) Micro-wave Links of Digital Terrestrial Broadcasting
- (3)Trans-poser of Digital Terrestrial Broadcasting and new technology
- (4)Peripherals



#### (1) High Power Digital Transmitter system

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



(b) Power Line-up in Japan

Area	Digital TX	Analog TX	note
Tokyo	UHF 10 kW	VHF 50 kW	wide area key station
Osaka	UHF 3 kW	VHF 10 kW	same as above
Nagoya	UHF 3 kW	VHF 10kW	same as above

(c) Examples of Hardware; see following pages

#### **Examples of High Power Digital Transmitter (Toshiba)**



0032

10 kW digital Transmitter(2/3 type)

#### Output power series;

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

## 3 kW digital transmitter rack

1 kW digital transmitter rack

#### 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 .





## Antennas(2)

□ 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.



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#### (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



#### (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



## Example of Wide KANTO area Network





#### Examples of Microwave STL/TTL (Toshiba)







- -Dual type, seamless switching
- -DVB-ASI digital interface

-Equipped automatic multi-path equalizer



#### IF TTL TX/RX

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

#### Examples of Digital Studio to Transmitter Link for TS Signal Transmission (Hitachi KokusaiElectric)



2 channels dual system

- Seamless SHF Output Signal Switching
- •DVB-ASI Digital Signal Interface

High-performance automatic equalizer diminishes multi-path distortion



#### **Digital Microwave Link**

#### Digital / Analog in single FPU that supports three modes

#### PF-503 TX-H



PF-503 RX-H



Ikegami FPU (PF-503/PP-57) makes it possible to select HDTV and SDTV by built-in Encoder Board.

PF-503 supports 3 mode transmission including analog mode. ①QAM (Single Carrier) ②QAM-OFDM (Multi Carrier) ③Analog (FM)

PF-57(QAM-OFDM) is suitable for wireless camera system in both SDTV and HDTV.





#### Examples of Microwave Television Relay Equipment (NEC)



#### Features

1) Supports triple mode transmission.

Single carrier QAM / OFDM-QAM / FM

2) Built-in MPEG-2 HD / SD CODEC is available.







#### (3) Trans-poser of Digital Terrestrial Broadcasting And new technology

(a) Conceptual Block diagram

Digital Broadcasting Experts Grou



(note) to save the cost, common amplifier is expected

#### (b) Key factors of digital terrestrial trans-poser

- 1. To reduce the cost, common <u>wideband amplifier</u> for plural channel is expected
- 2. In some cases, degradation caused on transmission link should be improved (<u>Multi-path, interference canceller, diversity reception</u>, etc)
- 3. For SFN, receiving and transmitting frequency is same, coupling of input and output should be decreased (coupling loop canceller)

(c) Examples of Hardware; see following pages

#### Examples of Digital Transposer (NEC)



#### 30W x 3-channels common amplification System

#### Features

- 1) Excellent IM (less than -50dB) using Feedforward 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 50W TX** 

#### **TS-TTL 3W TX**

Signal quality compensate equipment for Terrestrial Digital Broadcasting Relay Station MODEL AS-D860 (Panasonic).



- $\star$  Signal quality degradation by the multipath and fading is compensated.
- $\star$  Adopted to maximum-ratio-combined method.

★ Miniaturization Size : 480mm(W) × 400mm(D) × 50mm(H)

#### (4) Peripherals

#### (a) Peripherals for digital transmitter system

Peripherals for digital transmitting system are quite different from the ones for analog system. Many types of peripherals for digital have been developed and commercialized



(b) Examples of Hardware; see following pages



#### OFDM FIELD ANALYZER



\* Equipped with built-in very low noise UHF all channel down converter.

\* Output MPEG2-TS from demodulated OFDM signal.

\* Measured results are displayed on LCD and can be stored in memory card.

\* Displays transmission parameters at each hierarchical level, according to TMCC information.

\* In case measured value exceed normal range, alarm signal will be issued.

(Japan Communication Equipment Co.,Ltd. "Nitsuki")

## Introduction of measuring instrument for digital broadcasting

#### MS8901A(Anritsu) Digital Broadcast Signal Analyzer



This is a digital broadcasting signal analyzer that makes the base of high performance Spectrum Analyzer (9kHz~3GHz). Using Highspeed DSP, and you will be able to do some diverse measuring functions by installing the measurement software.

# Image: Constraint for the second s

#### MS8911A(Anritsu) Digital Broadcast Field Analyzer



MS8911A is a suitable and optimal measuring instrument for Digital Broadcasting Signal Wave (ISDB-T). This has the most advanced ultra-portable spectrum analyzer on the market, featuring unparalleled performance and size at a modest price.



## 5. ISDB-Tsb; Digital Audio Broadcasting (Family of ISDB-T)

#### **Features of ISDB-Tsb**

#### (1) What is ISDB-T<sub>SB</sub>

ISDB-Tsb transmission system is unique in ISDB-T family. This transmission system has been standardized for narrow band ISDB-T transmission system, which is focused to audio and data service, therefore, called ISDB-Tsb.

#### (2) <u>Commonality with ISDB-T</u>

(a) Same segment transmission construction. But ,considering narrow band reception, only 1 segment and 3 segment transmission systems are standardized

(b) Adopt same transmission parameters as ISDB-T.

(c) Commonality of 1 segment receiver with ISDB-T partial reception

#### (3) Efficient use of frequency resource

(a) <u>Consecutive transmission system</u>. This system is unique for ISDB-TSB, this transmission system is to transmit plural channel without guard band

(b) To achieve consecutive transmission, phase compensation technology at transmitter side is adopted



#### Promotion of the Digital Terrestrial Sound Broadcasting (DTSB) in Japan

#### 1 Purpose

The <u>Digital Radio Promotion Association</u> (**DRP**) was established in October 2001 to promote the Digital Terrestrial Sound Broadcasting (DTSB) in Japan.

#### 2 Activities

- Carry out the experimental DTSB services (started at 10 October 2003 in Tokyo and Osaka)
- Develop new application for DTSB
- Research of the demand for DTSB
- Promote the DTSB receivers
- 3 Members

DRP has 70 members (Sound Broadcasters, manufacturers etc)



#### **Trial Services of DRP**



Above example is Tokyo station, Osaka's all programs are 1seg. broadcasting.



DRP

#### **D**RP **Examples of ISDB-Tsb Receiver**

KDDI supports the diffusion of ISDB-Tsb service/receiver strongly

W52











- Presented by KDDI -

au



#### DRP Infrastructure for ISDB-Tsb(1/3)

#### **DRP** Tokyo master rack room



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#### **DRP** Tokyo digital radio transmitter room







#### DRP Infrastructure for ISDB-Tsb(3/3)

#### Antenna





**ISDB-T Seminar in Bangkok** 

## ขอบคุณ มาก ครับ Thank you!

#### **Digital Broadcasting Expert Group**

http://www.dibeg.org/ mail; info@dibeg.org

