

Presentation 2

Technical features of ISDB-T and Hardware

28th. February – 1st. March, 2007

Jakarta , Indonesia

DiBEG JAPAN

Yasuo TAKAHASHI
(Toshiba)

Contents

1. What is ISDB-T?
2. Features of ISDB-T system (Technical aspect)
3. Comparison of 3 DTTB systems
4. Structure of ISDB-T Standard
5. Outline of digital broadcasting receiver/service
6. Examples of Broadcaster's Infrastructure
7. ISDB-Tsb; Digital Sound Broadcasting(Family of ISDB-T)
8. New Application for One-Seg(Mobile Multimedia Service)
9. Conclusion

1. What is 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 digital 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 with Time Interleave.

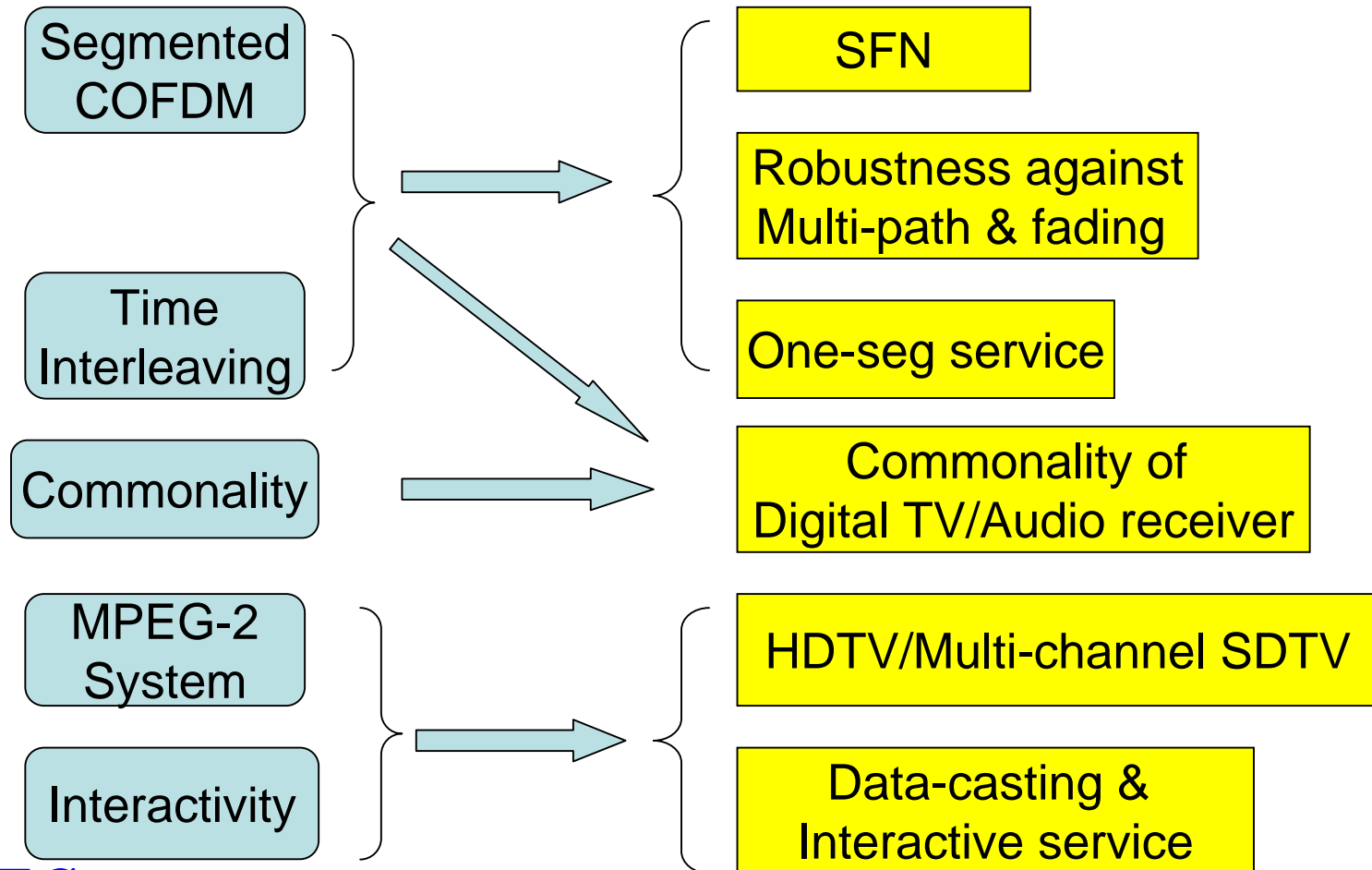
2. Features of ISDB-T System

2.1 relations technical features/Merit

Technical Features



Merits



(Details of Merit)

SFN

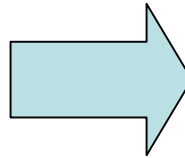
Robustness against
Multi-path & fading

One-seg service

Commonality of
Digital TV/Audio receiver

HDTV/Multi-channel SDTV

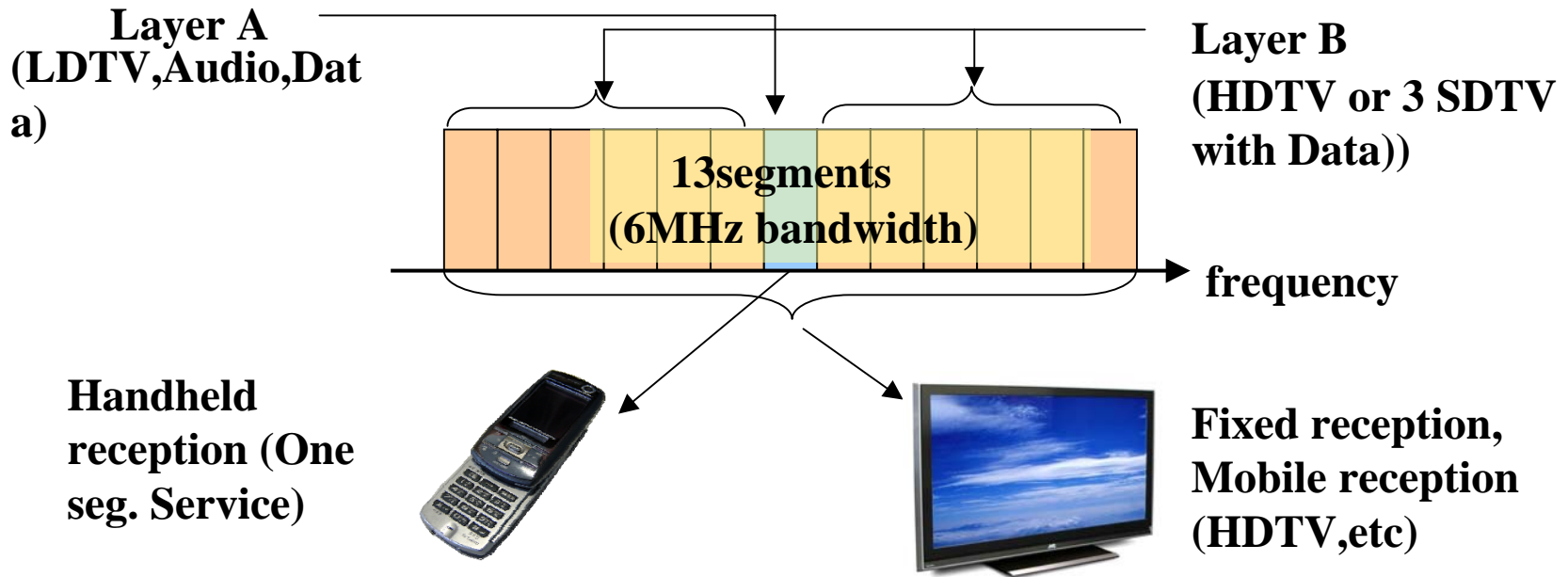
Data-casting &
Interactive service



- Save frequency resource
- Clear picture (free from ghost)
- **Mobile/portable reception**
- **Indoor reception**
- **One transmitter for fixed/
portable reception service**
- **Common receiver is available**
- **High quality TV service**
- Service flexibility
- Data associated TV
- Independent data service
- Harmonization with Internet

1.2 What is Band Segmented OFDM with time interleave?

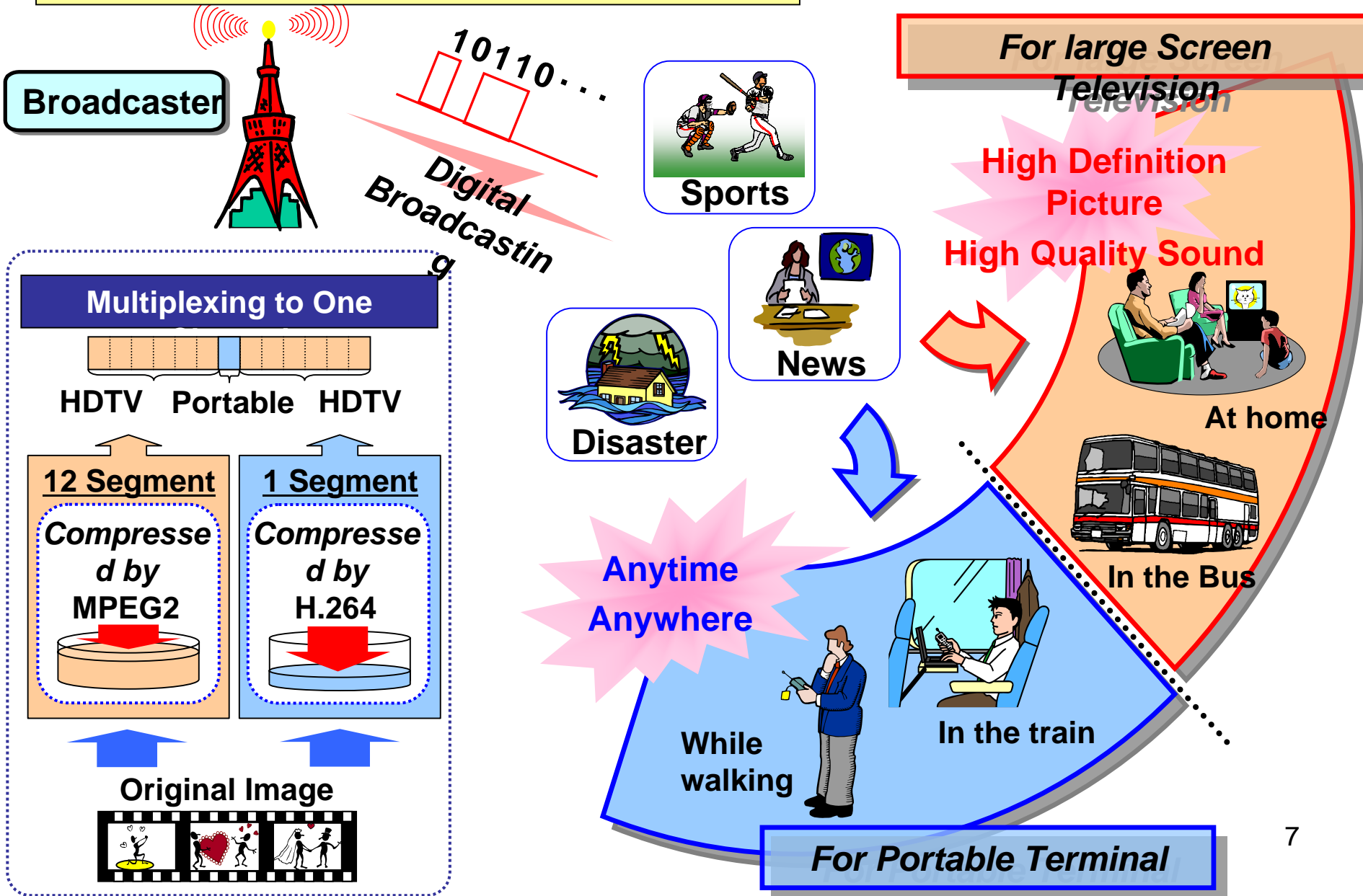
(Example; 1seg + 12 seg)



- **Segmented OFDM**; Possible to support fixed/mobile/handheld reception service
- **Time interleave**; reduce impulse noise and reduce the degradation caused by fading (tested in Brazil by Mackenzie and TV GLOBO)

1.3 Service Image of ISDB-T in Japan

One transmitter supports any kind of service



3. Comparison of 3 DTTB systems

- Comparison of 3 DTTV systems
- Results of comparison test in Brazil
- Summary of comparison

Broadcasting Services

<i>System</i> <i>Item</i>	<i>ATSC</i>	<i>DVB-T</i>	<i>ISDB-T</i>
HDTV/ SDTV Fixed reception	◎	◎	◎
Data broadcasting	◎	◎	◎
SFN	×	◎	◎
HDTV Mobile reception	×	× (○ SDTV)	◎
Portable reception with cellular phone	×	△	◎
Internet access	×	△	◎

Technical Detail of DTTV Systems - 1

System		ATSC	DVB-T	ISDB-T
Launch		1/Nov/1998	Sep/1998	1/Dec/2003
Video coding		MPEG-2 Video(ISO/IEC 13818-2)		
Audio coding		Dolby AC-3	MPEG-2 BC	MPEG-2 AAC
Data broadcasting	Presentation engine	Dase-1	(DVB HTML)	BML (XHTML), ECMAScript
	Execution engine	ACAP	DVB MHP	ARIB B 23
Multiplex		MPEG-2 Systems (ISO/IEC 13818-1)		
Conditional access		DES / NRSS	CSS / DVB CA	Multi 2 / ARIB B 25
Error correction	Outer	(207,187) Reed-Solomon code	(204,188) Reed-Solomon code	
	Inner	2/3Trellis Code	Conv.code(1/2-7/8)	

Technical Details of DTTV Systems - 2

System		ATSC	DVB-T	ISDB-T
Modulation		8VSB	COFDM (QPSK, 16QAM,64QAM)	SegmentedCOFDM (DQPSK,QPSK, 16QAM,64QAM)
Inter-leaving	Bit/Symbol	Yes	Yes	Yes
	Frequency	-	Yes	Yes
	time	-	-	0.1s,0.2s,0.4s,0.8s
Excess Bandwidth/ Guard Interval		11.5%	1/4,1/8,1/16,1/32	1/2, 1/4, 1/8,1/16,1/32
TMCC		-	-	Yes
Information 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

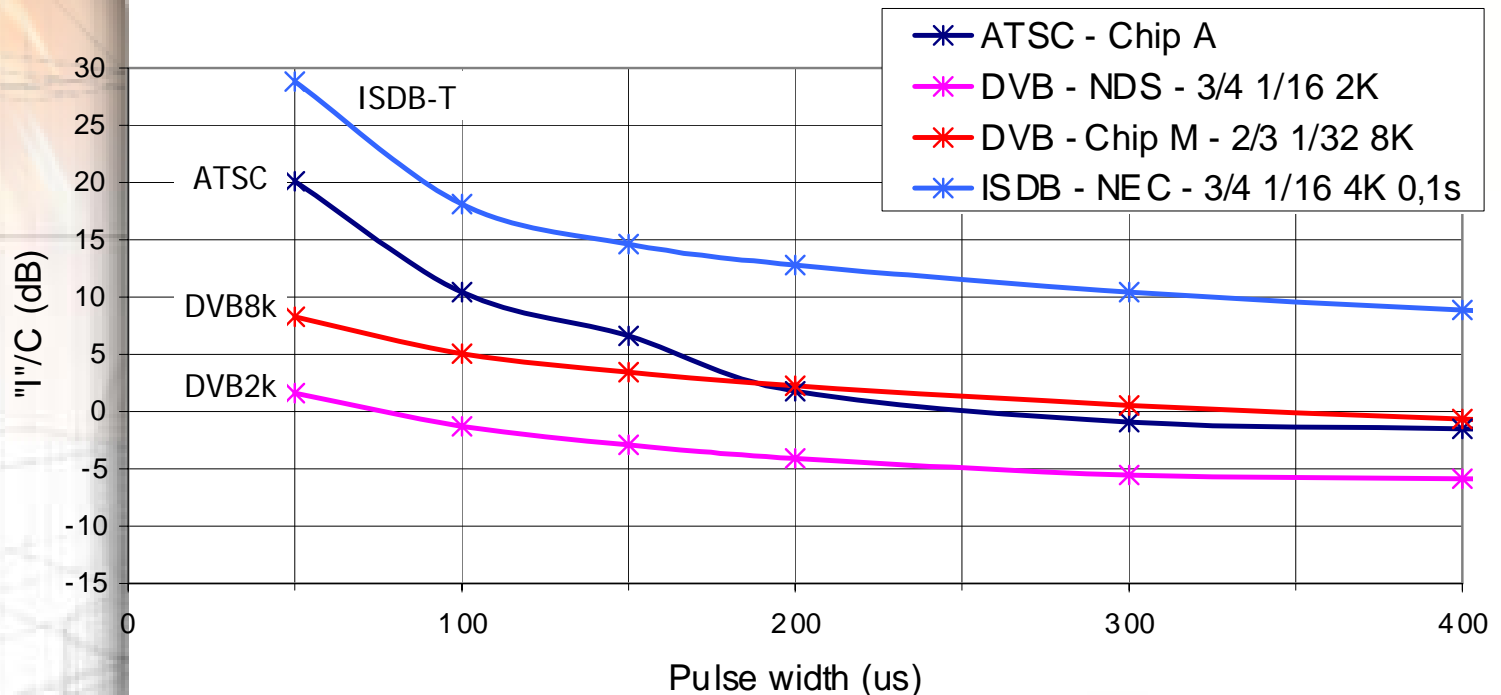
- **Comparison testing of three DTTB systems**
 - ATSC, DVB-T, ISDB-T
- **Carried out from Aug. 1999 to April 2000**
- **Laboratories tests**
 - AWGN, impulse noise, multipath interference
- **Field tests**
 - Coverage, indoor reception

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

Impulse Noise

Relation between the noise pulse width & interference to signal ratio

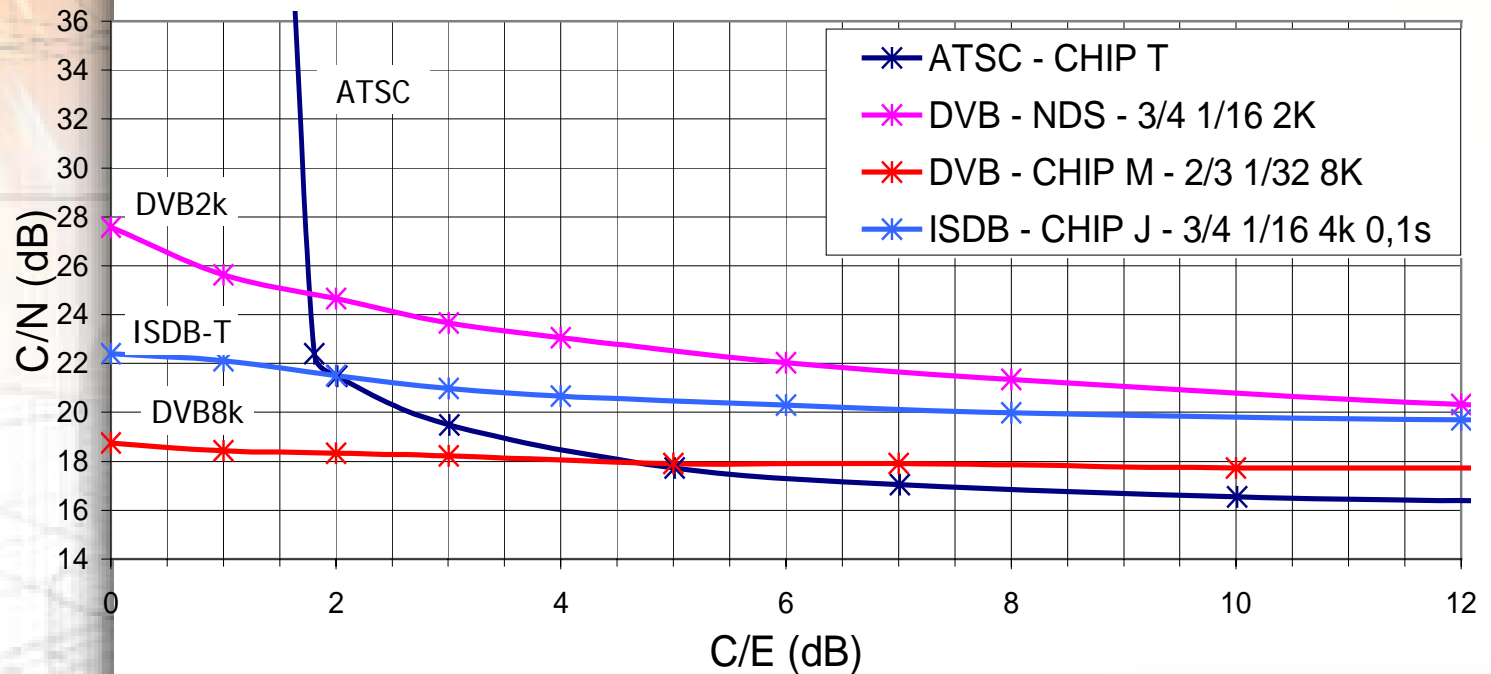


- Better performance of the ISDB-T system, by introducing time interleaving

(From the presentation of the Brazilian SET/ABERT study group at NAB2000)

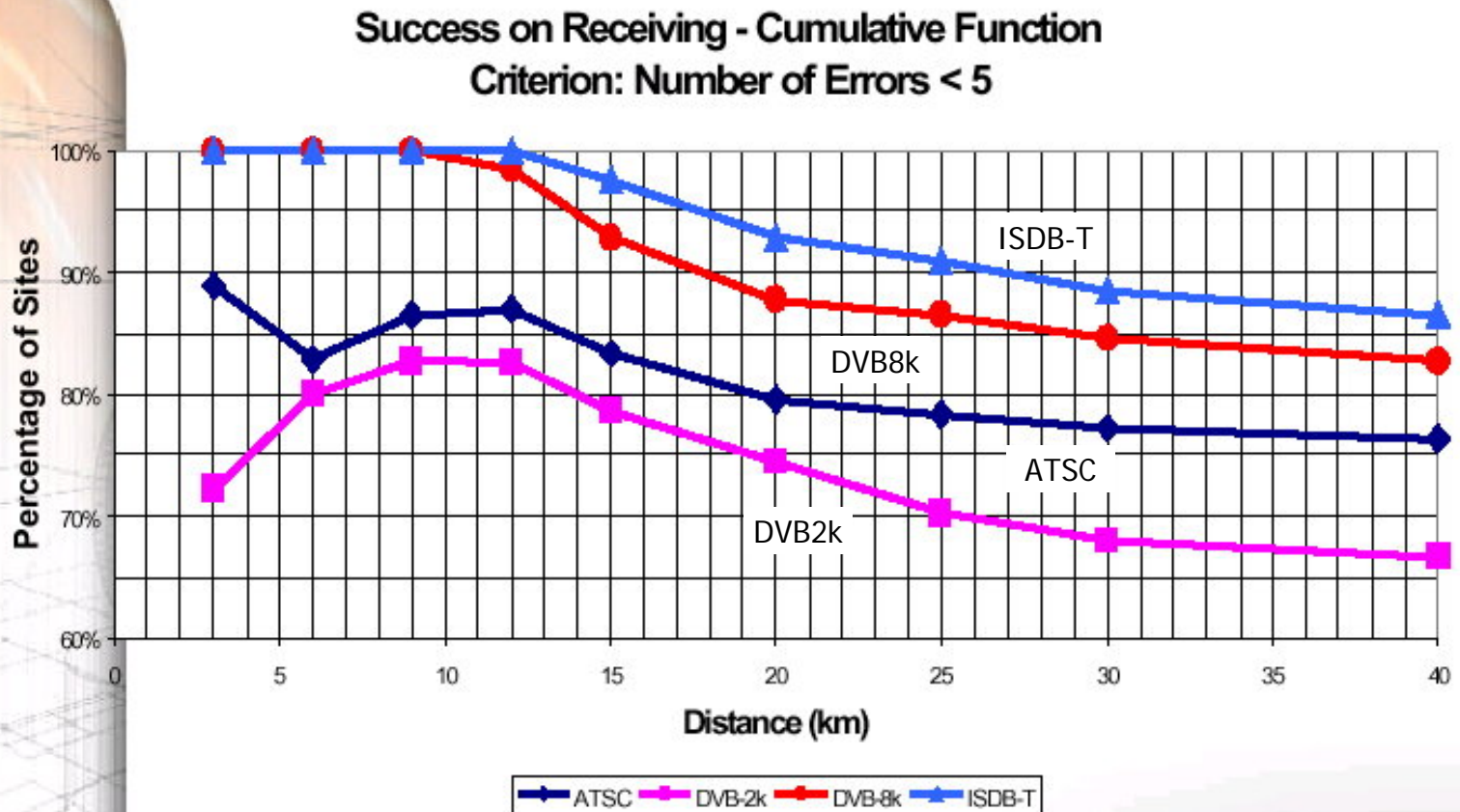
Static Multipath

Carrier to noise ratio as a function of carrier to echo ratio
Comparison at post-echo = 8 μ s



(From the presentation of the Brazilian SET/ABERT study group at NAB2000)

Outdoor: Coverage



(From the presentation of the Brazilian SET/ABERT study group at NAB2000)

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	
Wide area single frequency network (SFN) operation	DVB-T, ISDB-T
Mobility and Portability	DVB-T, ISDB-T

(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)

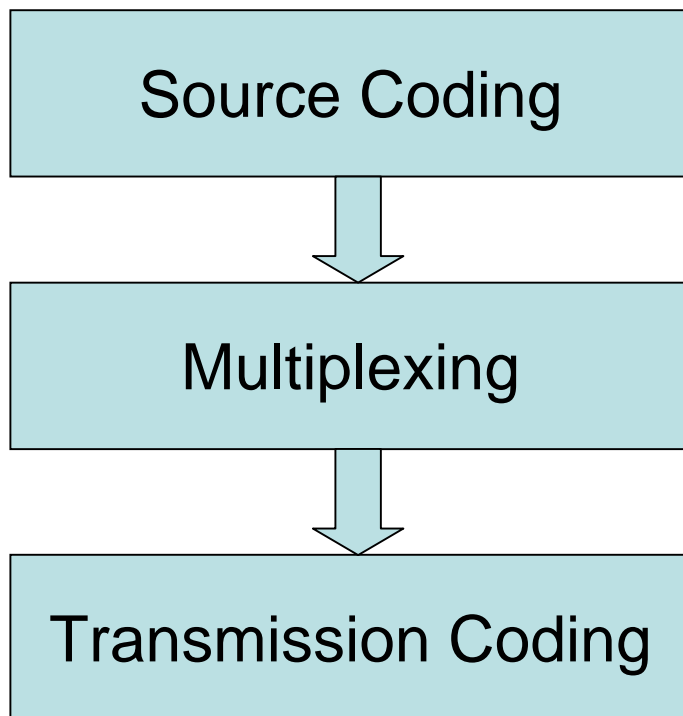
(note1) Save both frequency resource and Infrastructure cost

(note2) Multi purpose portable receiver is available

4. Structure of ISDB-T Standard

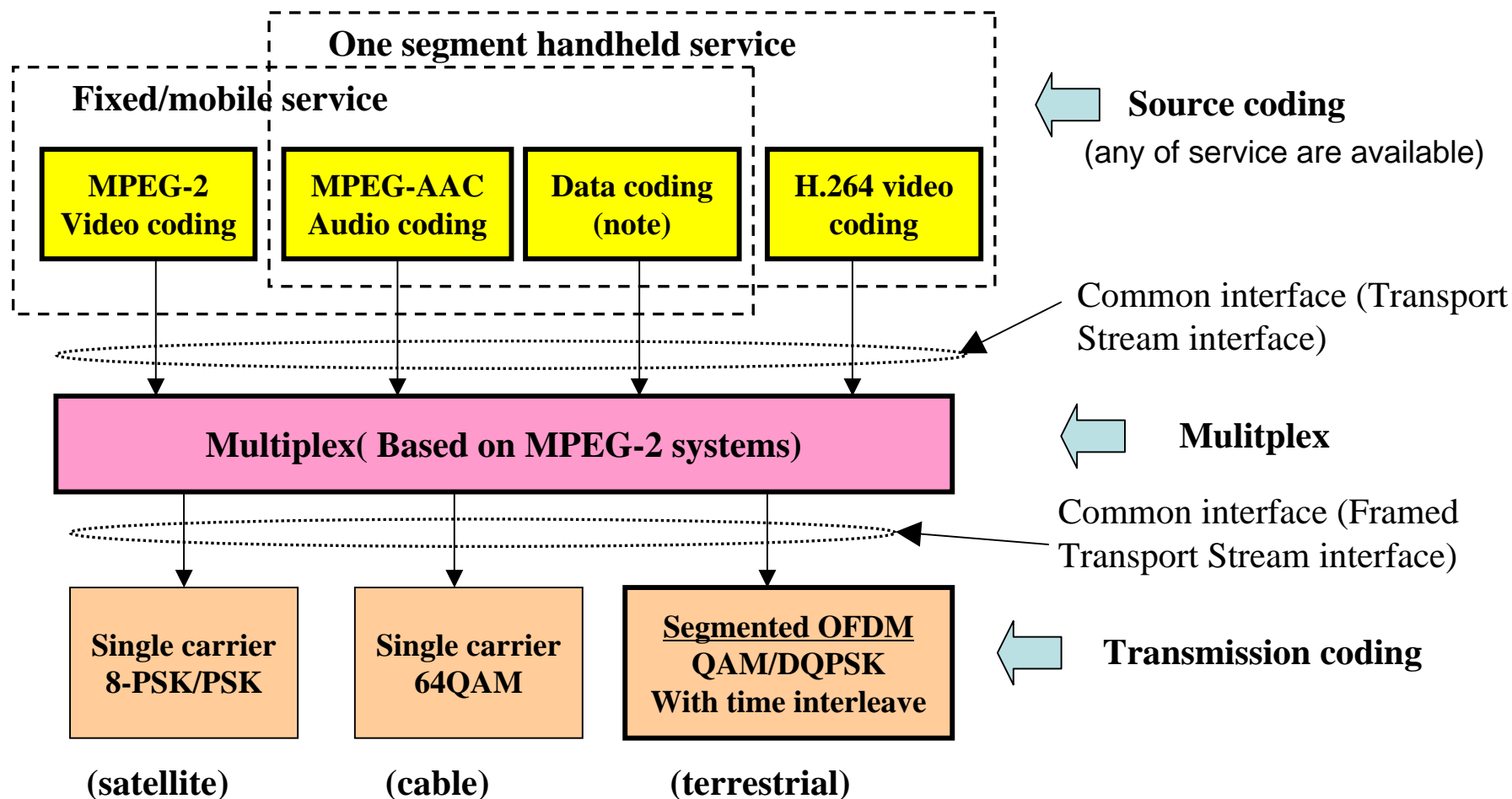
4.1 Structure of Japan's Digital Broadcasting system

General View of Structure



- Common for all Broadcast media to keep commonality
- Any services are available
- Multiplex all data from Source coding
- Interface to transmission media by TS format
- Modulation system is optimized for each media

4.1 Continued (details of structure)



(note) both BML and MHP are available,
But in Japan now BML is only service in.

4.2 ISDB-T transmission system

•Features of transmission system

1. Efficient frequency utilization

- (1) Adopt OFDM transmission system; SFN operation
- (2) Adopt hierarchical transmission; service for different type of reception in one frequency channel

2. Mobile/ handheld service in one transmission standard

- (1) Time interleave; Improve mobile reception quality
- (2) Partial reception; handheld service in same channel

3. Robustness against interference

- (1) Adopt concatenated error correction with plural interleave
- (2) Time interleave; very effective for impulse noise (urban noise)

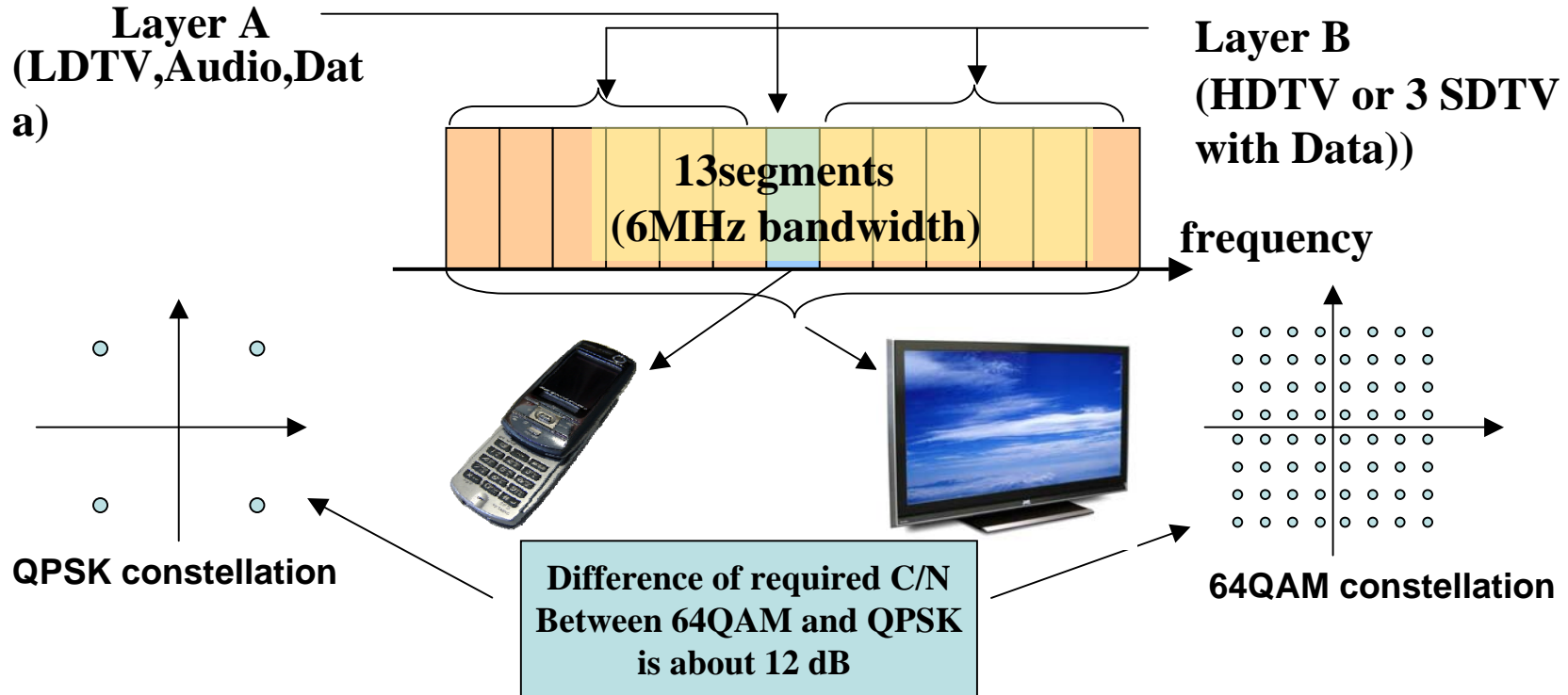
4. Flexibility for several type of service/ reception style

5. Commonality of TV/audio transmission standard

6. Auxiliary (AC) channel can be used for transmission network management

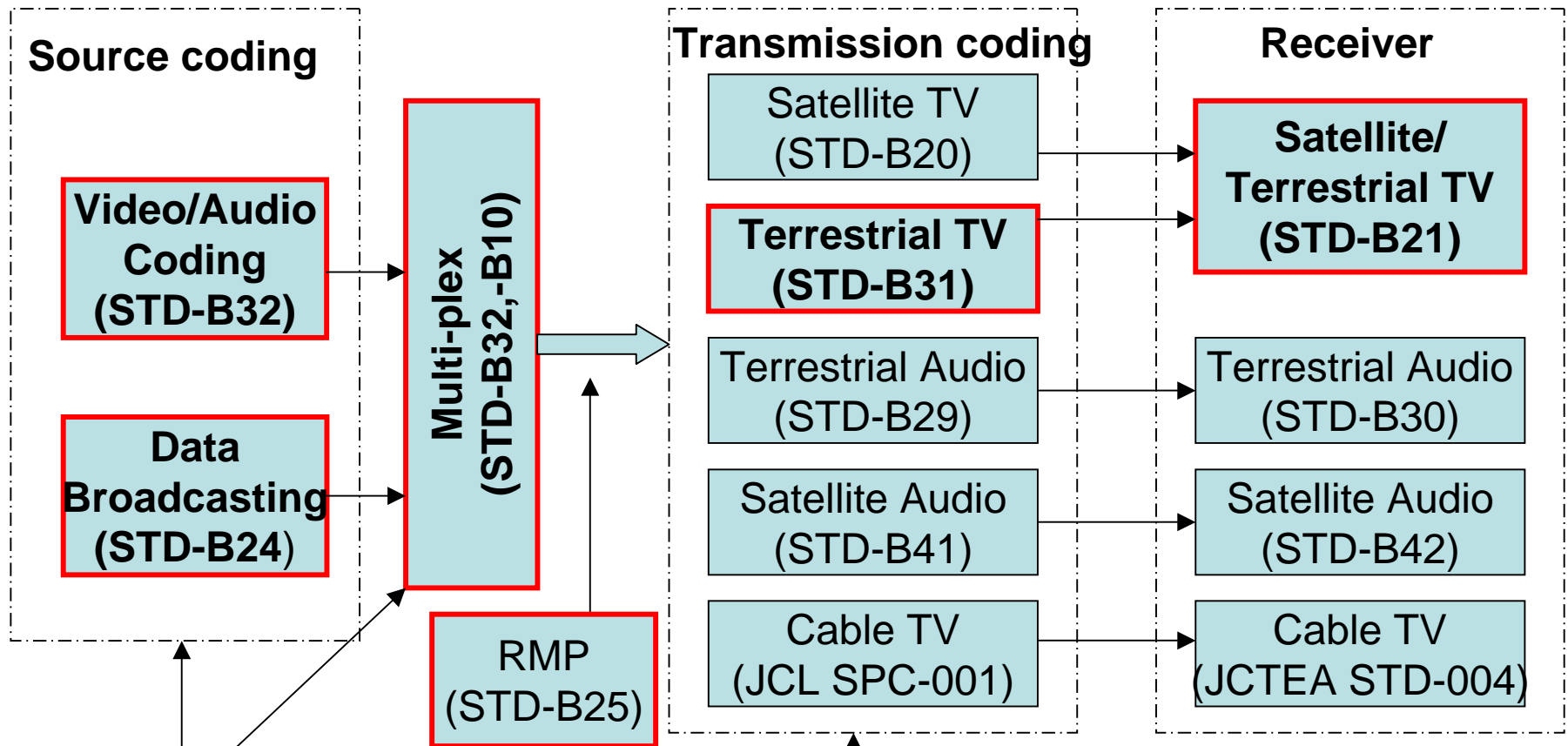
Feature of Segment transmission; Different service in same band

(Example; 1seg + 12 seg)



- *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)

Digital Broadcasting Standard in Japan



Source coding and MUX systems are common for each system

Transmission systems are different

Note: Cable transmission system standards are defined at another consortium

5. Outline of Receiver/Service

Features of ISDB-T from service aspect

ISDB-T system supports any type of reception system
any of kinds of broadcast service in one channel

- Reception style; see next page

Fixed reception , Mobile reception and Portable reception service are available in one channel at same time.

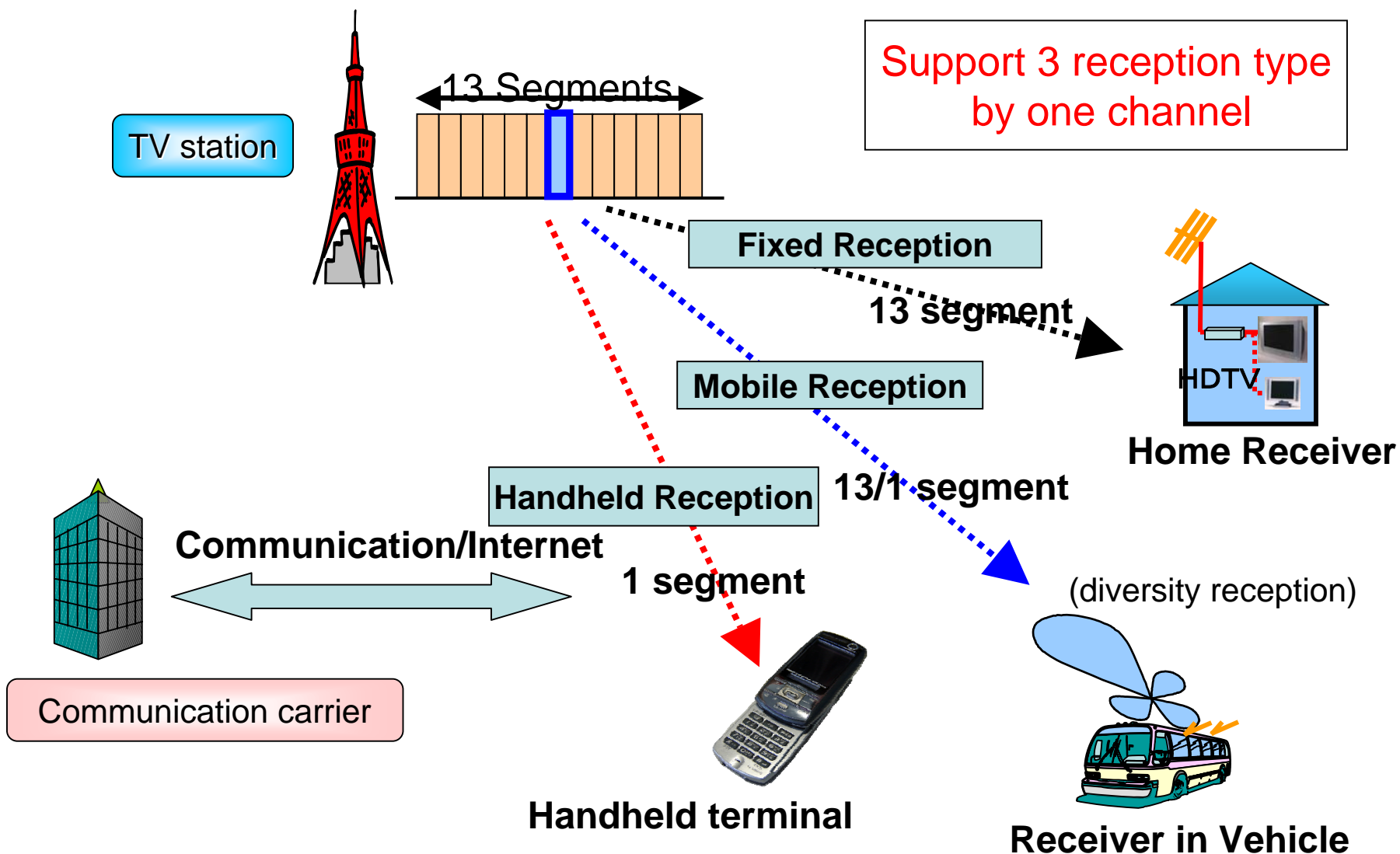
Details of receivers are presented in “ISDB-T receivers”

- Broadcast service

HDTV, Multi-channel SDTV, Data-casting, Interactive, One-seg, and any other applications are available on ISDB-T.

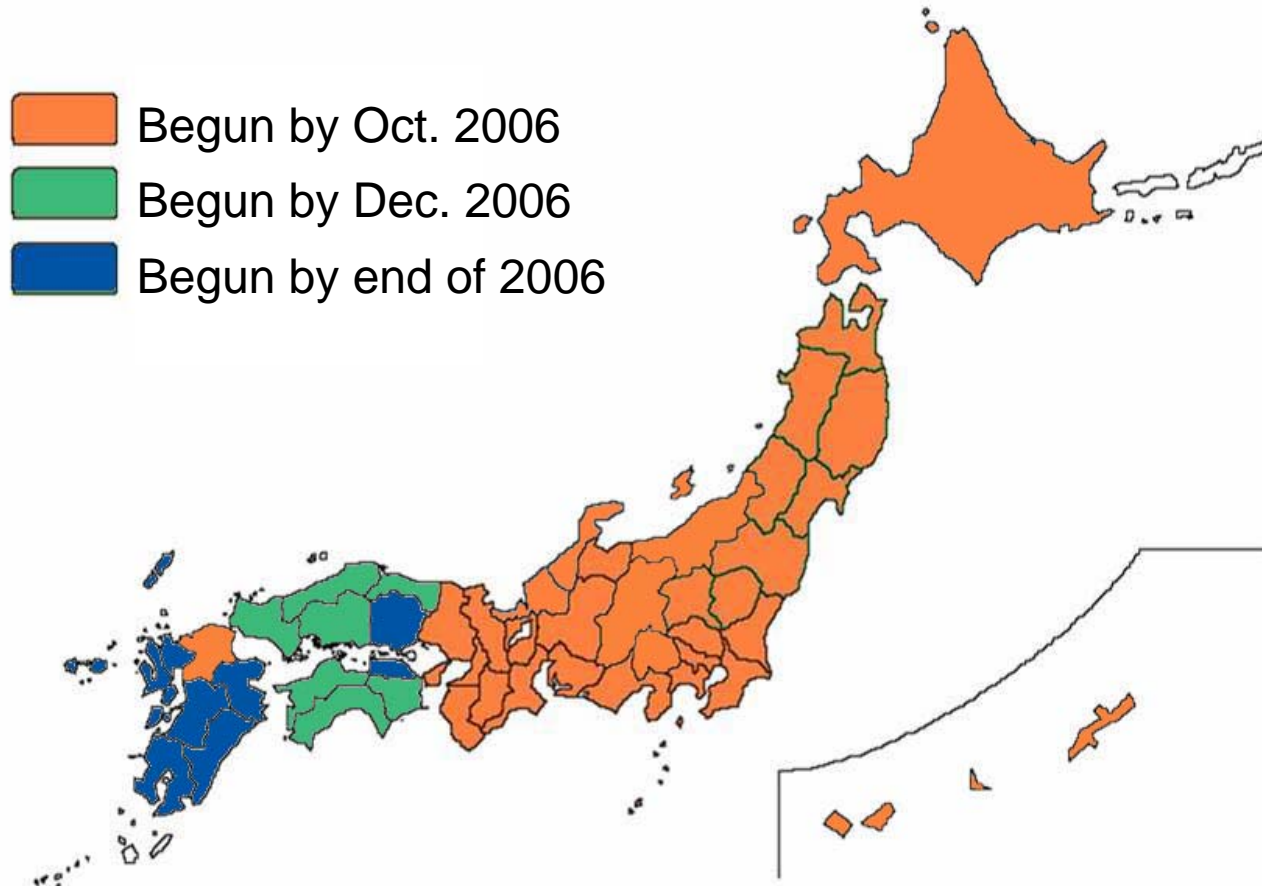
Details are presented in “Service Features of ISDB-T”

ISDB-T supports any type of reception



6. Examples of Broadcaster's Infrastructure

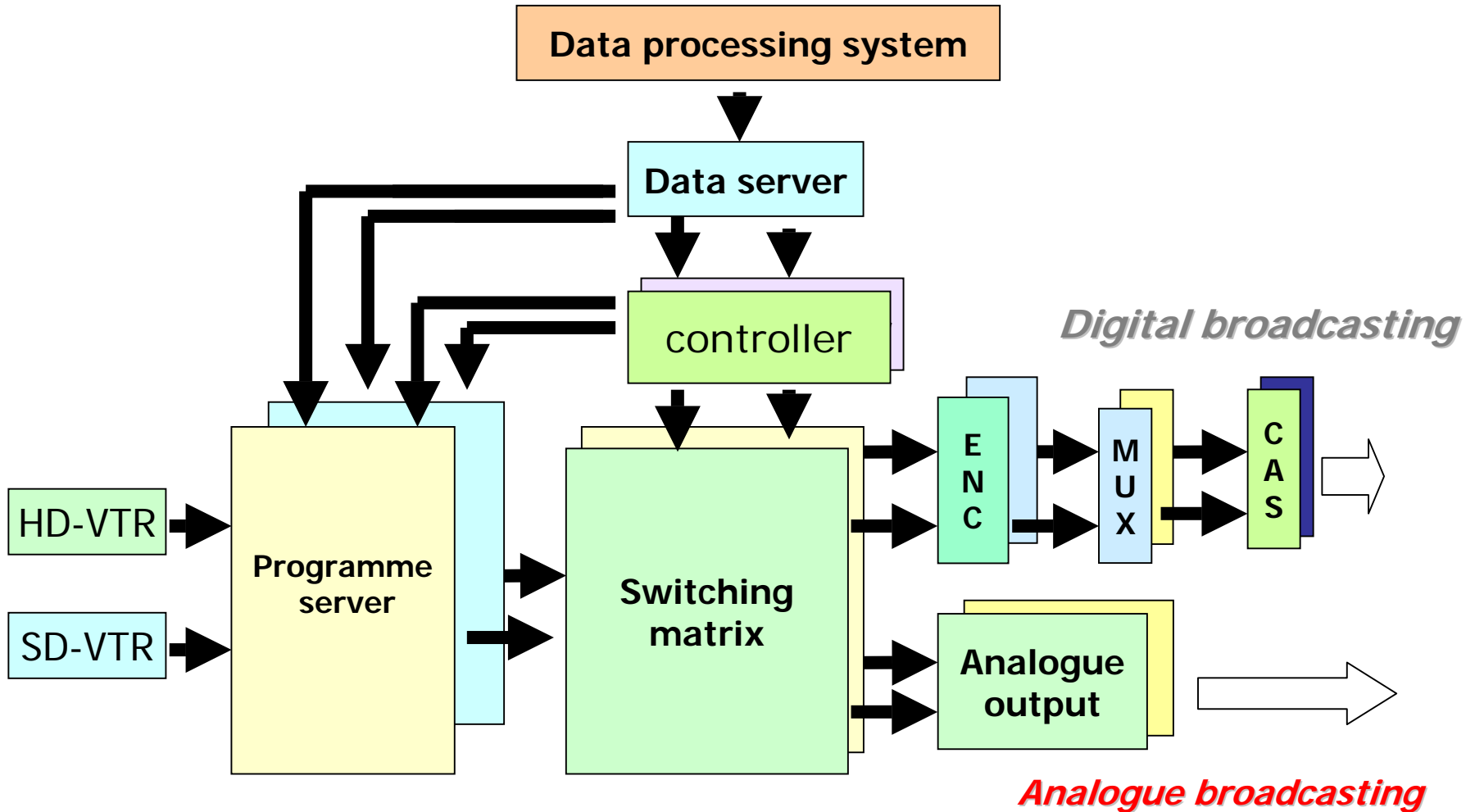
As shown below, Digital Terrestrial Broadcasting has started
In all Prefecture



DiBEG
Digital Broadcasting Experts Group



Master control system(1)



Master control system (2)

Characteristics of Master Control Switcher System

□ Massive and SD/HD Multi-format System

- SD/HD router ; 256 x 128

□ High Reliability

- Triple redundant system
- Input part ; Dual

□ Scalability

- Easy extension by addition of MK part
- Software update by using Test part

□ Efficient monitoring and operations

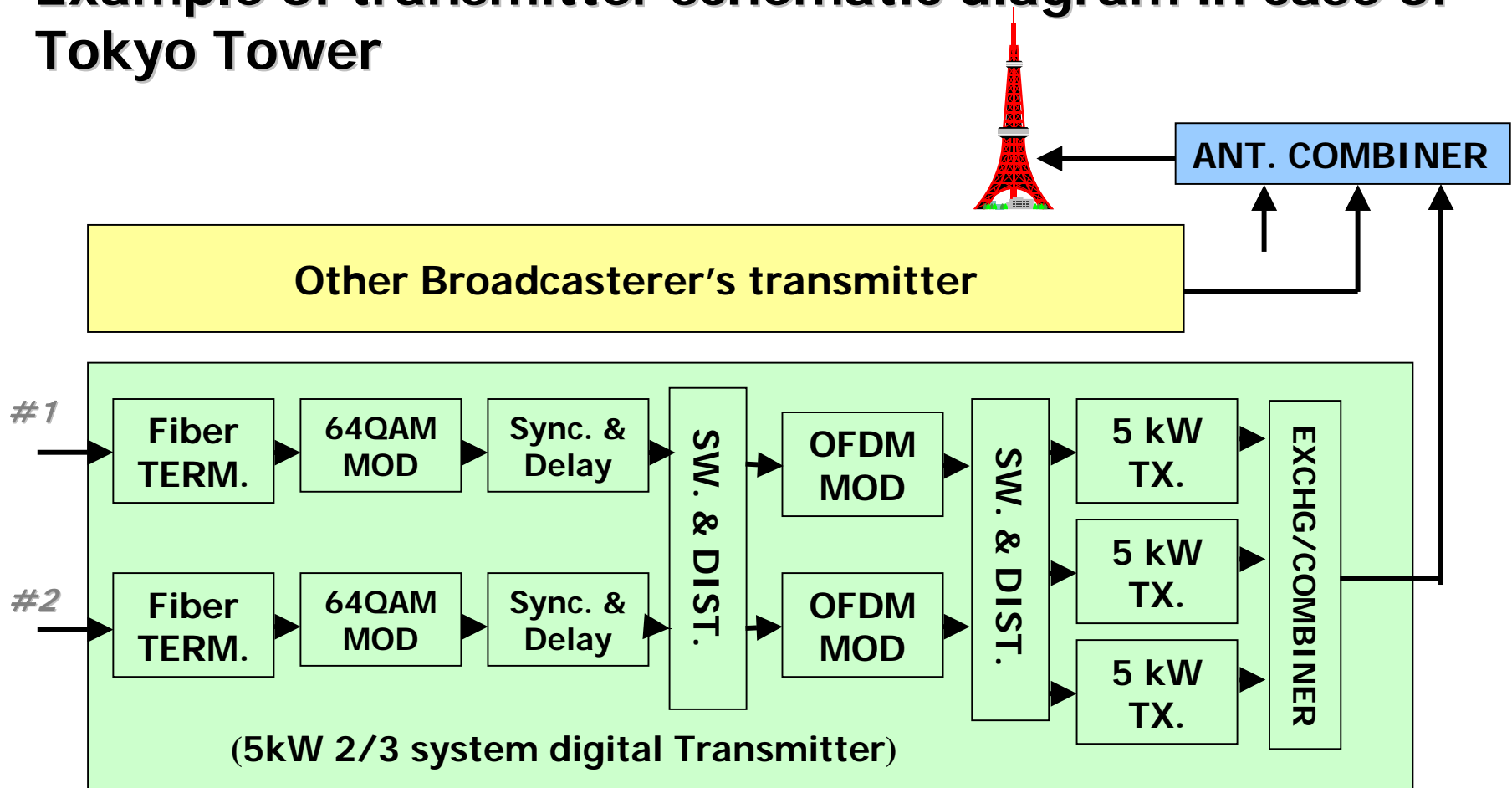
- Integrated monitoring system
- Multi-monitor, Touch panel

Master control system (3)



Digital transmitter system

Example of transmitter schematic diagram in case of Tokyo Tower



Digital Transmitter system

- *Three 5kw transmitters for redundant operation.*
- *Output power is 10kW(Tokyo Area)*



TOSHIBA



NEC

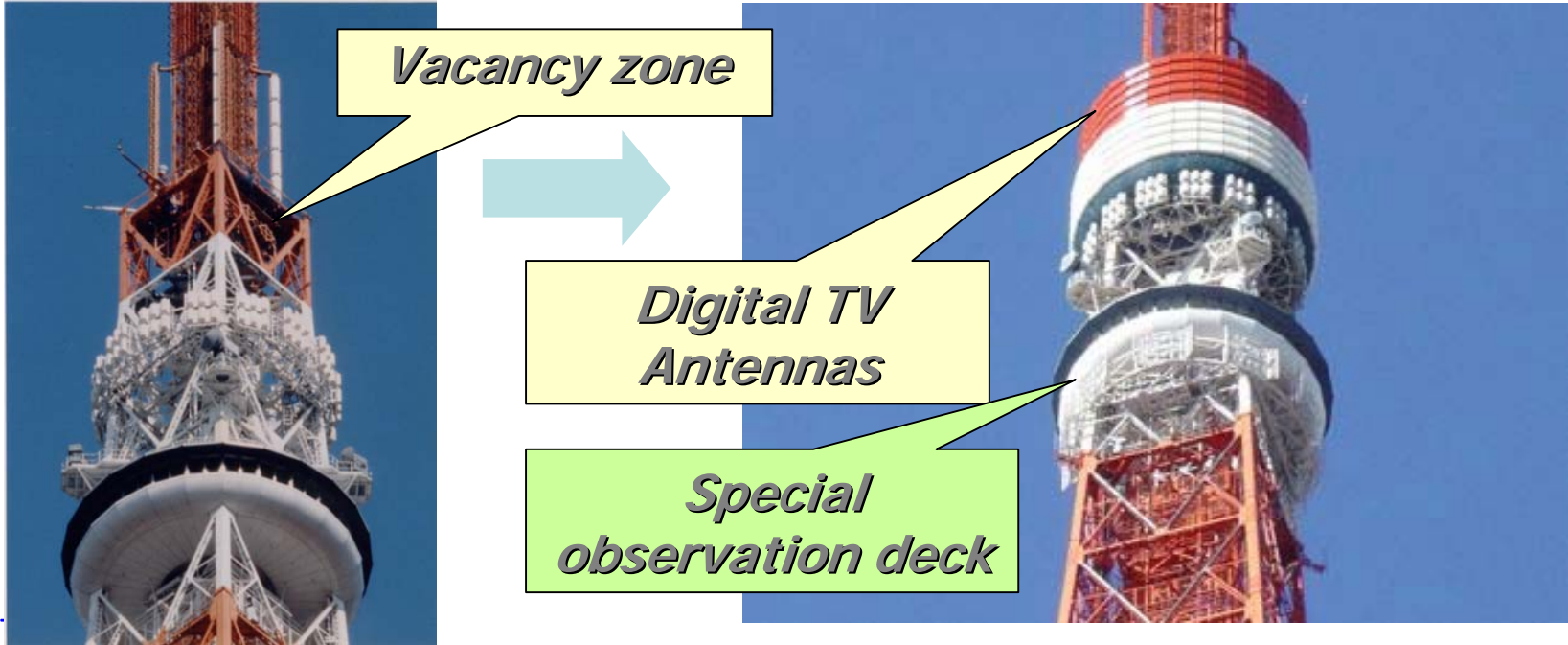
Antennas(1)

A number of analog TV antennas were already mounted on the optimum position of Tokyo Tower .



Antennas(2)

□ Vacancy zone is around 250mH 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.



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

7.1 Features of ISDB-Tsb

(1) What is ISDB-T_{SB}

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) Commonality with ISDB-T

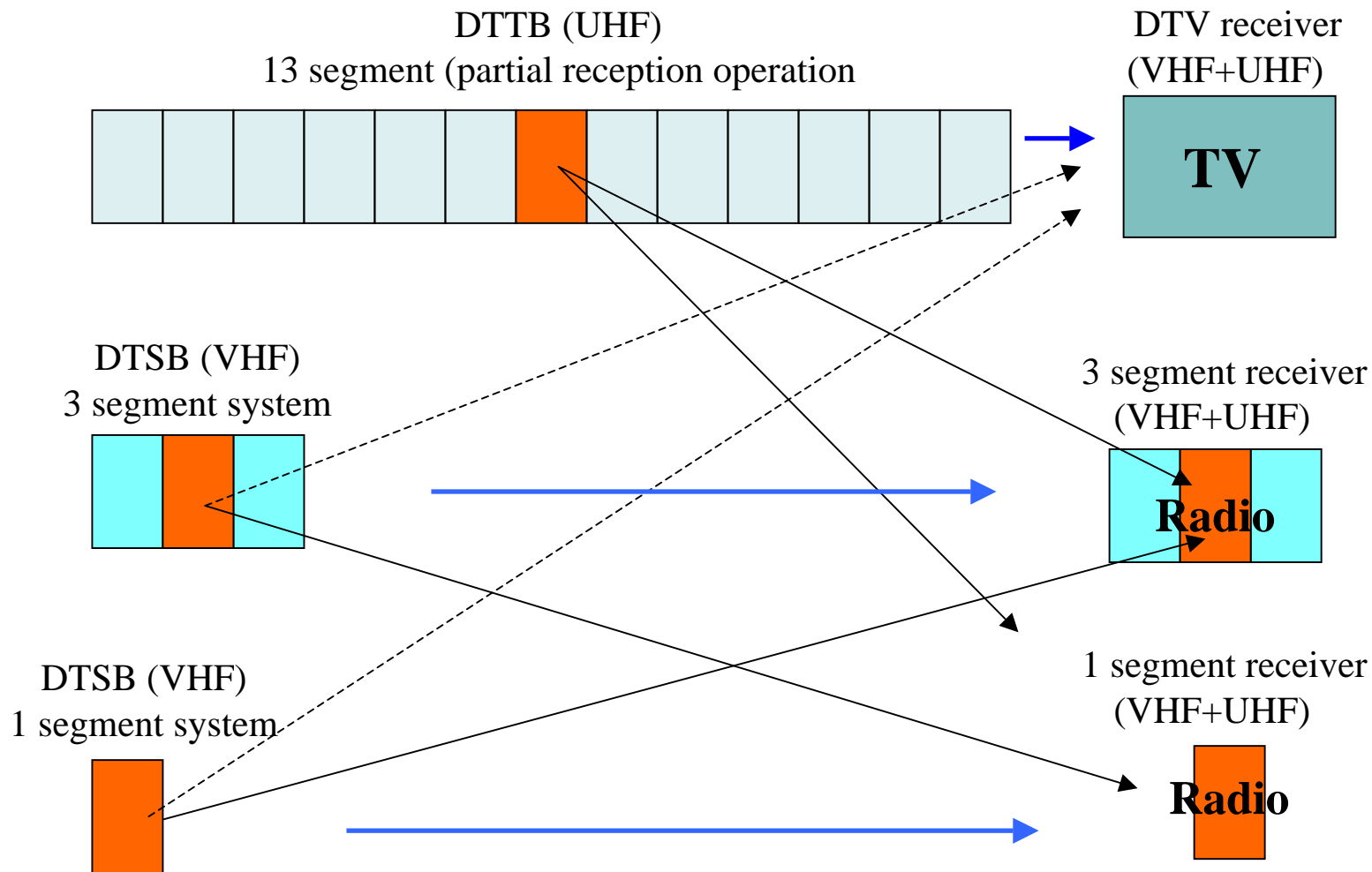
- (a) Same segment transmission construction. But ,considering narrow band reception, only 1 segment and 3 segment transmission systems are standardized
- (b) Adopt same transmission parameters as ISDB-T.
- (c) Commonality of 1 segment receiver with ISDB-T partial reception

(3) Efficient use of frequency resource

- (a) Consecutive transmission system. 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

7.2 Commonality with ISDB-T

(Digital radio/digital TV compatible receiver)



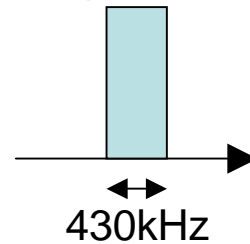
7.3 Efficient use of frequency resource (Flexibility of channel plan)

For ISDB-Tsb transmission system, any type as follows are available according to usable bandwidth

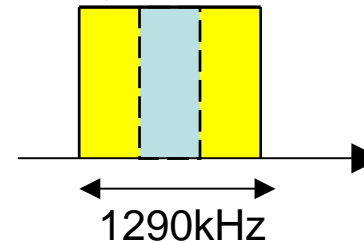
For narrow band
channel plan



1 segment type

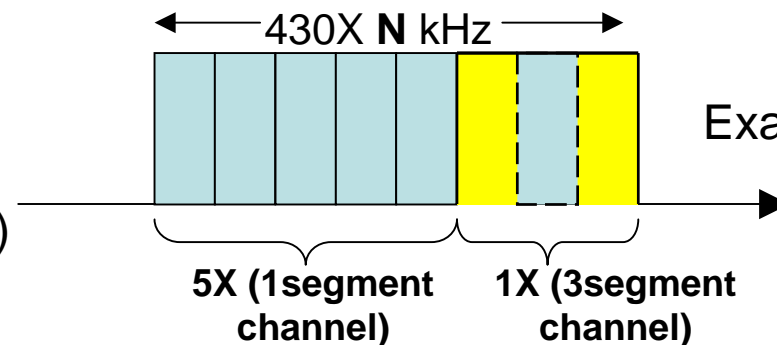


3 segment type



(One channel in One band)

For wide band
channel plan
(Consecutive transmission system)



Example; N=8
(note)

(6 channel{1X(1 seg)+1X(3 seg)} in one band)

(note) Any number of segment(up to 13) are available

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

1 Purpose

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

2 Activities

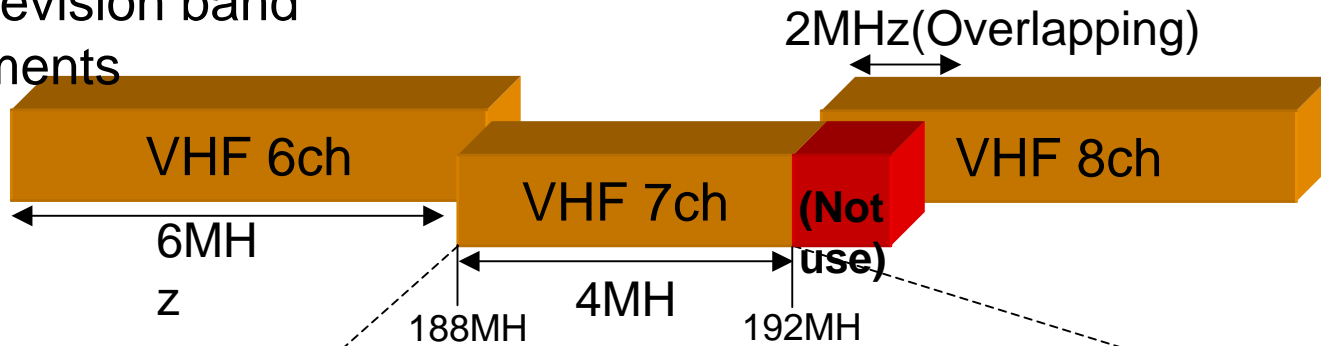
- Carry out the experimental DTSB services (started at 10 October 2003 in Tokyo and Osaka)
- Develop new application for DTSB
- Research of the demand for DTSB
- Promote the DTSB receivers

3 Members

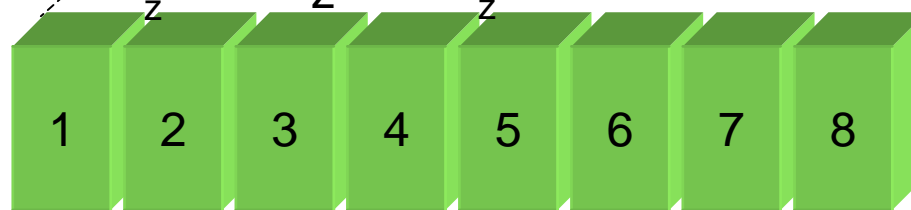
DRP has 70 members (Sound Broadcasters, manufacturers etc)

Trial Services of DRP

VHF television band assignments



Segment structure



8 segments
(Normally 13seg.)

3seg. broadcasting

Broadcast programs



Above example is Tokyo station , Osaka's all programs are 1seg. broadcasting₃₈

7.5 Examples of ISDB-Tsb Receiver

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



W44S
(SONY ERICSSON)

au by KDDI

In
Store



W51T
(TOSHIBA)

au by KDDI

In
Store



W52T
(TOSHIBA)

au by KDDI

In
Store



W51SH
(SHARP)

au by KDDI

Coming
Soon!

- Presented by KDDI -

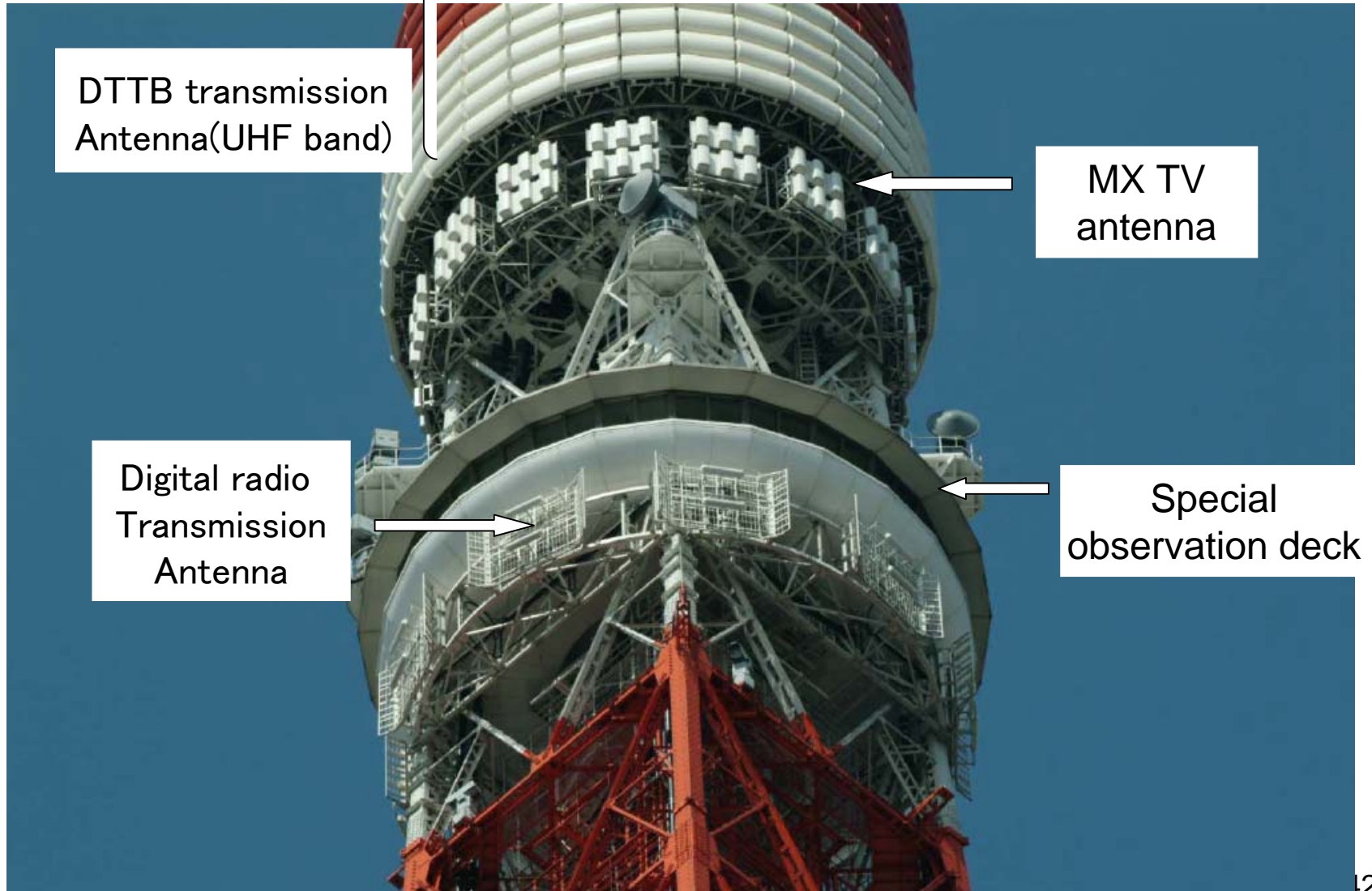
DRP Tokyo master rack room



DRP Tokyo digital radio transmitter room



Antenna



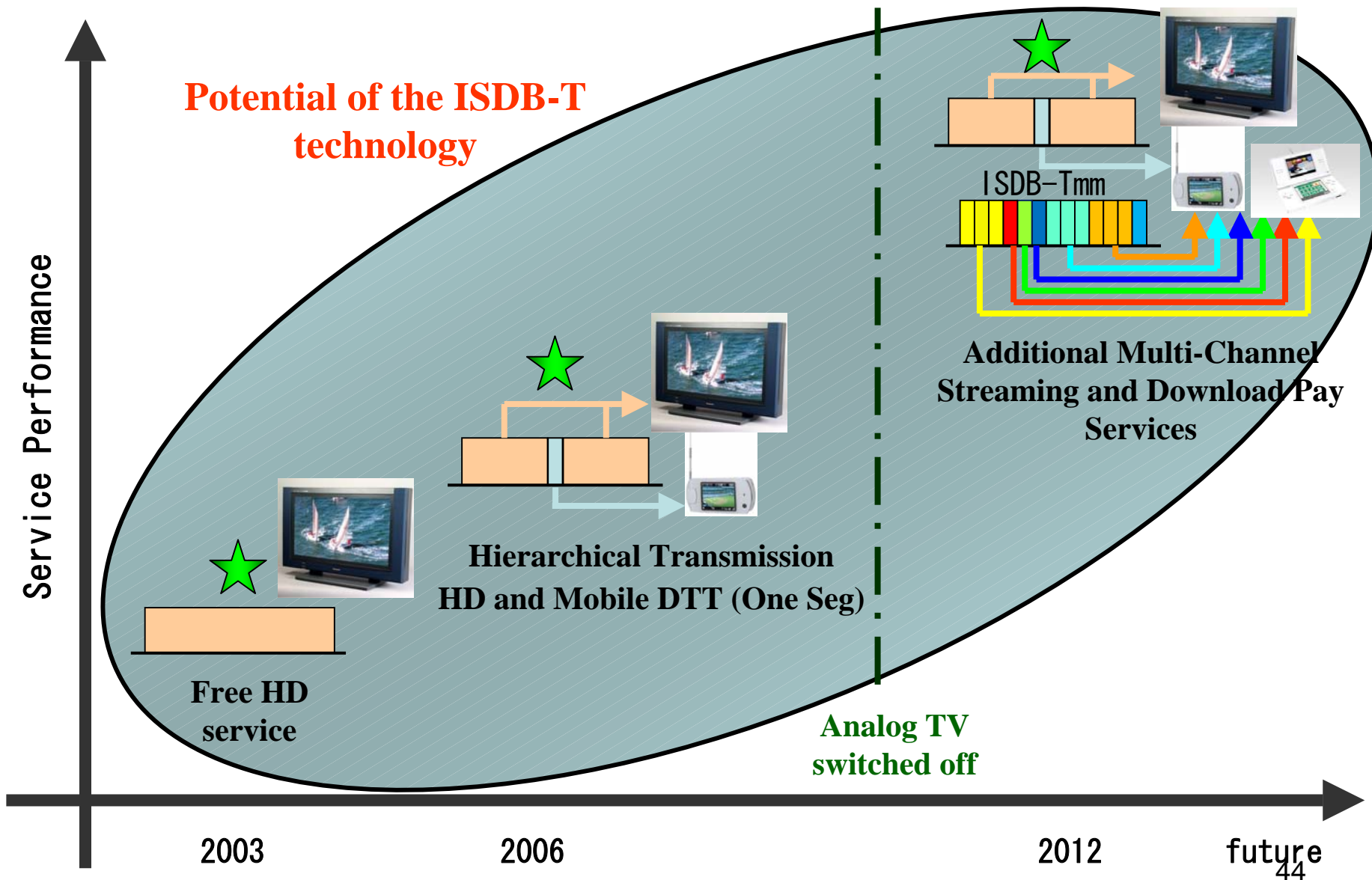
8. New Application for One-Seg (Mobile Multimedia Service)

In Japan, Organization for research of new One-seg service has been established in end of last year.

One-seg is very attractive transmission system for Mobile Multimedia Service with consecutive transmission technology.

The outline of Mobile Multimedia Service are demonstrated in demonstration room.

Migration Scenario to ISDB-T_{mm} (mobile multi-media)



Variety of Mobile Multimedia services

Ticketing Channel

MTV Down load

Storage Service



Shopping Channel



Gourmet Channel



Pay Movie Channel



9. Conclusion(1/2)

1. ISDB-T is the only one system which enable fixed/mobile/portable reception service in one channel!

- (1) **Save frequency resource** (not necessary for portable reception service separately)
- (2) **Save the broadcaster's infrastructure cost** (Only one transmitter for different service)

2. ISDB-T uses OFDM technology for transmission system

- (1) Save the frequency resource by using SFN technology

3. ISDB-T adopt Segment transmission system with time interleave

- (1) **Enable portable reception service (One seg) in same channel**
- (2) Enable the HDTV mobile reception (receive same signal as fixed reception)
- (3) **Enable indoor reception service** because of the robustness against signal level fluctuation

4. Enable service flexibility by using MPEG systems for multiplex

- (1) Any type of TV service are available; **HDTV, Muliti-channel SDTV, One-seg LDTV, Data service and interactive service**
- (2) Future development is also available to include into digital TV service

9. Conclusion(2/2)

5. Support any type of multi-media service

- (1) ISDB-T includes 2 types of multi-media service, one is presentation engine type(BML), which is defined in ARIB STD-B24, other is the execution engine type, which is defined in ARIB STD-B24
- (2) Presentation engine type service data-casting is now in service in Japan and very popular.

6. Bandwidth

- (1) Prepare the standard for 6.7,8 MHz system.

7. ISDB-Tsb: Digital Terrestrial Sound Broadcasting

- (1) Same performances as ISDB-T for mobile/portable reception
- (2) Commonality with ISDB-T: Common receiver is available
- (3) Efficient use of Frequency resource: Flexibility of channel plan
Any number of channels are available according to usable bandwidth

Thank You for Your Attention

Digital Broadcasting Expert Group

**<http://www.dibeg.org/>
mail; info@dibeg.org**