Overview
ISDB-T for sound broadcasting
Terrestrial Digital Radio in Japan

Shunji NAKAHARA
NHK (Japan Broadcasting Corporation)

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Features of ISDB-T_{SB} system

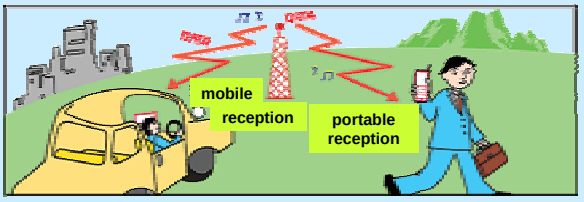
Current status of digital radio in Japan

Examples of services

Conclusion

Expectation for ISDB-T_{SB}

- AM broadcasters:high quality audio services
  (CD quality, stereo, no interference with by other AMs)
- FM broadcasters：multimedia services
  (data services, still images,simple motion picture)
- Audience：stable reception even in mobile reception, high quality audio, useful information
  (news, weather forecast, traffic information, information related to current program)



Requirements for ISDB-T_{SB}

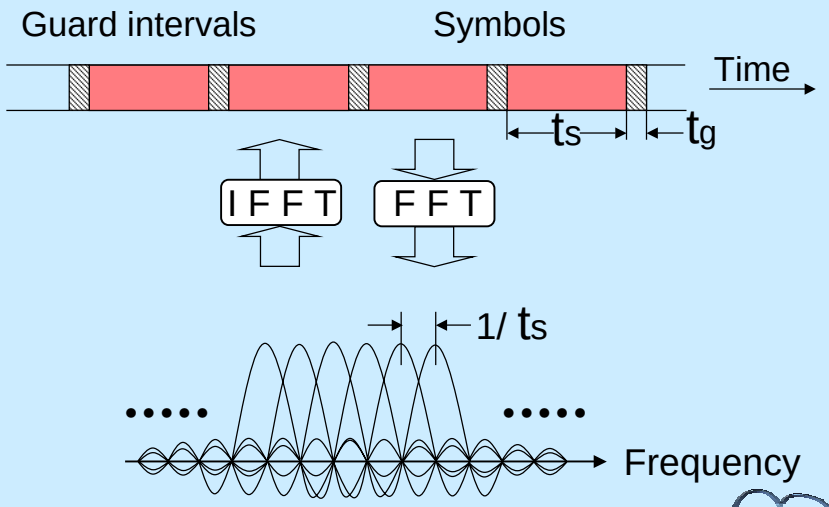
- enable mobile / potable reception like AM,FM
- transmit high quality audio equivalent to CD
- provide data services
  - information related to current program
  - independent information ex. latest news, weather forecast, traffic information, so on
  - Electronic Program Guide
- save frequencies
  - no guard bands between adjacent broadcasters who transmit at a same site
  - simplify allotment of channels for ISDB-T_{SB}
  - Single Frequency Networks

Elemental technologies of ISDB-T_{SB}

technologies to realize requirements

- enable mobile / potable reception
  - OFDM modulation scheme
- transmit high quality audio
  - MPEG-2 AAC (Advanced Audio Coding)
- provide data services
  - MPEG-2 Systems provide multimedia broadcasting
- save frequencies
  - SFN
  - band-segmented OFDM

Modulated OFDM signals
(Time and Frequency domains)



Transmission parameters of OFDM segment

ISDB-T Mode	Mode 1	Mode 2	Mode 3
Bandwidth	430kHz		
Carrier spacing	3.968kHz	1.984kHz	0.992kHz
Total number of carriers	108	216	432
Carrier modulation	QPSK, 16QAM, 64QAM, DQPSK (OFDM)		
Number of symbols per frame	204		
Useful symbol duration	252 µs	504 µs	1.008 ms
Guard Interval duration	1/4, 1/8, 1/16, 1/32 of useful symbol duration		
Frame duration	53 - 64 ms	106 - 129 ms	212 - 257 ms
Inner code	Convolutional Code (1/2, 2/3, 3/4, 5/6, 7/8)		
Outer code	RS (204,188)		
Interleaving	frequency and time interleaving		
Length of time interleaving	0, 0.1, 0.2, 0.4, 0.8s		
Information rate	280kbps - 1.8Mbps		

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ISDB-T_{SB} commenced in Japan

- started in Oct. 10 2003
- services as an independent new medium
- Analog AM and FM are continued
- Frequency : 188-192MHz (VHF ch.7)
- Bit Rate : 330kbps (=1 Segment)
- High quality sound (MPEG-2AAC 144Kbps = CD Quality)
- Radio broadcaster can send still images and motion pictures
- Receiver presents Electronic Program Guide

ISDB-T_{SB} Receiver

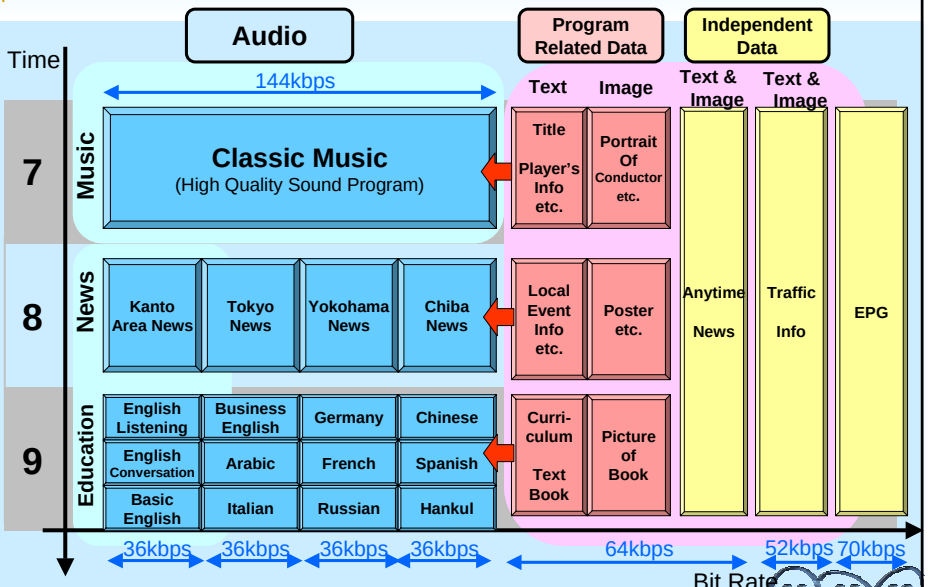
Features of ISDB-T_{SB} system

ISDB-T_{SB} commenced in Japan

Examples of services

Conclusion

Examples of services on a program guide



Features of ISDB-T_{SB} system

ISDB-T_{SB} commenced in Japan

Examples of services

Conclusion

Conclusion

- Features of ISDB-T_{SB} system
  - uses OFDM scheme and MPEG2 AAC
  - provides high quality audio and data services
- ISDB-T_{SB} commenced in Japan
- Examples of services
- more details of ISDB-T_{BS} are introduced in next session
  - business, receivers,frequencies, and coverage

Thank you for your attention.

implementation issues

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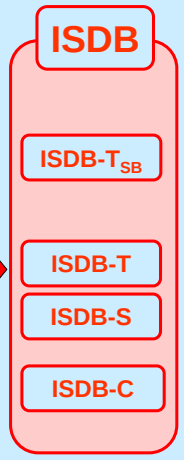
Analog Media

(As of 2002)

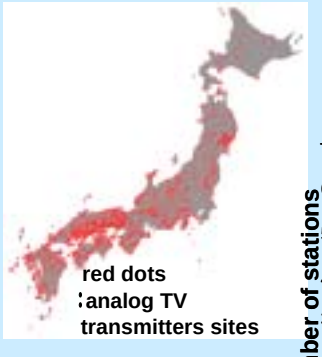
Media	Service began	Num of Stations	Num of Transmitters (satellites)	Freq.	Rate of Penetration
AM Radio	1925	47	621	531-1602 KHz	99.9%
FM Radio	1969	53	810	76-90 MHz	96.0%
Terrestrial TV	1953	127	15058	90-770 MHz	99.4%
Satellite	1984	19	5	11-12 GHz	43.3%
Cable	1955	669	994	90-770 MHz	19.3%

Road Map to the Digital in Japan

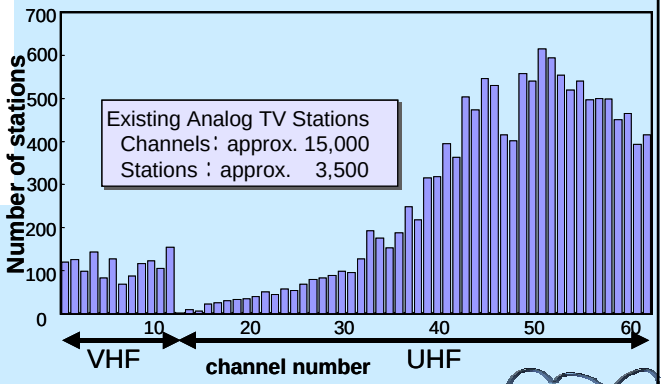
Media		Digital begins	Analog ends	Service
AM Radio	→	As a New Media	Remain	Audio Text Still Images Motion Pictures
FM Radio	→	2003.10		
Terrestrial TV	→	2003.12	2003.11	Motion Pictures
Satellite TV	→	2000.12	2003.11	Hi-Vision 5.1 Surround Text Still Images
Cable TV	→	2001		



Frequencies for terrestrial broadcastings in Japan

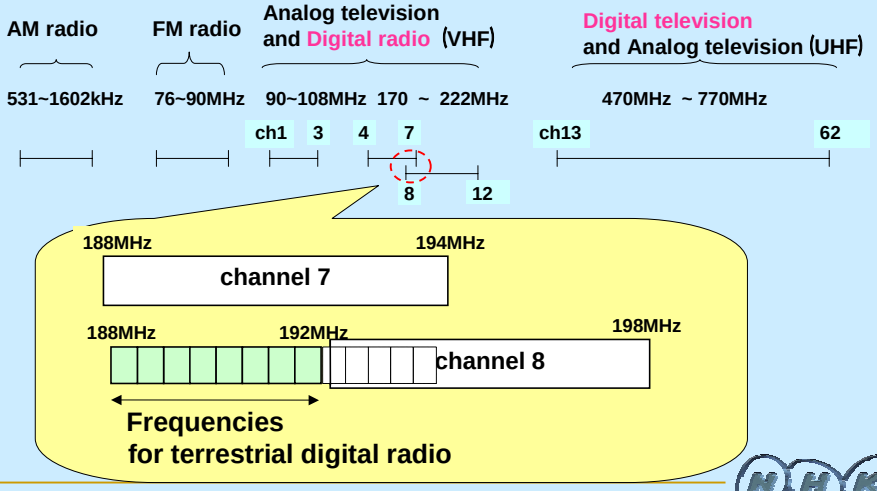


- Sites and numbers of existing Analog TV stations
  - Digital Radio introduced in VHF
  - Digital TV introduced in UHF



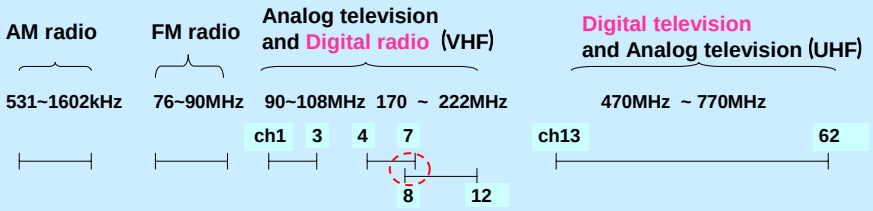
Frequencies for terrestrial broadcastings in Japan

Assignment from 2003 to the year 2011

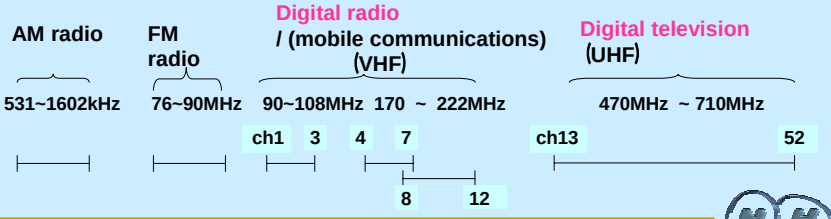


Frequencies for terrestrial broadcastings in Japan

Assignment from 2003 to the year 2011



Assignment after the year 2011



Significant features of ISDB-T_{SB} (1)

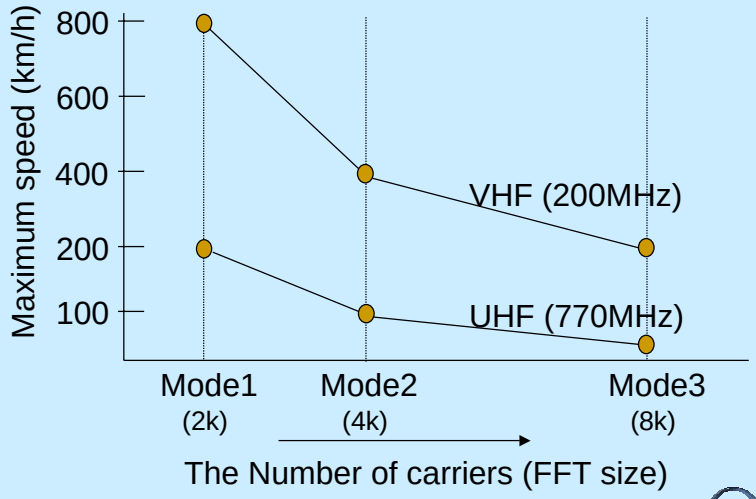
ISDB-T_{SB} is named digital system F
in Recommendation ITU-R BS.1114-2

- Source coding
  - MPEG-2 AAC (Advanced Audio Coding)
  - international standard : ISO/IEC 13818-7
  - AAC coding of 144kbps can bring High-quality and efficient sound broadcasting
- Multiplexing
  - MPEG-2 Systems
  - international standard : ISO/IEC 13818-1
  - provide multimedia broadcasting
  - ISDB-T_{SB} has compatibility with many digital systems through MPEG-2 transport stream
- Transmission (next slide)

Significant features of ISDB-T_{SB} (2)

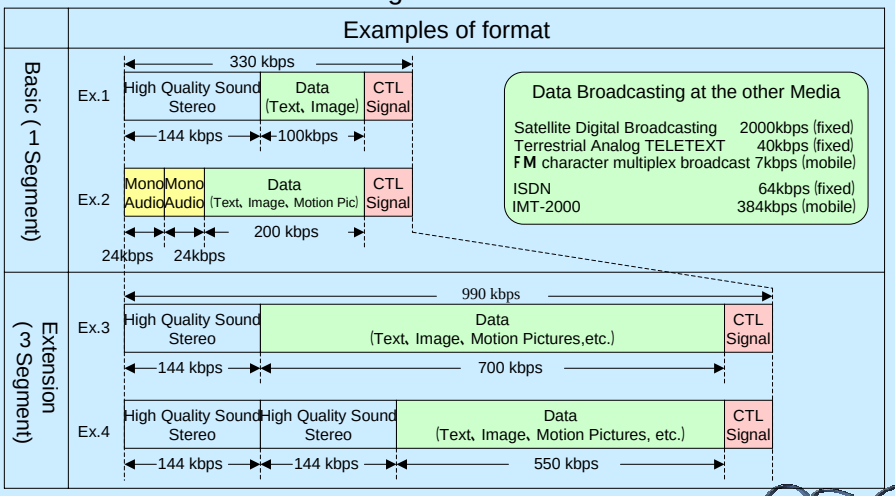
- Transmission scheme
  - Common system both television and sound broadcasting
  - rugged system which uses
    - OFDM modulation scheme (band segmented OFDM)
    - two-dimensional frequency-time interleaving
    - Convolutional code + Reed-Solomon code
  - realize high reliability to make Mobile and portable reception possible
  - capable to transmit information bit rates of 330kbps per segment
  - save frequencies because of SFN (Single Frequency Network) and a connected transmission scheme

Maximum speed depending on Mode

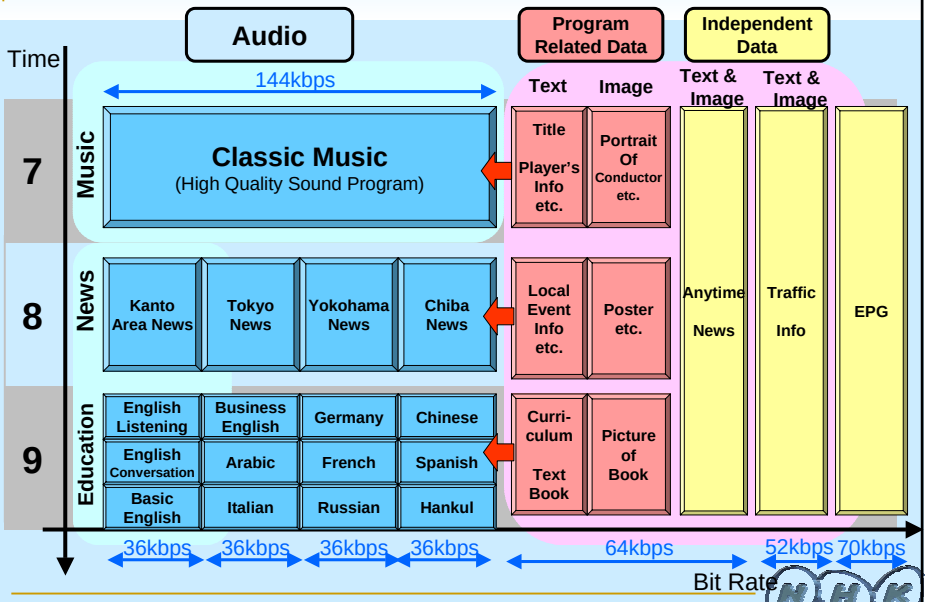


Format of Digital Terrestrial Audio and Example of Services

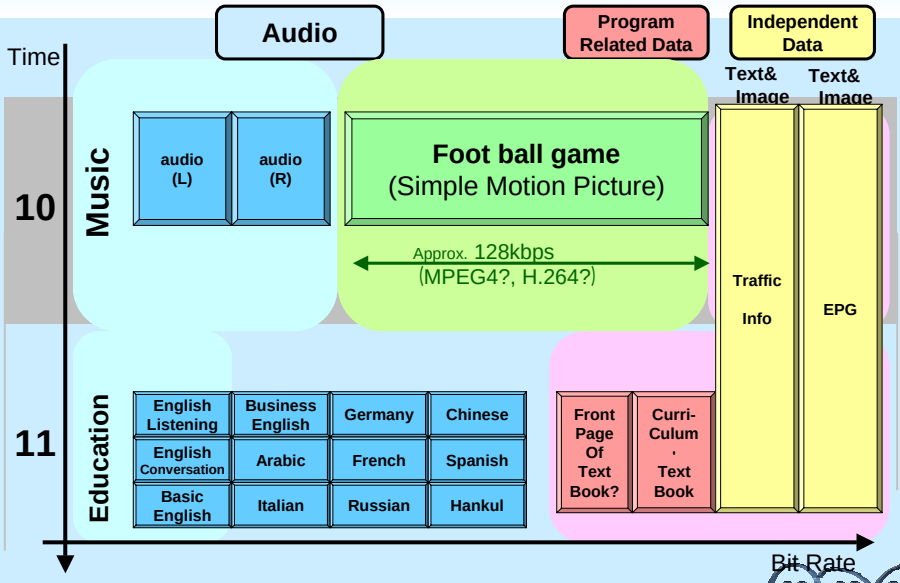
- Audio and Data Broadcasting



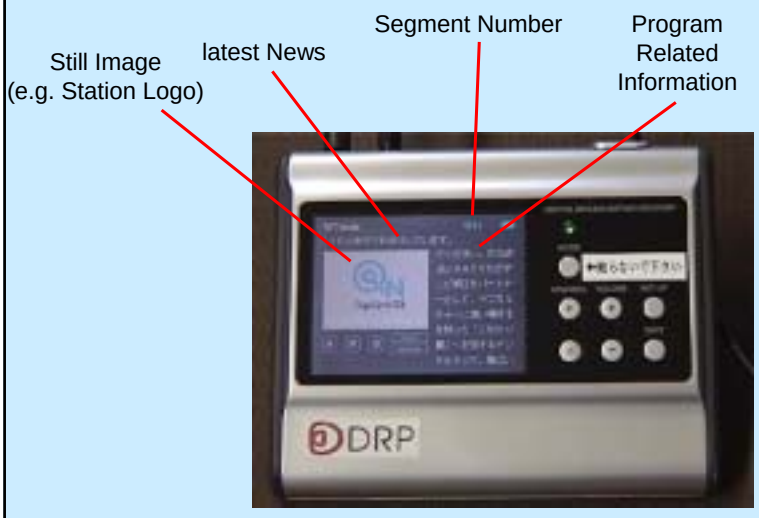
Examples of services on a program guide



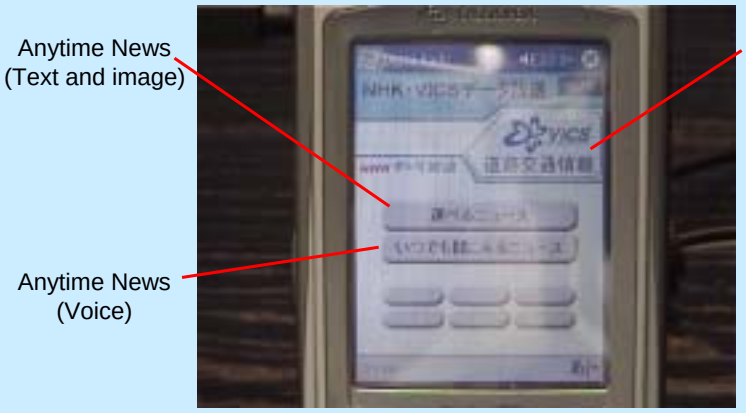
Examples of services on a program guide



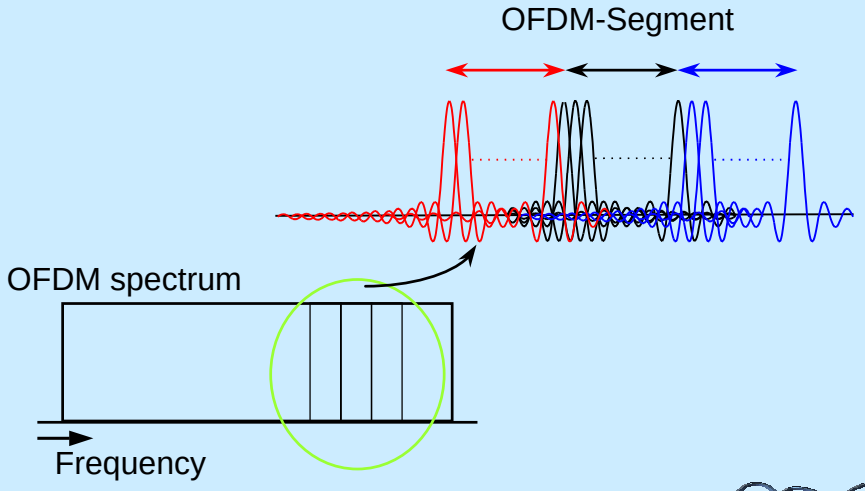
Digital Radio Receiver (1)



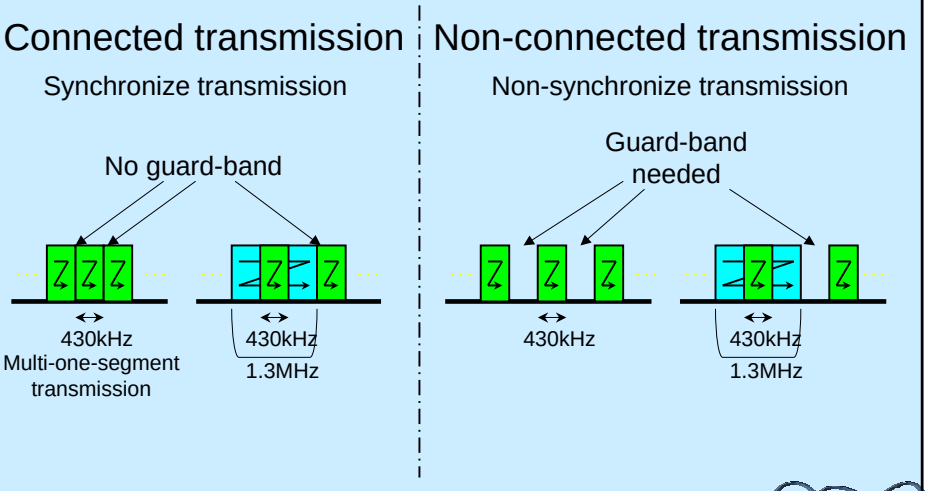
Digital Radio Receiver (2)



Segmented OFDM transmission

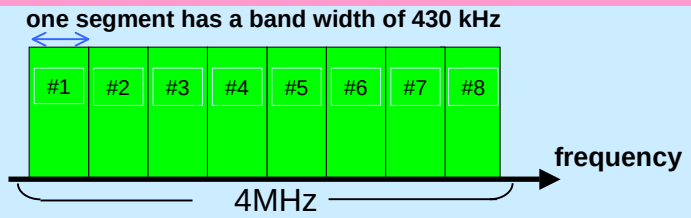


Connected transmission

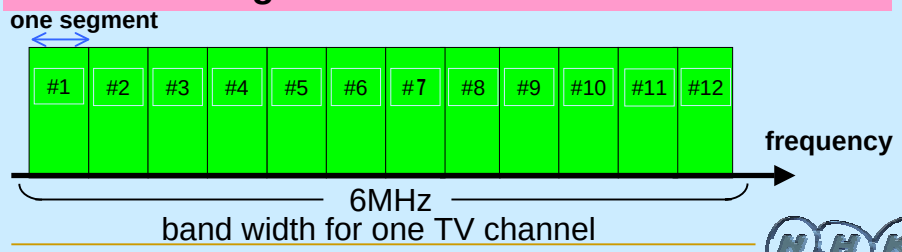


Connected transmission

connected segments between ch.7 and 8 at present



connected segments in a TV channel after 2011



Digital radio project and broadcasters in Japan (1)

Digital Radio Promotion Association (DRP) was organized as a consortium constructed by 32 broadcasters as below

Tokyo metropolitan area　　：existing AM, FM broadcasters

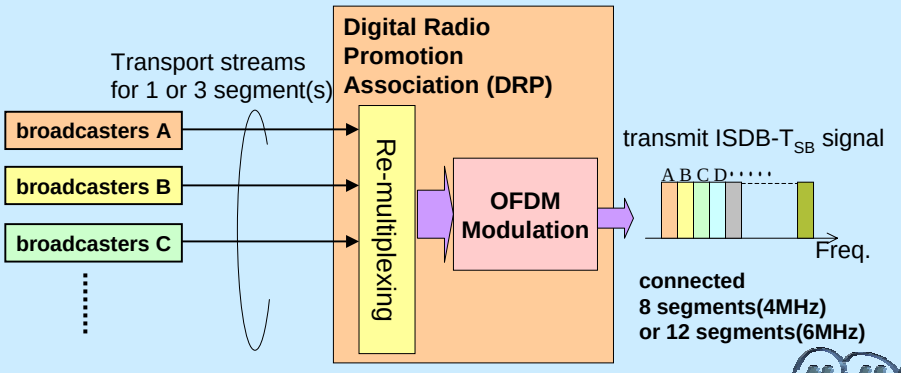
SEG #1	SEG #2	SEG #3	SEG #4	SEG #5	SEG #6,7,8 (use 3ses)
NHK VICS	FM ヨコハマ TBS R&C BAY FM ﾗｼﾞｵたんぱ	NACK 5 文化放送 テレビ朝日	J-WAVE ﾒｶﾞﾎﾟｰﾄ放送 ラジオ日本	伊藤忠商事 SONY SONY communications network	TOKYO FM ニッポン放送 ＪＦＮＣ（B会員）

OSAKA metropolitan area

SEG #1	SEG #2	SEG #3	SEG #4	SEG #5	SEG #6	SEG #7	SEG #8
NHK VICS	ＭＢＳ	ＡＢＣ 兵庫FM	FM 802 伊藤忠商事ﾌﾞﾛｰﾄﾞﾊﾞﾝﾄﾞ	ラジオ大阪 AM神戸	Fm osaka 読売テレビ	FM京都 関西テレビ	BS京都

Digital radio project and broadcasters in Japan (2)

- Each group of broadcasters send MPEG2 transport streams (TS) to DRP
- DRP as a consortium re-multiplexes TS and modulates to an OFDM signal
- The OFDM signal is connected by 8 or 12 segments, and transmitted
- Receivers then tune into a segment to enjoy the programs



License for Digital Radio in Japan

licensed party	Digital Radio Promotion Association (DRP)	
Station	Tokyo station	Osaka station
Start	October 10th 2003	
Center frequency	190.214286 MHz (in channel 7)	
transmit power (Power/ segment)	800 W (100 W)	240 W (30 W)
transmit site	Tokyo tower	Mount ikoma
Coverage are	Tokyo metropolitan area	Osaka metropolitan area

Transmitting tower

■Tokyo Tower

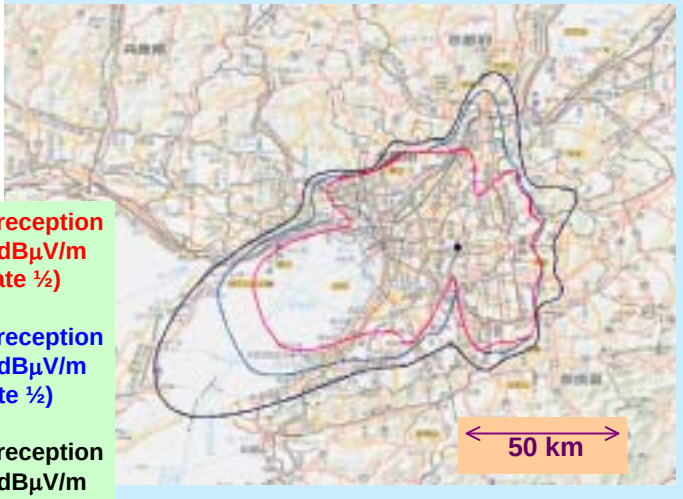
Coverage over Tokyo metropolitan area

Coverage for mobile reception
:field strength of 57dBμV/m
(16QAM,coding rate ½)

Coverage for mobile reception
:field strength of 51dBμV/m
(QPSK,coding rate ½)

Coverage for mobile reception
:field strength of 39dBμV/m
(QPSK,coding rate ½)

Coverage over Osaka metropolitan a



Coverage for mobile reception
:field strength of 57dBμV/m
(16QAM,coding rate ½)

Coverage for mobile reception
:field strength of 51dBμV/m
(QPSK,coding rate ½)

Coverage for mobile reception
:field strength of 39dBμV/m
(QPSK,coding rate ½)

"Analog to Digital" by ISDB

Frequencies for Digital Radio in Japan

Features of ISDB-TSB

Actual services and receivers

Structure of ISDB-TSB segments

Digital radio project and broadcasters

Conclusion

Conclusion

- Digital radio business in Japan
  - DRP as a consortium started digital radio business Oct.10th this year
- Digital radio system
  - use ISDB-T for sound broadcasting system
  - provide high quality audio and data services

Thank you for your attention.