

Section 5

Multiplex system and Service information

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Digital Broadcasting Expert Group (DiBEG)

Japan

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Preface

Theme of this section is covered service multiplex and control information for ISDB-T system. This function is positioned between source coding and transmission coding. Therefore, it is necessary to understand the outline of structure/ function of Multiplex system and service information to introduce ISDB-T system.

As you know, Multiplex system and part of PSI (Program specific information) is specified almost based on MPEG-2 systems, and ARIB specified other PSI and Service Information (SI) refer to DVB-SI system.

But, unique specifications to support ISDB-T system are also included.

In this seminar, I wish participant to understand outline of MUX and SI, and also understand the relations to encoding system and transmission system.

One-seg service is the unique feature of ISDB-T, and slightly seems to understand, therefore, text for technical bases of partial reception will be prepared separately.

Finally, Japanese system and Brazilian system is not completely same, especially SI, but the outline and structure are same, so, this seminar will be useful for understanding of Brazilian system as a reference.

Contents

Multiplexing

- (1) Digital broadcasting and Multiplex
- (2) Multiplex system(MPEG-2 Systems)

Specification of PSI/SI

- (3) Program Specific Information(PSI) & Service Information(SI)
- (4) PSI
- (5)SI

Operation of PSI/SI

- (7) Operation of PSI/SI for DTTV

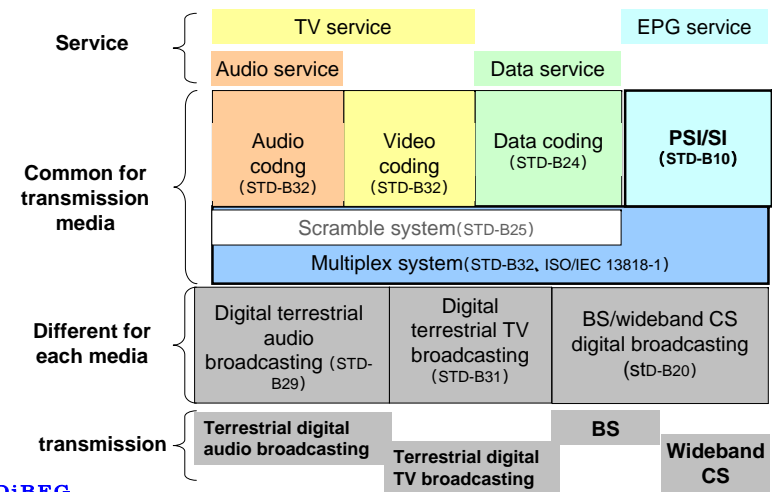
(note) contents of this short course seminar are only a part of standard.

Digital broadcasting and Multiplex

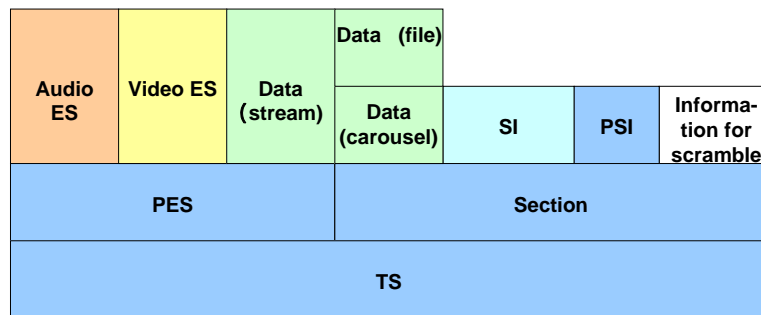
Digital broadcasting & Multiplex system Functions and Features of Multiplex

- Functions
 - Function of Multiplex
 - Multiplex plural services/program/component on transmission
 - Signal format is common for any kind of service, program and component
 - Free from transmission media
 - Function of synchronization
 - Synchronization between transmission side and receiving side
 - Synchronization between program component(video, audio)
 - Function of selection
 - Service information for selection of service and program
- Features
 - flexibility
 - Support any service, program and component
 - Expandability
 - Applicable for new program component

Digital broadcasting & Multiplex system Structure of Digital broadcasting



Digital broadcasting & Multiplex system Signal format of digital broadcasting



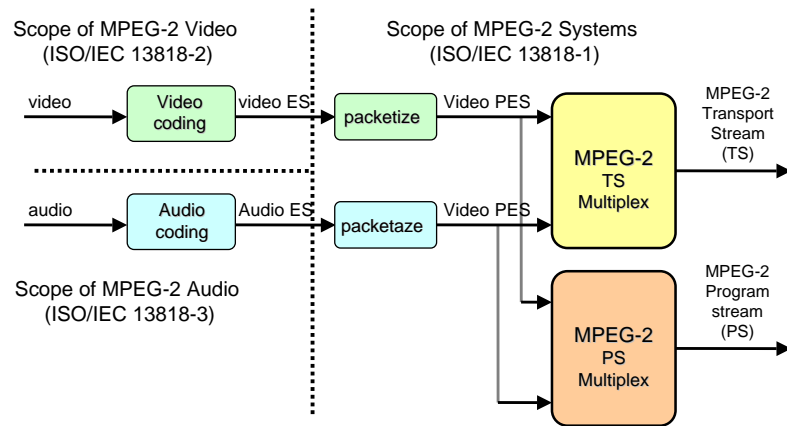
(note) signal format of PES, TS and Section area is defined in ARIB STD-B32, based on MPEG-2 systems

(note) PSI is defined in both STD-B32 and STD B10. In STD-B32, only outline related to MPEG -2 systems is defined

MPEG-2 Systems

ISO/IEC 13818-1
ITU-T Rec. H.222.0
ARIB STD-B32 Part.3

MPEG-2 Systems 2 kinds of multiplex system



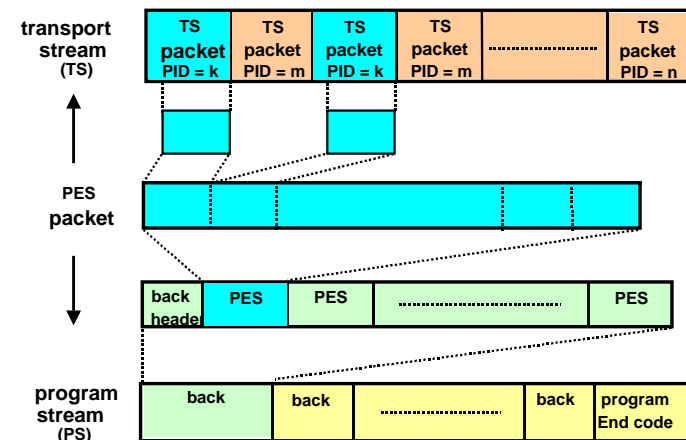
MPEG-2 Systems Multiplex signal format (TS,PS)

- TS (Transport Stream)
 - PES packet is divided into TS packet.
 - Used for transmission and recording in which error may occur.
 - Plural program are multi-plexed into 1 TS.
- Used for digital broadcasting
- PS (Program Stream)
 - Signal stream of plural PES packets
 - Used for transmission and recording in error free condition
 - Multiplex 1 program
 - Compatible to MPEG-1
- Used for package media such as DVD

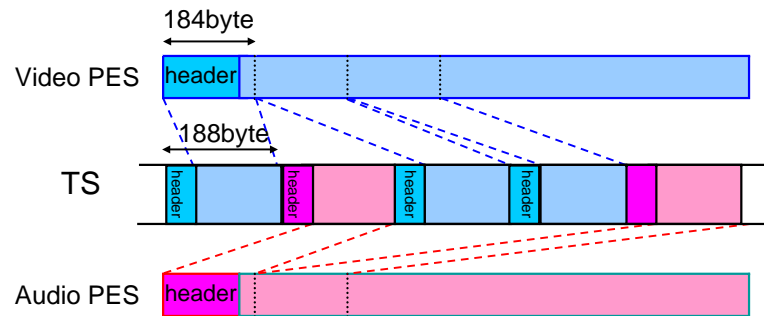
MPEG-2 Systems signal format before Multiplexing (ES,PES, section)

- ES (Elementary Stream)
 - Coded video and audio stream
- PES (Packetized Elementary Stream)
 - Packetize video and audio ES into defined unit(video frame, audio block ,etc)
 - Variable length packet
 - Interface format to TS, PS
- Section
 - Signal format for PSI/SI
 - Variable length
 - Used for only TS

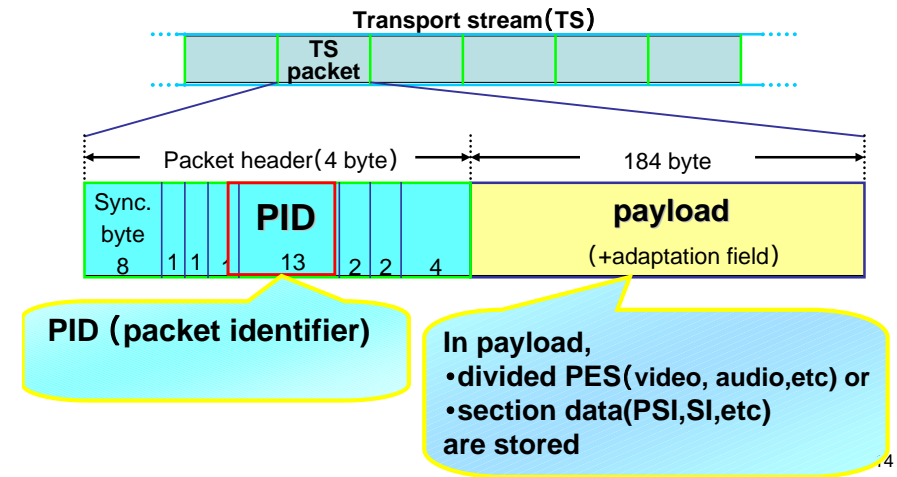
MPEG-2 Systems Relationship between TS and PS



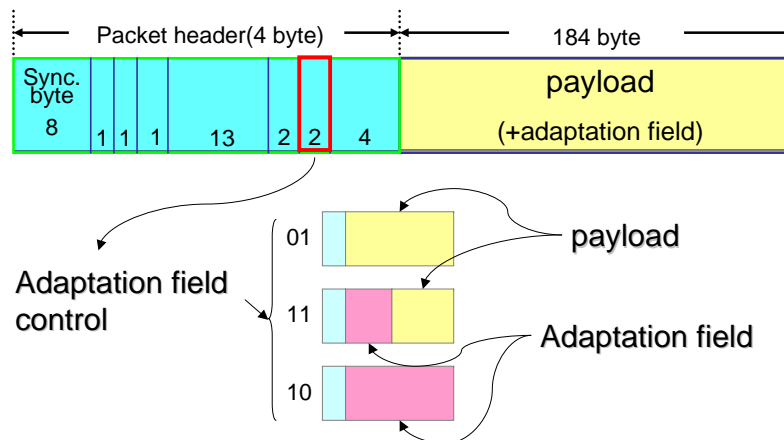
MPEG-2 Systems TS multiplexing method



MPEG-2 Systems header and payload of TS packet

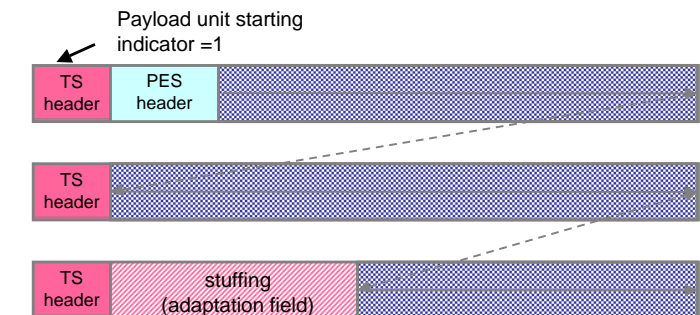


MPEG-2 Systems Payload area of TS packet



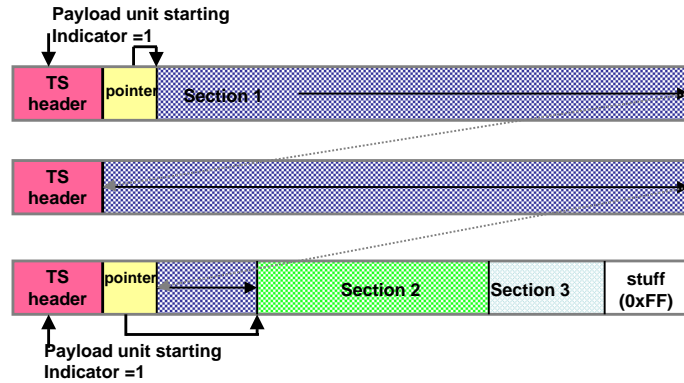
MPEG-2 Systems Process to convert from PES to TS

- Only one PES packet is divided into plural TS packets of same PID group
- Payload unit starting indicator "ON" ; start fist byte of PES
- In last TS packet,stuffing data is inserted to adjust the length of TS packet

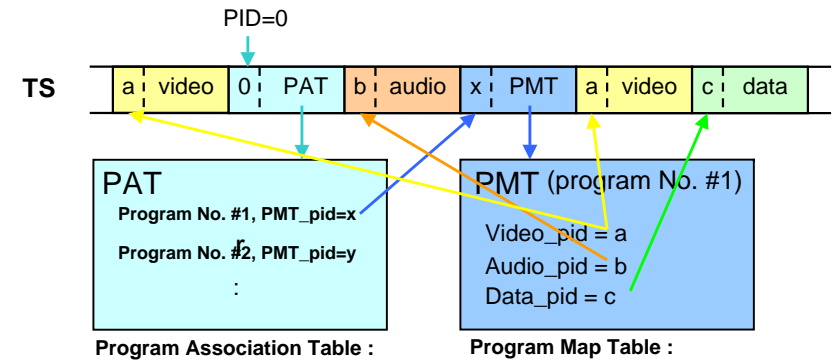


Process to convert from Section to TS

- Plural section data are transmitted in same PID TS packet
- Payload unit starting indicator ON
⇒new section starts at this TS packet (indicate the start point by pointer)



Transmission control in MPEG-2 Systems Indirect assignment of PID by PSI



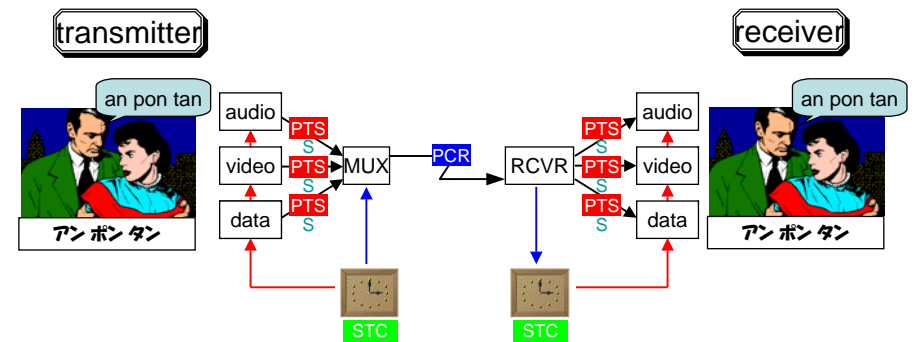
■ PSI(PAT,PMT, etc) are transmitted repeatedly

Transmission control in MPEG-2 Systems PSI Table

4 tables written below are defined as Program Specific Information

- **PAT**: Program Association Table
 - PID=0x0000 (fix)
 - Assign the program PID of PMT including in TS
- **PMT**: Program Map Table
 - PID is assigned indirectly by PAT
 - Assign the PID of Components which construct the TV program (video ,audio, etc)
 - Assign the PID of the information for scramble (ECM) in case that conditional access system is available
- **NIT**: Network Information Table
 - PID is assigned by PAT(for he rile of SI, PID is fixed to 0x0010)
 - Assign the network parameter(details are defined in SI)
- **CAT**: Conditional Access Table
 - PID=0x0001 (fixed)
 - Assign the PID for the information related to scramble (EMM)

Synchronization method of MPEG-2 Systems STC and Time stamp



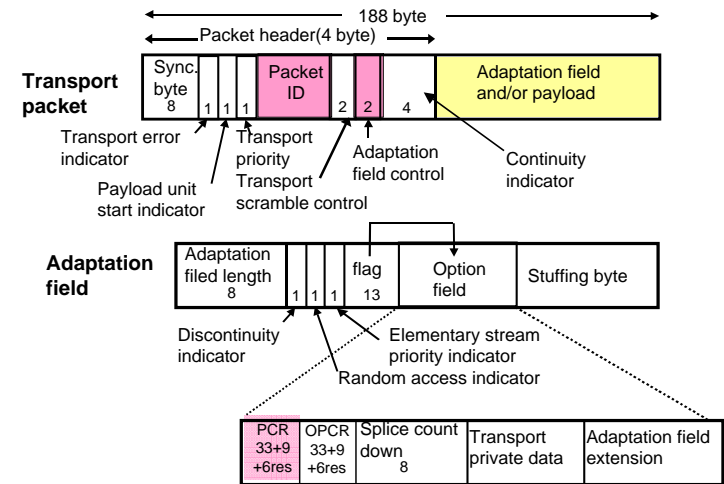
- 1 Set the STC in both side
- 2 Synchronize both STC by PCR transmitted by TS
- 3 Based on STC, PTS is attached to PES data.

Synchronization method of MPEG-2 Systems STC and transmission of time stamp

- PCR
 - Calibration of STC
 - PCR_base(upper digit): number of 90KHz clock count(33bit)
 - PCR_ext(lower digit): number of 27MHz clock count(9bit)
 - transmission
 - Adaptation of TS packet
 - Transmission period is no longer than 0.1 second
- PTS/DTS
 - PTS, DTS
 - number of 90KHz clock count(33bit)
 - transmission
 - Header of PES packet
 - Transmission period is no longer than 0.7 second

Signal format used in MPEG-2 Systems Structure of TS packet

As an example, structure of TS packet is shown, refer ARIB STD-B32 for details



Transmission control(PSI) and service information(SI)

PSI/SI relationship between PSI and SI

	PSI	SI
function	Signal selection from MPEG-2 TS	Support the program selection
Support plural TS	Identify by TS_id only	yes(broadcasting for plural TS)
Time schedule support	none	yes(program)
Information format	table	table
Signal format	section	section
Transmission style	Transmit repeatedly	Transmit repeatedly
specification	ISO/IEC 13818-1	ARIB STD-B10
reference	-	ISO/IEC 13818-1
scope	Used for any media	broadcasting

PSI

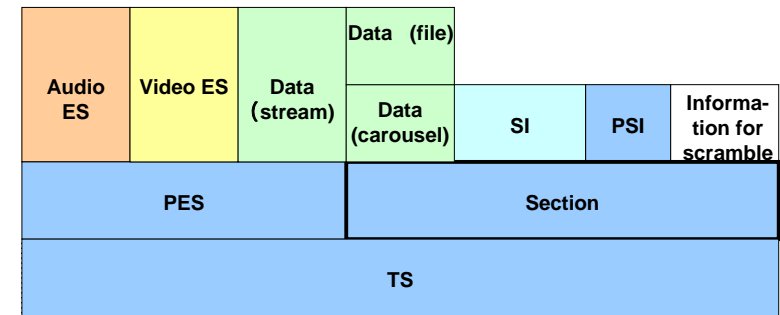
Based on PSI, extend for broadcast service

SI

PSI/SI Table and section

- Information of PSI/SI is called table
 - table
 - Whole information for specific function
 - Function of table is identified by table_id
 - A set of sub tables
 - Sub table
 - Information for specific matter in table
 - Table_id extension designates the kind of information
- PSI/SI data is transmitted as section format
 - Section
 - Signal format to divide and transmit the table (sub table) data
 - Descriptor
 - Lower layer signal format for inserting section into section
 - Used for description of option field of section

Signal format used for PSI/SI Section

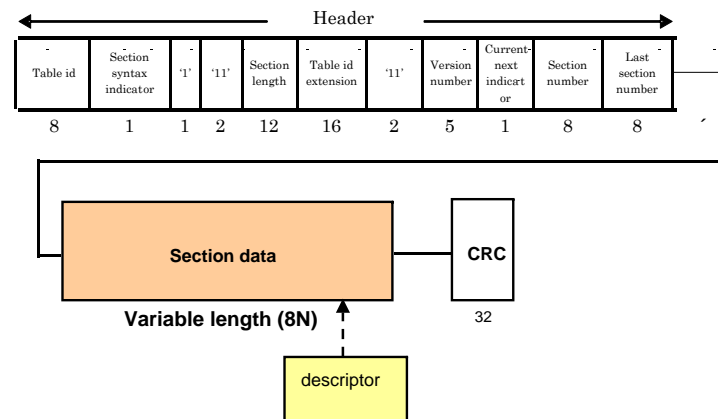


(note) signal format of PES, TS and Section area is defined in ARIB STD-B32, based on MPEG-2 systems

(note) PSI is defined in both STD-B32 and STD B10. In STD-B32, only outline related to MPEG -2 systems is defined

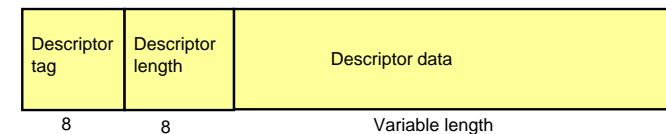
Signal format used for PSI/SI Structure of Section

(refer ARIB STD-B32 Part 3, section 3.2)



Signal format used for PSI/SI Structure of Descriptor

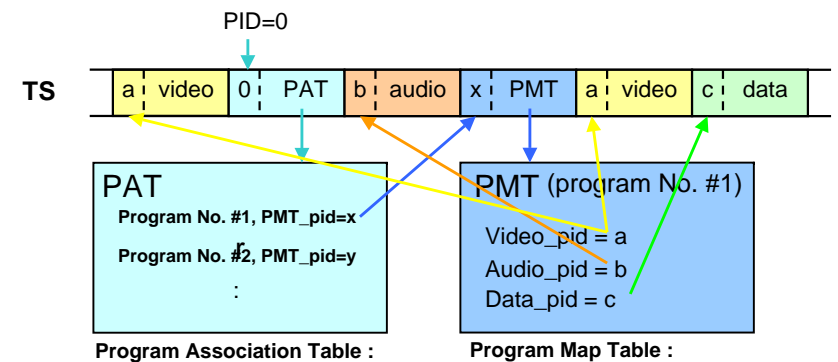
(refer ARIB STD-B32 Part 3, section 3.5)



Transmission control (Program Specific Information;PSI)

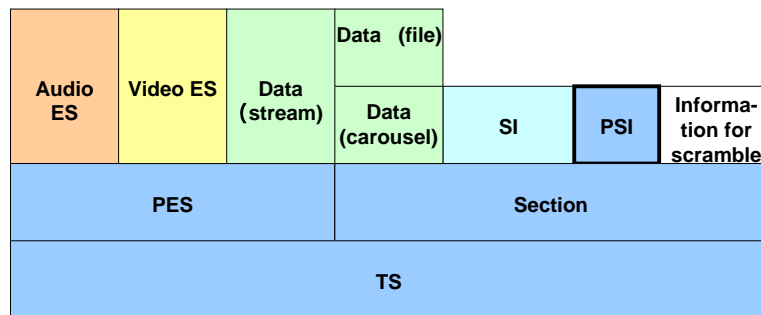
ISO/IEC 13818-1
ITU-T Rec. H.222.0
ARIB STD-B32 part 3

Function of PSI Indirect assignment of PID



■ PSI(PAT,PMT, etc) are transmitted repeatedly

Signal format of PSI PSI



PSI Its table and functions

Tables which are defined in ISO/IEC

table_id	table	function	pid
0x00	PAT (Program Association Table)	PAT designates packet identifier of TS packet which transmits PMT related to broadcasting program.	0x0000
0x01	CAT (Conditional Access Table)	CAT designates packet identifier of the TS packet, which transmits individual information among related information of charged broadcasting..	0x0001
0x02	PMT (Program Map Table)	PMT designates packet identifier of TS packets and packet identifier of TS packets, which transmit common information among related information of charged broadcasting, which transmits each coded signal comparing a broadcasting program	Indirectly designated by PAT

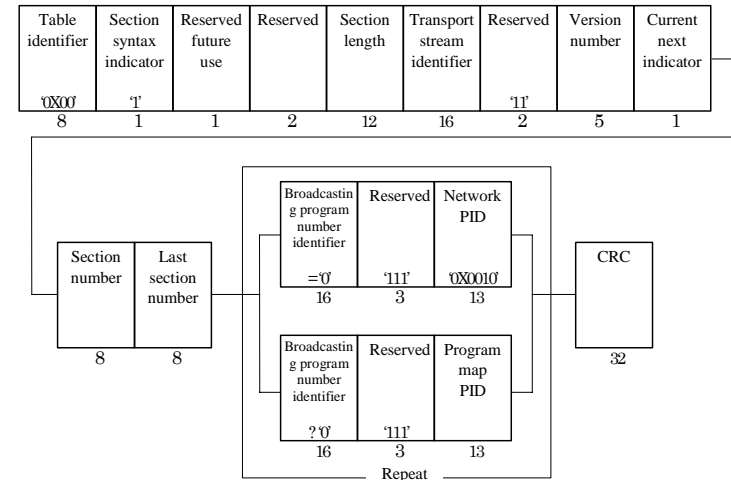
Table which is reserved by ISO/IEC, and defined by radio regulation

table_id	table	function	pid
0x40	NIT (Network Information Table)	Information for transmission	0x0010
0x41			

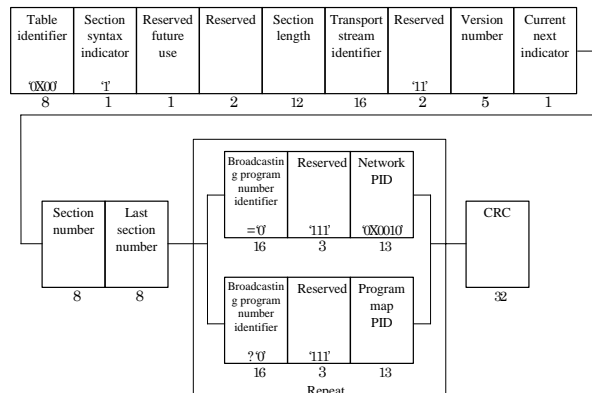
Descriptors used in PSI table

Descriptors used in PSI table are listed in [Table 6-1 of Part 2 of ARIB STD-B10](#).

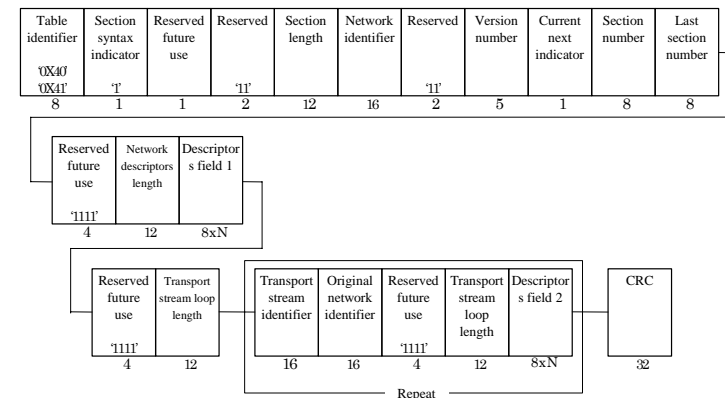
Data structure of PAT



Data structure of PMT



Data structure of NIT

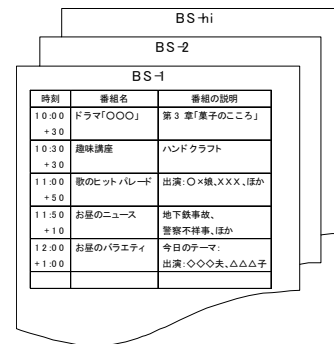


Service information(SI)

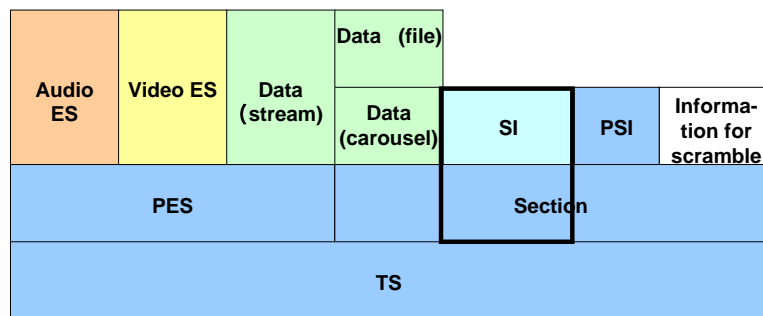
ARIB STD-B10

Function of SI

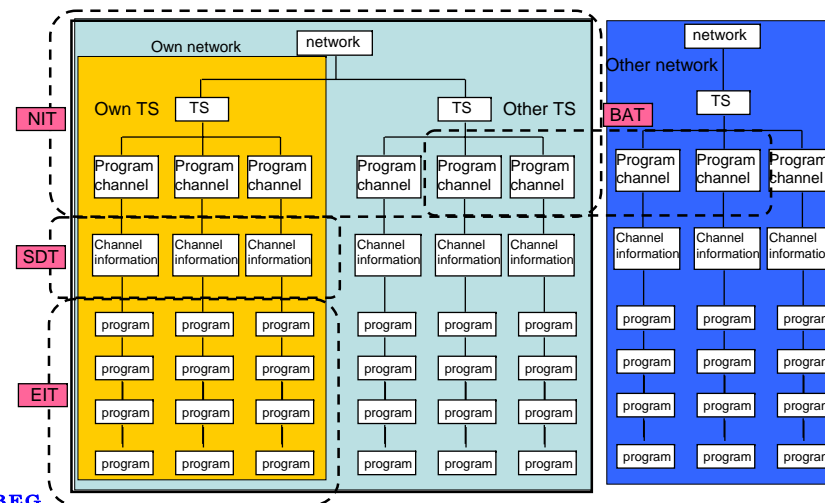
- Supplement of PSI, control the receiver
- Function of EPG(Electronic Program Guide)



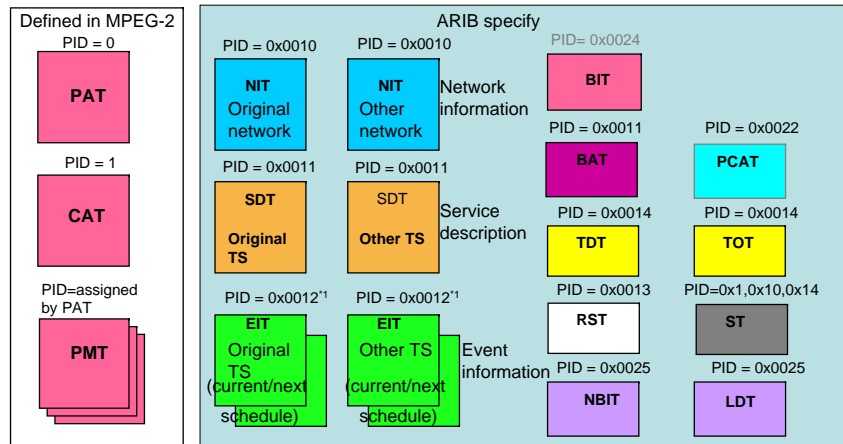
Signal format of SI



PSI/SI Unit of information in digital broadcasting



PSI/SI structure of PSI/SI table



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SI definition of program and event in digital broadcasting

- Identify the program channel
 - Identify the network (considering re-transmission, identify by network_id before re-transmission)
 - Identify the plural TS in the network by TS_id
 - Identify the program channel in TS by service_id (program_number)
 - (original_network_id/TS_id/service_id)
- Identify the program event
 - Unit which shows the program event (such as drama, sport, etc)
 - Identify the program event by event id
 - (original_network_id/TS_id/service_id/event_id)

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SI table and its functions(1)

Tables specified based on DVB-SI

table_id	table	function	pid
0x42 0x46	SDT (Service Description Table)	Transmits information related to organized channel such as organized channel name and broadcasting company name.	0x0011
0x4A	BAT (Bouquet Association Table)	Instructs information related to bouquet (set of organized channels) such as names of bouquet and included organized channels.	0x0011
0x4E~ 0x6F	EIT (Event Information Table)	Instructs information related to program such as program name, broadcasting date, and explanation of contents.	0x0012 0x0026, 0x0027
0x71	RST (Running Status Table)	Instructs program running status	0x0013
0x70	TDT (Time Date Table)	Instructs present date and time	0x0014
0x73	TOT (Time Offset Table)	Instructs present date and time, and designation of time difference between present time and indication time for humans.	0x0014
0x72	ST (Stuffing Table)	Make table invalid	

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Table and its functions(2)

ARIB specified originally

table_id	table	functions	pid
0xC2	PCAT (Partial Content Announcement**)	Partial content announcement in data broadcasting	0x0022
0xC4	BIT (Broadcaster Information**)	Designates unit of broadcaster and SI transmission parameter of each broadcaster unit.	0x0024

ARIB specified originally (for program index)

table_id	table	functions	pid
0xD0	LIT (Local Event Information**)	Instructs information related to local event such as discrimination (time), name and explanation of local event (scene etc.) in the program.	0x0020
0xD1	ERT (Event Relation Table)	Indicates relationship between programs or local events, such as groups and attributes of programs and local events.	0x0021
0xD2	ITT (Index Transmission Table)	Describes information related to program index when sending the program.	

(note) NBIT and LDT are only used for communication satellite(CS) broadcasting, therefore, skip in this seminar

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Descriptors used for SI table

Descriptors used in SI table are listed in Table 6-1 of Part 2 of ARIB STD-B10.

Operational guideline of PSI/SI for digital terrestrial TV broadcasting(DTTV) in Japan

ARIB TR-B14 section 4

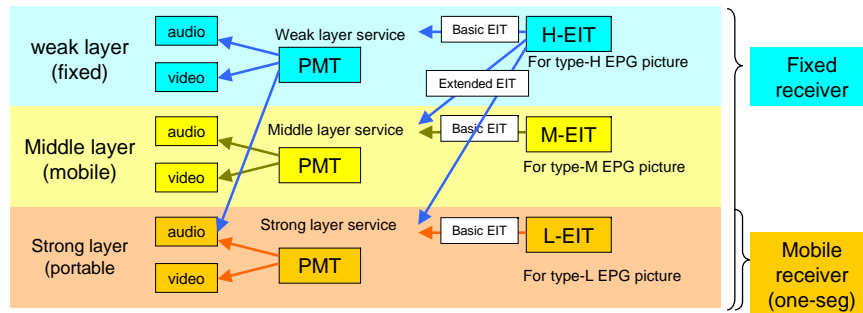
Digital terrestrial TV broadcasting Features of operation

- Hierarchical transmission
 - Possible to transmit maximally 3 layers
 - H-EIT/M-EIT/L-EIT
 - Basic EIT/expanded EIT
- Transmit original station SI
 - Transmit the SI of own station(own network)
 - Receiver gathers the SI of all received stations
 - background
 - Received station depend on received area
 - Many stations compare to BS (in Japan, NHK+ more than 100 stations)
- Network ID is assigned to each station

Network ID assignment and NIT guideline

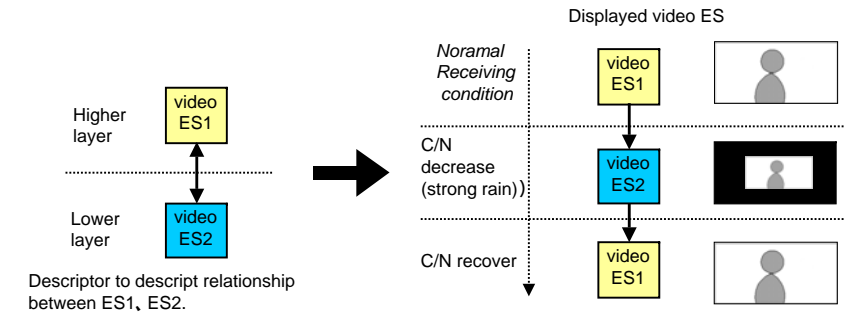
- BS digital broadcasting
 - One network ID for all BS digital broadcasting
 - The information for all station is written in NIT
- Digital Terrestrial broadcasting
 - Each station has its original network
 - Several kinds of service area (wide area/ prefecture area/ fringe area, etc)
 - ↓
 - Each station has its original network ID (relay stations are included in same network)
 - Only its original station information is written in NIT

Digital terrestrial TV broadcasting Hierarchical transmission and PSI/SI



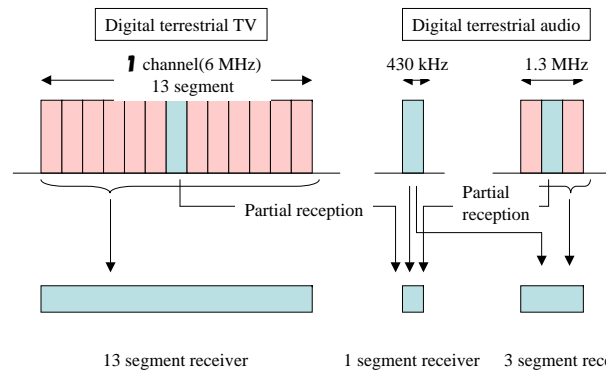
Hierarchical transmission In case of satellite Broadcasting

- Hierarchical transmission
 - For BS transmission, hierarchical transmission system is prepared. In case of strong rain fall, switched to lower layer in which the same program is sent. For this process, it is possible to see same program continuously
- Hierarchical transmission descriptor (PMT)
 - By making use of this descriptor, designate the relation between components which are transmitted by different layer



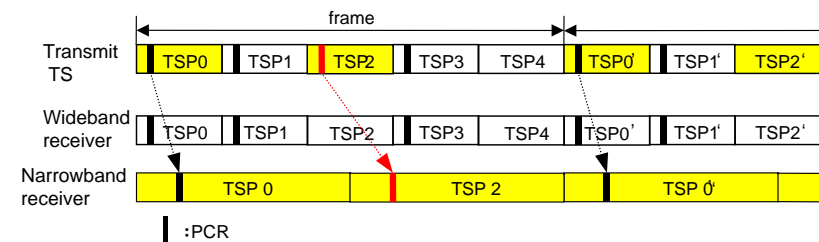
Segment structure and Partial reception

- Partial reception (one-seg) service
 - In TV band, 1 segment service is available with fixed reception service
- Partial reception descriptor (NIT)
 - Designate the situation to receive one-seg by this description



partial reception and PCR

- Fix the position of TSPs which include PCR
 - as a result, it is possible to receive one-seg service by narrow band receiver with low clock rate (details are shown separately)



Digital terrestrial TV broadcasting
PSI/SI used for DTTB and transmission layer

table_id	table	Transmission guideline	PID transmitted
0x00	PAT	◎(strong layer)	0x0000
0x01	CAT	○(strong layer)	0x0001
0x02	PMT	◎(each service layer)	Indirectly assigned by PAT
0x40	NIT[actual]	◎(strong layer)	0x0010
0x41	NIT[other]	×	
0x42	SDT[actual]	◎(strong layer)	0x0011
0x46	SDT[other]	×	
0x73	TOT	◎(strong layer)	0x0014
0xC4	BIT	◎(strong layer)	0x0024
0x4E	EIT[p/f actual]	◎(strong layer)	0x0012 (fixed)
0x4F	EIT[p/f other]	×	0x0026 (mobile)
0x50~0x57	EIT[schedule actual basic]	◎(fixed)/ × (others)	0x0027 (portable)
0x58~0x5F	EIT[schedule actual extended]	○(fixed)/ × (others)	
0x60~0x67	EIT[schedule other basic]	×	
0x68~0x6F	EIT[schedule other extended]	×	

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END of Seminar #5

Thank you for your attention

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