Seminar 8

Outline of Coding/Datacasting/Multiplexing system for ISDB-T in Japan

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Digital Broadcasting Expert Group (DiBEG)

Japan

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(Toshiba)

Preface

Coding/Datacasting/Multiplexing system is one of important technology in digital broadcasting system.

For coding/multiplexing, based on MPEG-2 technology and integrated unique parts and make up as broadcasting standard,

For datacasting, two standard have been issued, ARIB STD-B23 and ARIB STD-B24, but B-24 is in service, which is based on BML(customized for Broadcasting use).

The technical standard and operational guideline have been standardized in ARIB, and adopted to Japanese digital terrestrial broadcasting service/ hardware.

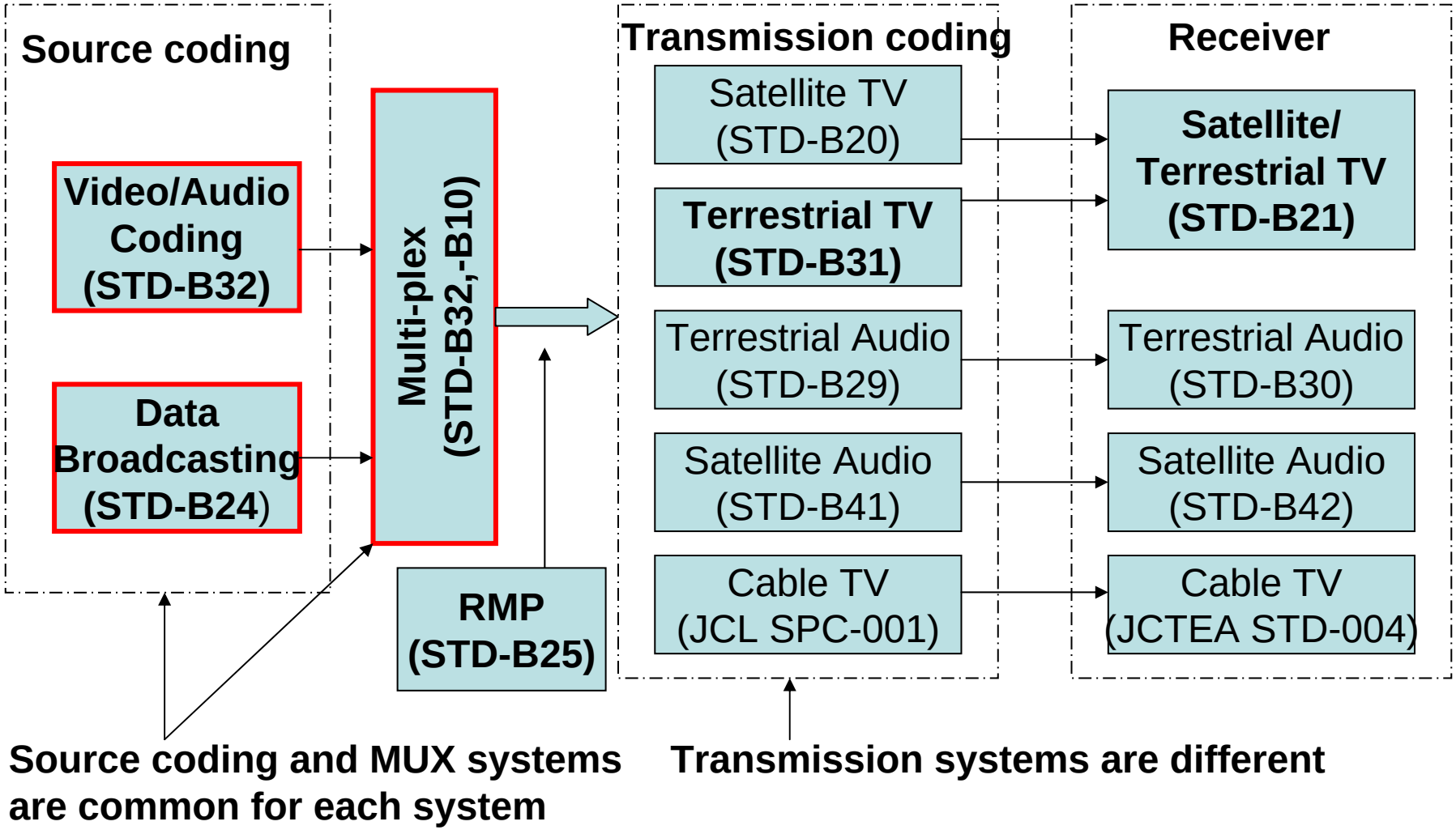
Unfortunately, not enough time to explain for details.

Therefore, in this seminar, only show you the outline and relationship between Broadcaster's studio system.

Note: Brazil adopts MPEG-4/H.264 for Video coding system,
So, in this seminar, we call "ISDB-T in Japan"

Contents

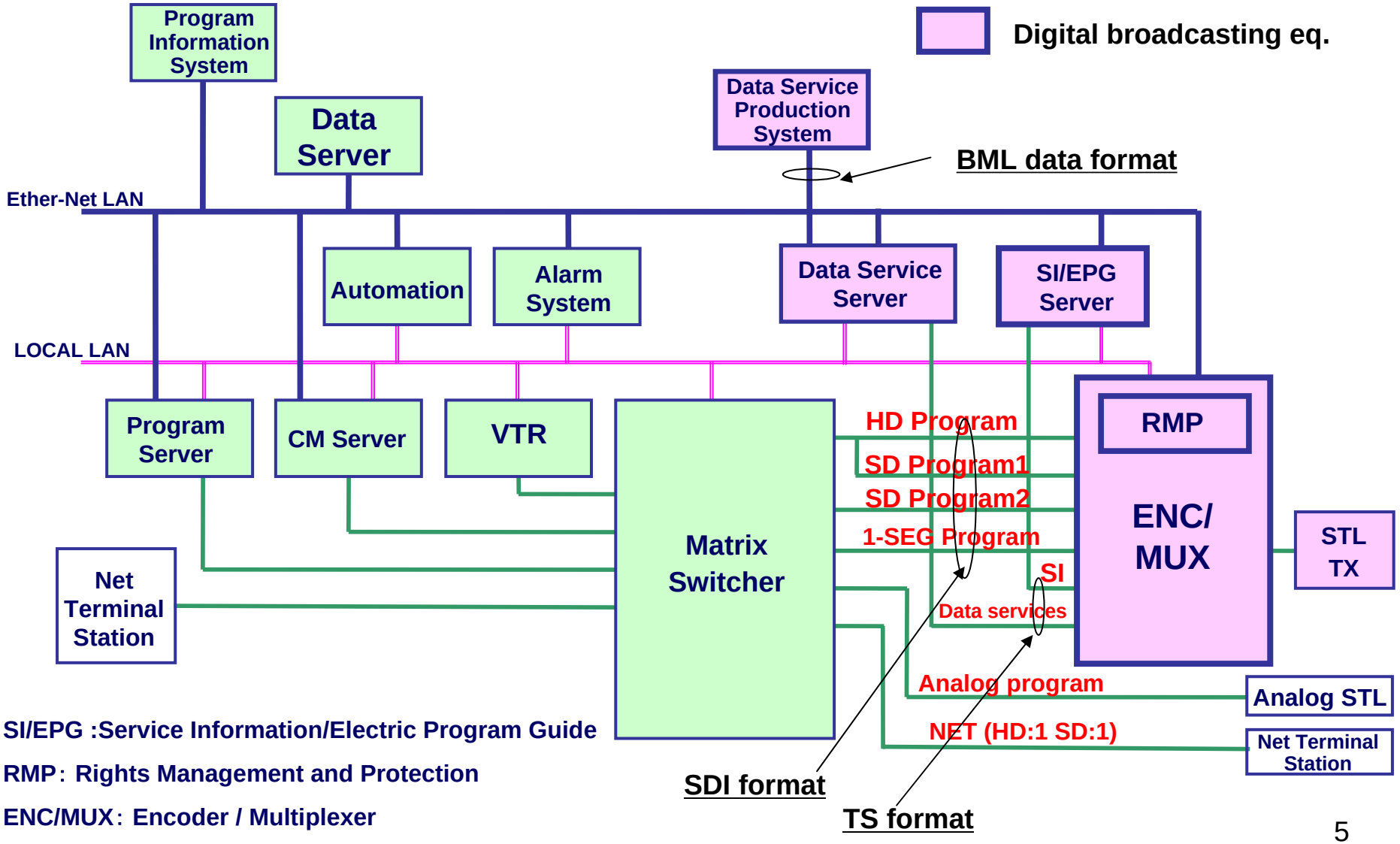
1. Structure of Standards of ISDB-T in Japan



Note: Cable transmission system standards are defined at another consortium

Reference only

An example of overall Block Diagram of DTTB studio system



SI/EPG :Service Information/Electric Program Guide

RMP: Rights Management and Protection

ENC/MUX: Encoder / Multiplexer

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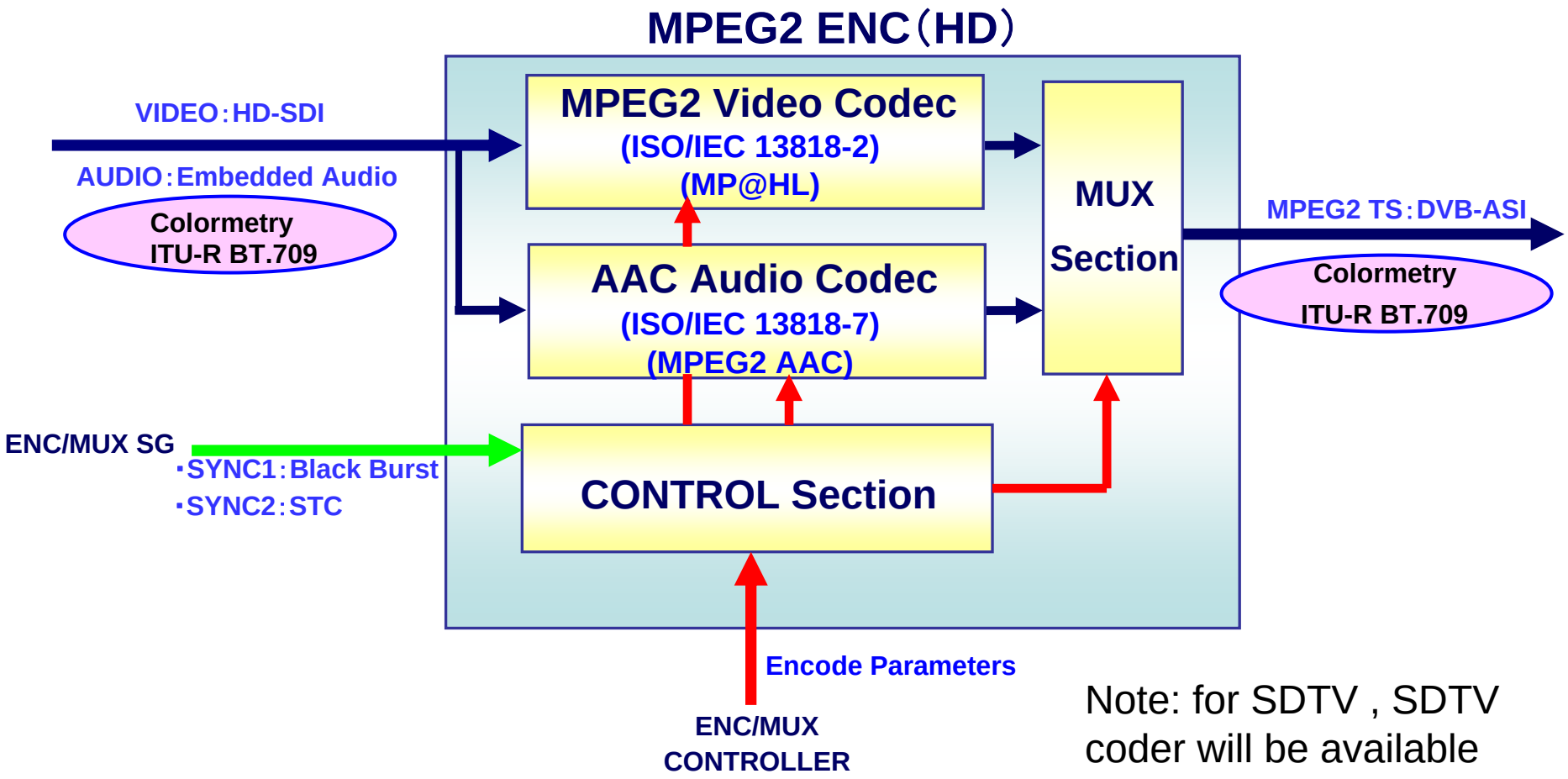
2. Coding System

Reference only

An example of Video/Audio encoder of Japanese ISDB-T



Note: for SDTV , SDTV coder will be available

2.1 Video Coding System

(ARIB STD B-32 Part 1)

In Japan, HDTV had been developed since 1980's, and analog HDTV trial service, named MUSE, has already started. Because of this situation, video coding system for DTV should support many video format and has capability of video format change according to display aspect ratio.

because of above reasons, specifications of video coding should have following features

(1) Video coding system; adopt most popular system MPEG2

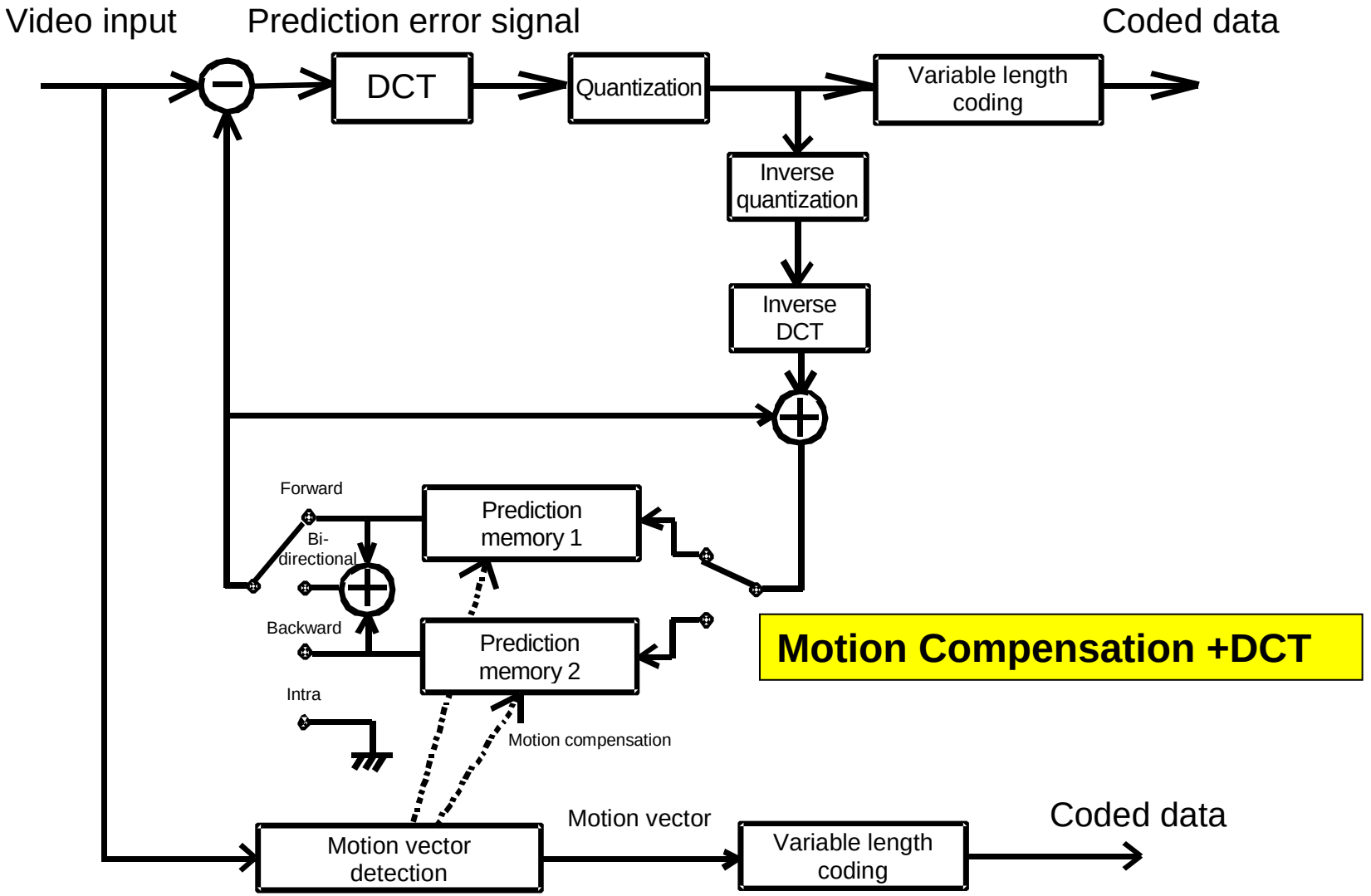
(2) Support many types of video format; 480i/480p/1080i/720p

(3) Specify the relationship of video source and display aspect ratio

Video coding system is specified in ARIB STD-B32 Part 1(note)

(note) Video coding system for LDTV is specified in ARIB STD-B24 separately

Video compression, coding block diagram



(ARIB STD-B32 Part 1, chapter 4.1)

Video signal parameters

Number of lines		525	525	750	1125
Number of active lines		483	483	720	1080
Scanning system		Interlaced	Progressive	Progressive	Interlaced
Frame frequency		30/1.001 Hz	60/1.001 Hz	60/1.001 Hz	30/1.001 Hz
Field frequency		60/1.001 Hz			60/1.001 Hz
Aspect ratio		16 : 9 or 4 : 3	16 : 9	16:9	16 : 9
Line frequency f_H		15.750/ 1.001kHz	31.500/ 1.001 kHz	45.000/ 1.001 kHz	33.750/ 1.001 kHz
Sampling frequency	Luminance signal	13.5 MHz	27 MHz	74.25/1.001MHz	74.25/1.001MHz
	Color-difference signals	6.75 MHz	13.5 MHz	37.125/ 1.001MHz	37.125/ 1.001MHz
Numbers of samples per line	Luminance signal	858	858	1650	2200
	Color-difference signals	429	429	825	1100
Number of samples per active line	Luminance signal	720	720	1280	1920
	Color-difference signals	360	360	640	960
Filter characteristics		See Fig. 1	See Fig. 2	See Fig. 3	
Line synchronizing signal		See Fig. 4		See Fig. 5	See Fig. 6
Field synchronizing signal		See Fig. 7	See Fig. 8	See Fig. 9	See Fig. 10

(ARIB STD-B32 Part 1, chapter 2.4)

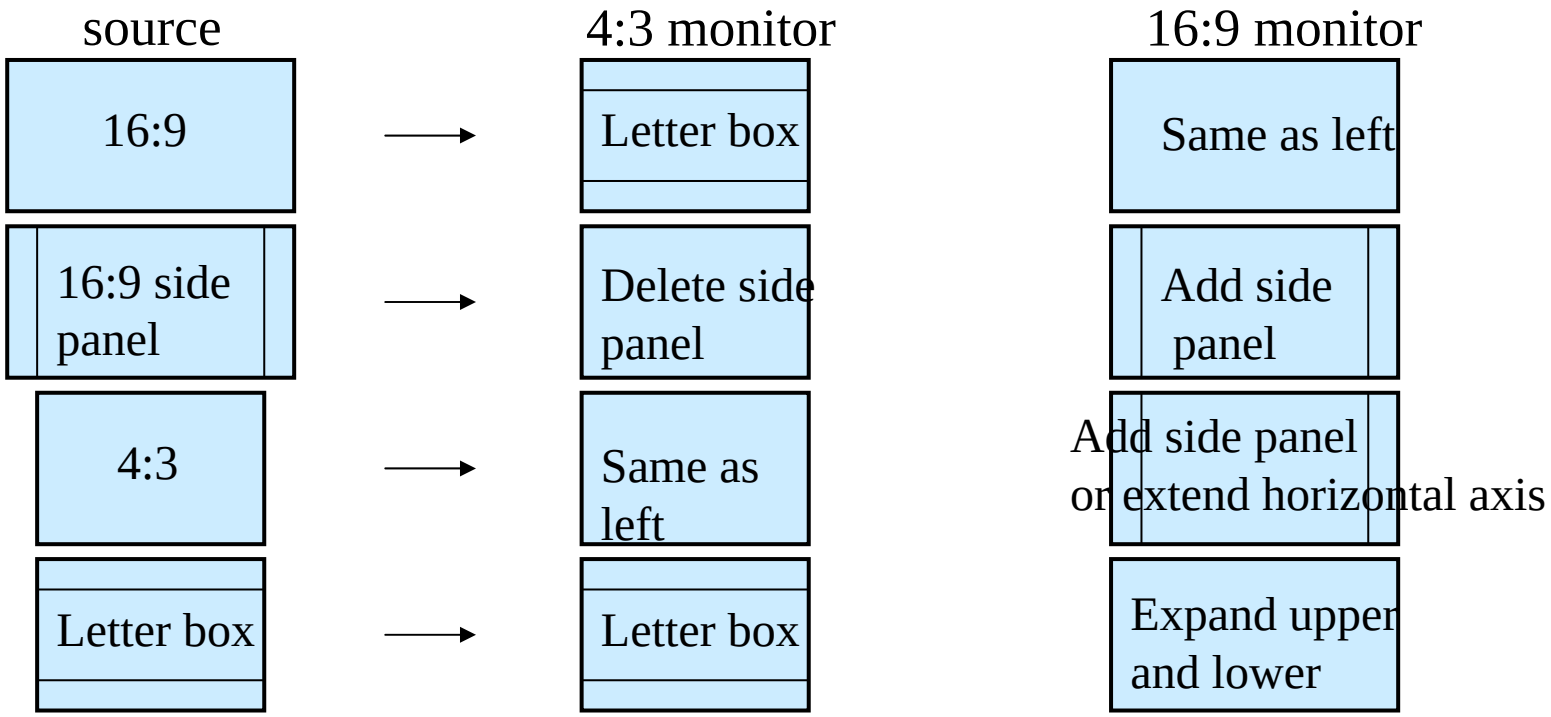
Note:
Low Definition TV(LDTV) coding system is defined in ARIB STD-B24 separately

（Reference） Actual video bit rate

No. of line	profile	actual bit rate
1080i	MP@HL	BS:12-24Mbps DTTB:8-20Mbps
720p	MP@HL	
480p	MP@H-14	BS:4-24Mbps DTTB：4-20Mbps
480i	720*480	1.5-15Mbps
240p	720*480	0.2-4Mbps

Video decoding processing in TV receiver

Decode HL, H14, ML, LL of MPEG-2 main profile. The output format is either of 1125i, 750p, 525p, 525i format.



2.2 Audio Coding System

(ARIB STD B-32 Part 2)

(a) Audio Input Format

Parameter	Restriction
Audio mode Possible audio modes	Monaural, stereo, multichannel stereo (3/0, 2/1, 3/1, 2/2, 3/2, 3/2+LFE) (Note 1), 2-audio signals (dual monaural), multi-audio (3 or more audio signals) and combinations of the above
Recommended audio mode	Monaural, stereo, multichannel stereo (3/1, 3/2, 3/2+LFE) (Note 2), 2-audio signals (dual monaural)
Emphasis	None

(Note 1) Number of channels to front/rear speakers:	Example:3/1 = 3 front + 1 rear 3/2 = 3 front and 2 rear
(Note 2) LFE = Low frequency enhancement channel	

ARIB STD-B32 part 2 Chapter 5.1

(b) Main parameters of audio coding

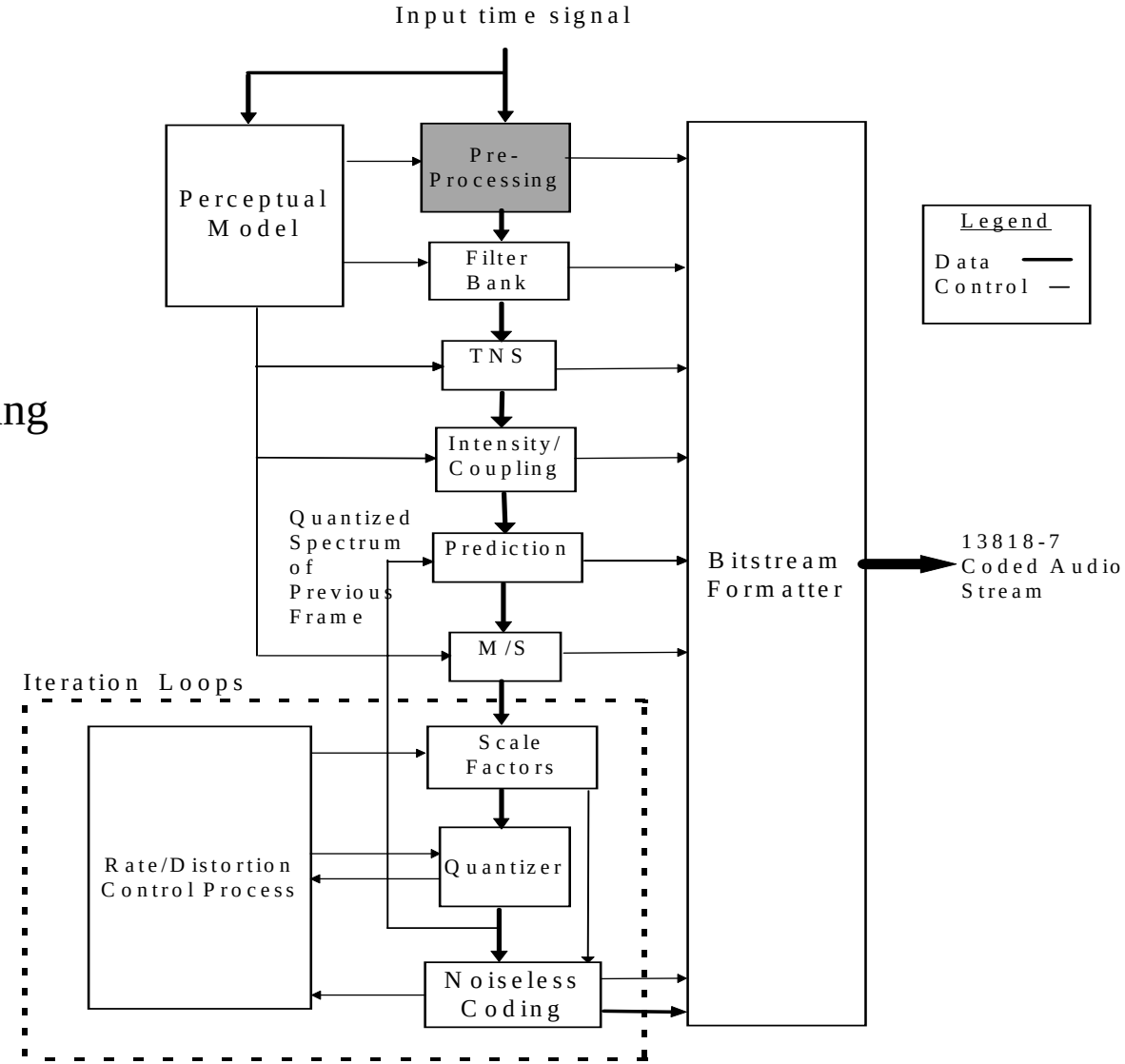
Parameter	Restriction
Bit stream format	AAC Audio Data Transport Stream (ADTS)
Profile	Low Complexity (LC) profile
Max. number of coded channels	5.1 channels(Note) max. per ADTS
Max. bit rate	As per ISO/IEC 13818-7

(Note) 5 channels + LFE channel

ARIB STD-B32 part 2 Chapter 5.2

AAC encoder Block Diagram

AAC: advanced audio coding



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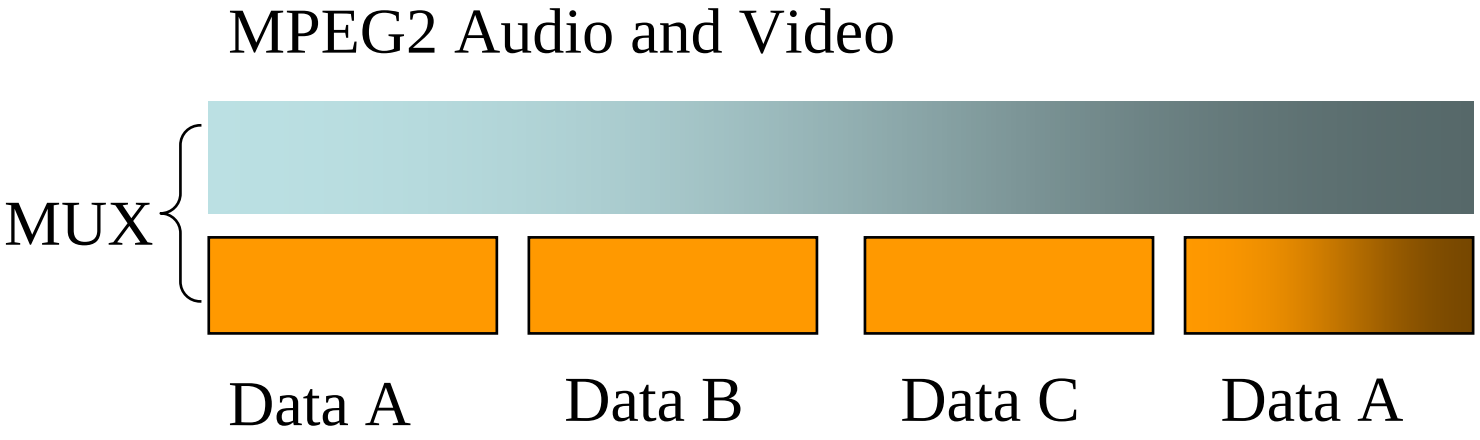
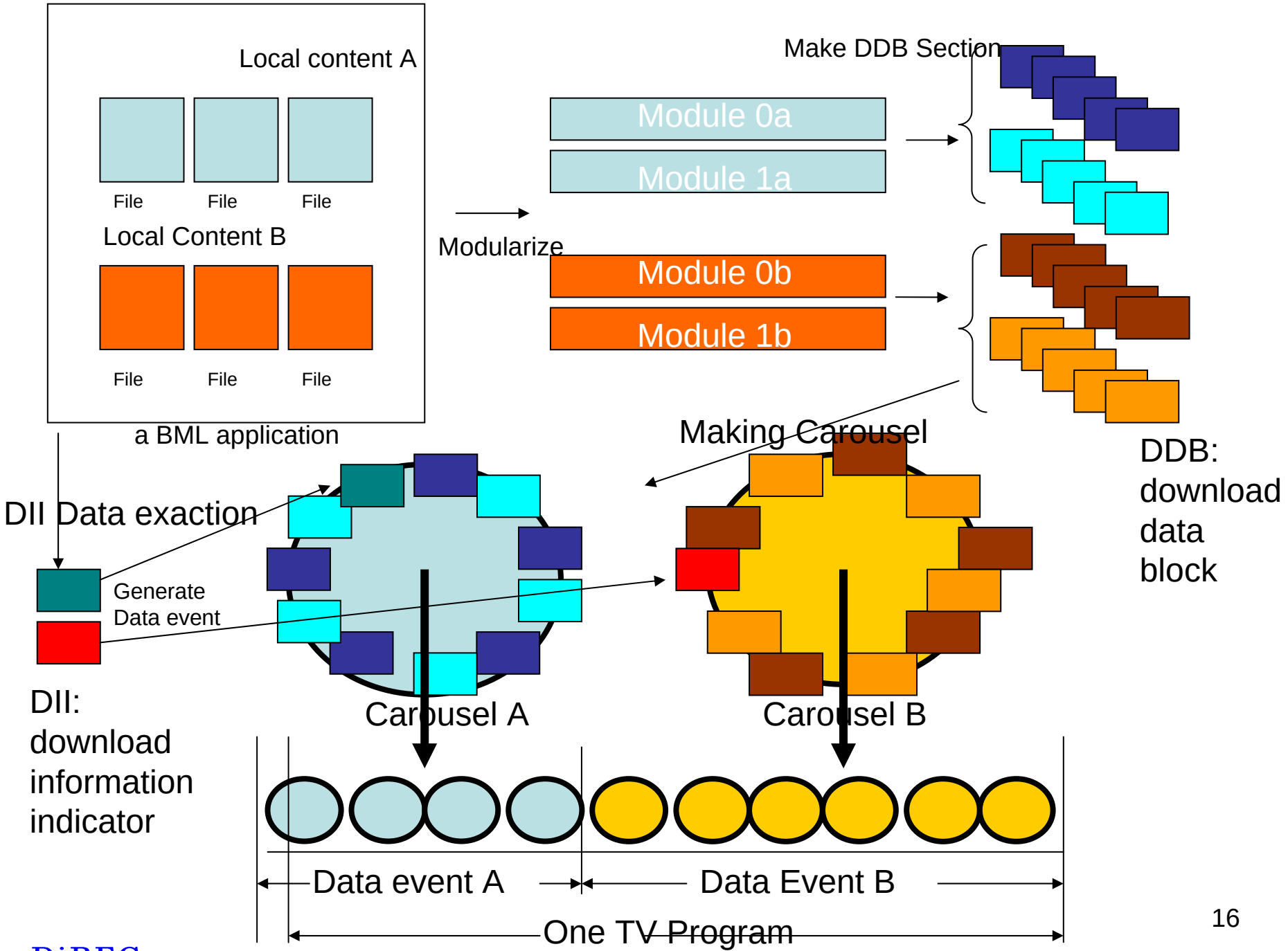
3. Data casting

(ARIB STD B-24 Part 2)

Data Composition



Each data broadcast as module repeatedly.
Same module will appear in some period.
(MPEG / DSM-CC Data Carousel)



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Data Broadcasting

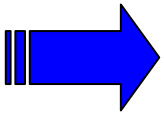
All DTTB Broadcasters and BS Broadcasters providing Data broadcasting (datacast) now

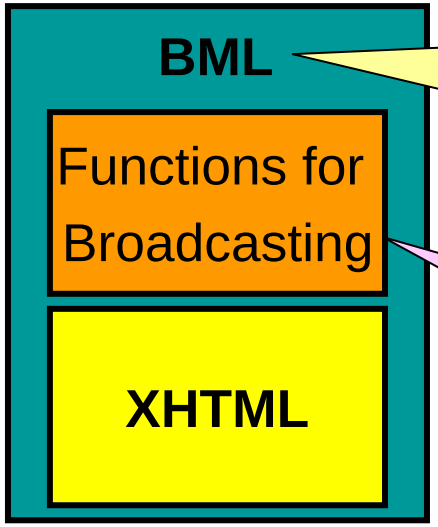
Program related information	Anytime news
Weather information	Report of sports game etc,

Currently the description language is BML format

Based on

XHTML





Features

Easy creation of contents

Facilitate convergence of internet

Additional capability

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Example for Datacasting(1)

Top menu

Example for Datacasting(2)

Weather news

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Example for Datacasting(3)

Program related data

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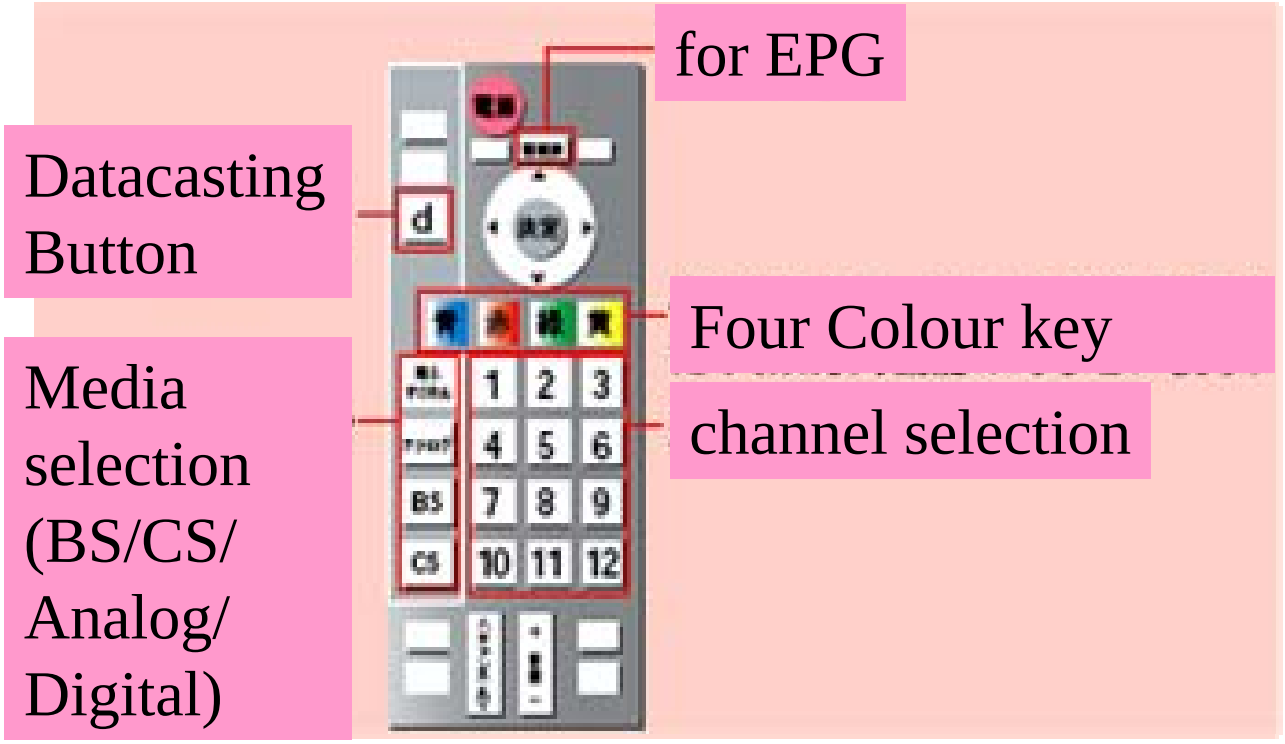
(Reference)

Remote Controller for Datacasting

- Colour key and Arrow Key (four directional)
- Datacasting Trigger Button
- Back key (for interactive application)



ARIB STD-B24

- B24 consist of three volumes (four books)
  - Volume 1: Mono media
  - Volume 2 (book1/book2): BML
  - Volume 3: Transmission
- Volume 2 consist of six parts
  - Main context (Standard)
  - Appendix 1 (Supplement of standard)
  - Appendix 2 (Basic profile)
  - Appendix 3 (Advanced profile)
  - Appendix 4 (Profile for Mobile phone)
  - Appendix 5 (Profile for Vehicle)

Overview of datacasting services

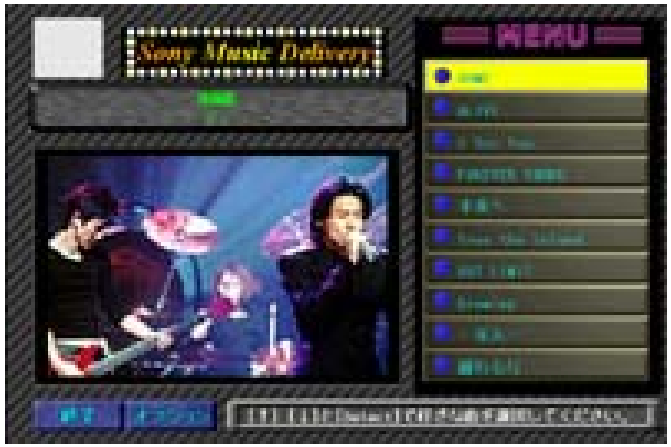
See STD B24 Vol.1 Informative explanation 1

- Example of services
  - EPG：TV Program selection
  - Index: Choice of TV program, contents
  - Subtitle: Synopsis subtitle, multi-language
  - Commentary audio: for vision-impaired
  - Program supplemental information: Additional information of TV Program (ex. brief)
  - Multi-view television (Multi angle)
  - User interaction program: Shopping, Questionnaire

BML

- Multimedia data representation coding scheme for Digital broadcasting
  - Specified in XML
  - Textual notation
  - Extension for broadcasting feature
- XHTML1.0 + ECMAScript + CSS1/2 + DOM1+ Broadcast Extension
  - All component defined by W3C, which is main stream for the internet content specification.
  - difference between broadcast content and internet content
    - bi-directional communication
    - hardware platform (CE vs PC)

Difference between BML and HTML

	BML	HTML
Sample	 Suitable operation for TV	
Feature	• **Few hyperlinks per one screen** • **Intuitive providing information by using bitmap and video** • **Scroll is optional** • **Update latest information automatically** • **Synchronize between TV and Radio program**	• **Many hyperlinks in one screen** • **Text centric information providing by small letter presentation** • **Suppose to scroll functionality** • **Need to push “reload” button for retrieving latest information generally**

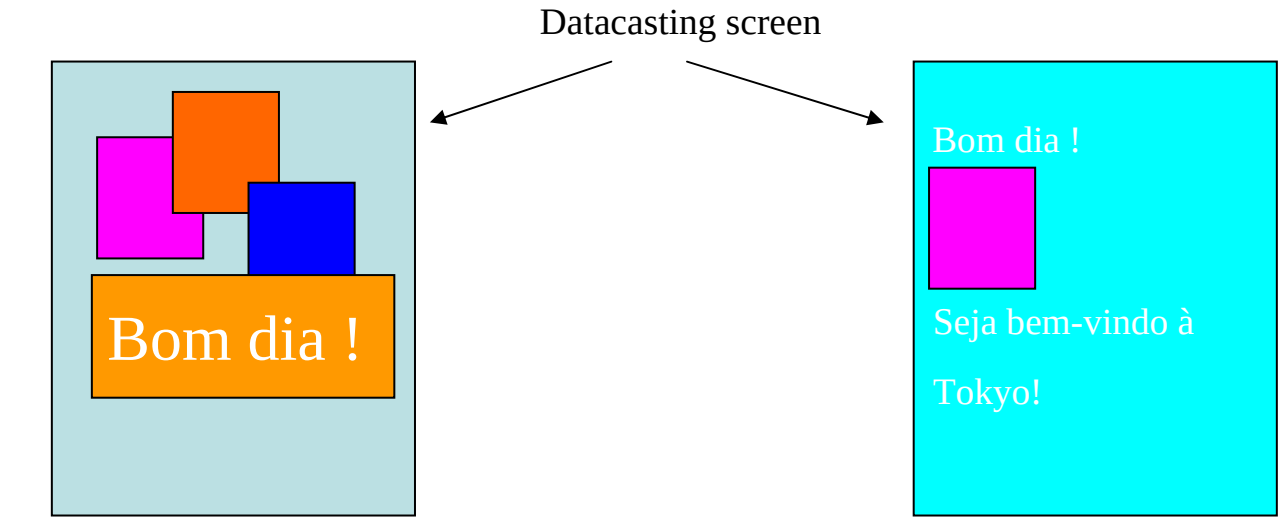
Difference between BML and HTML (cont.)

	BML	HTML
Use case	• **Viewing distance: 1～3m** • **Focus display: Focus of Hotspot** • **Input device: Remote controller with colour key**	• **Viewing distance: 30～50cm** • **Focus display: Free cursor** • **Input device: Wheel mouse + keyboard or Touch panel + keyboard**

Functionality	• Synchronization with TV program (bevent)
	• Accessibility of Set top box (Script API)
	  • NVRAM, Tuner, device ID, etc.
	• Absolute positioning with CSS
	  • Fix display place at reading BML doc
	• Multiple plane model including blending between planes
		• No Sync. Mechanism (cf. SMIL)
		• Accessibility of STB by plug-in module
		• Relative positioning by brawser
		  • Display place may change by context
		  • position can change dynamically
		• Single plane model basis, no transparent colour

Difference between BML and HTML (cont.)

BML	HTML



Only absolute positioning is permitted.

Layout are decided by browser dynamically

4. Video Coding for “One-seg” Service

(ARIB STD B-24 Volume 1, Part 2)

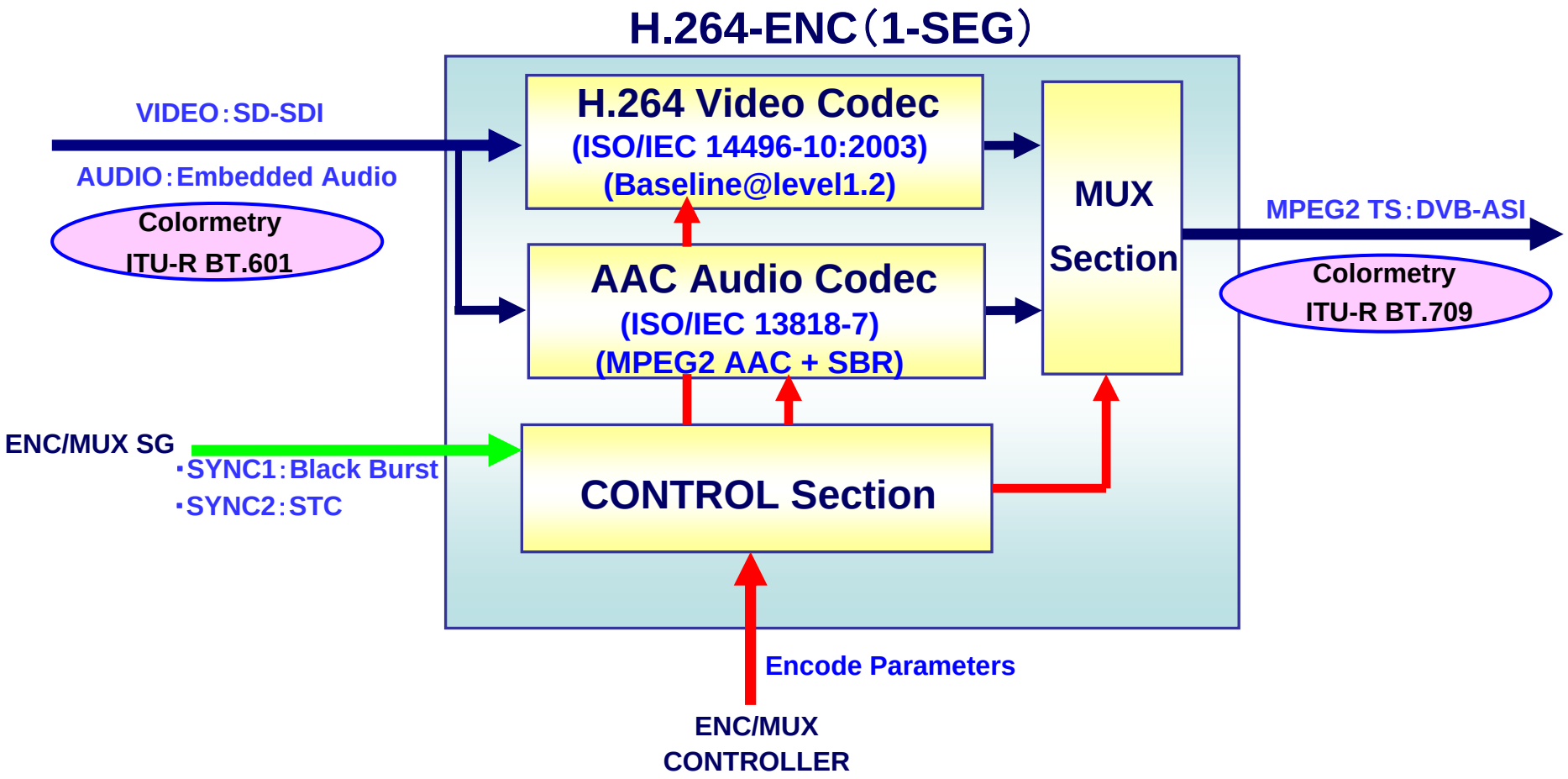
- Video coding system; H.264/AVC(ITU-T Rec. H264|ISO/IEC 14496-10)

- Specified in ARIB-STD-B24, as one of Mono-media coding system

- Specified in Operational Guideline(TR-B14), as Video coding system for “One Seg” service

Reference only

An example of Video/Audio encoder of Japanese ISDB-T for One segment service



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EXAMPLE

Recommended Operational Guideline for Baseline Profile **(ARIB STD-B24 ANNEX G)**

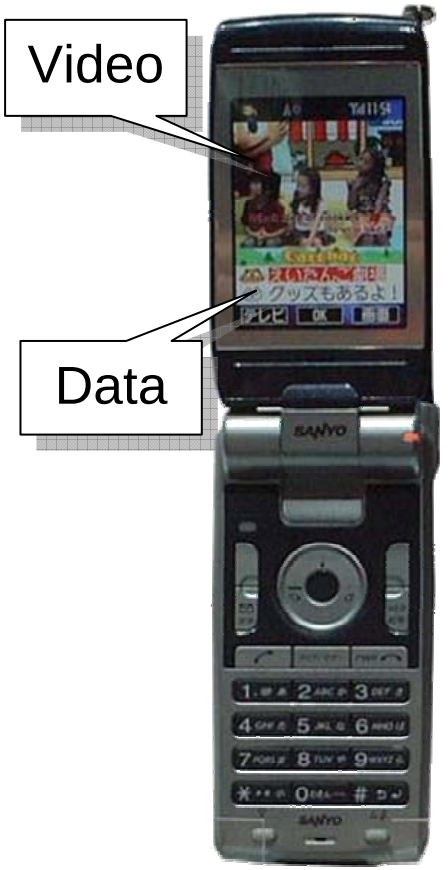
- Associated service requirement
  - **(1) Bitrate ; 64 – 384 Kbps**
  - **(2) Video format; SQVGA, 525QSIF, QCIF, QVGA, 525SIF, CIF**
  - **(3) Frame rate; 5,10, 12, 15, 24, 30 Hz (*1000/1001), no limitation for frame skip**
  - **(4) Aspect ratio of picture; 4:3, 16:9**
- **Operation level; any of level 1, 1.1, 1.2**

Parameter set of One-Seg broadcasting service

One Seg Service video coding parameter set

parameter	Specification
Coding system	**H264/AVC**
Profile/level	**Baseline profile, level 1.2**
Video format	**•320 Pixel * 240 line, or** **320 pixel * 180 line** **•Aspect ration of pixel; 1:1** **•Minimum frame period; 1/15 second (video source; 30fps, or 24 fps)**
others	**Compatible to ARIB STD-B24**

(specified in ARIB TR-B14)



5. Multiplexing/PSI/SI

Functions of Multiplexer (see next page)

1. Multiplex any Broadcast service of TS format (see next page)

   ⇒ Signal format and multiplexing are defined in ARIB STD-B32

   Kinds/contents of SI data are defined in ARIB STD-B10

   (note) all input data format should be TS format including datacasting and SI

2. Multiplex PSI data (see next page)

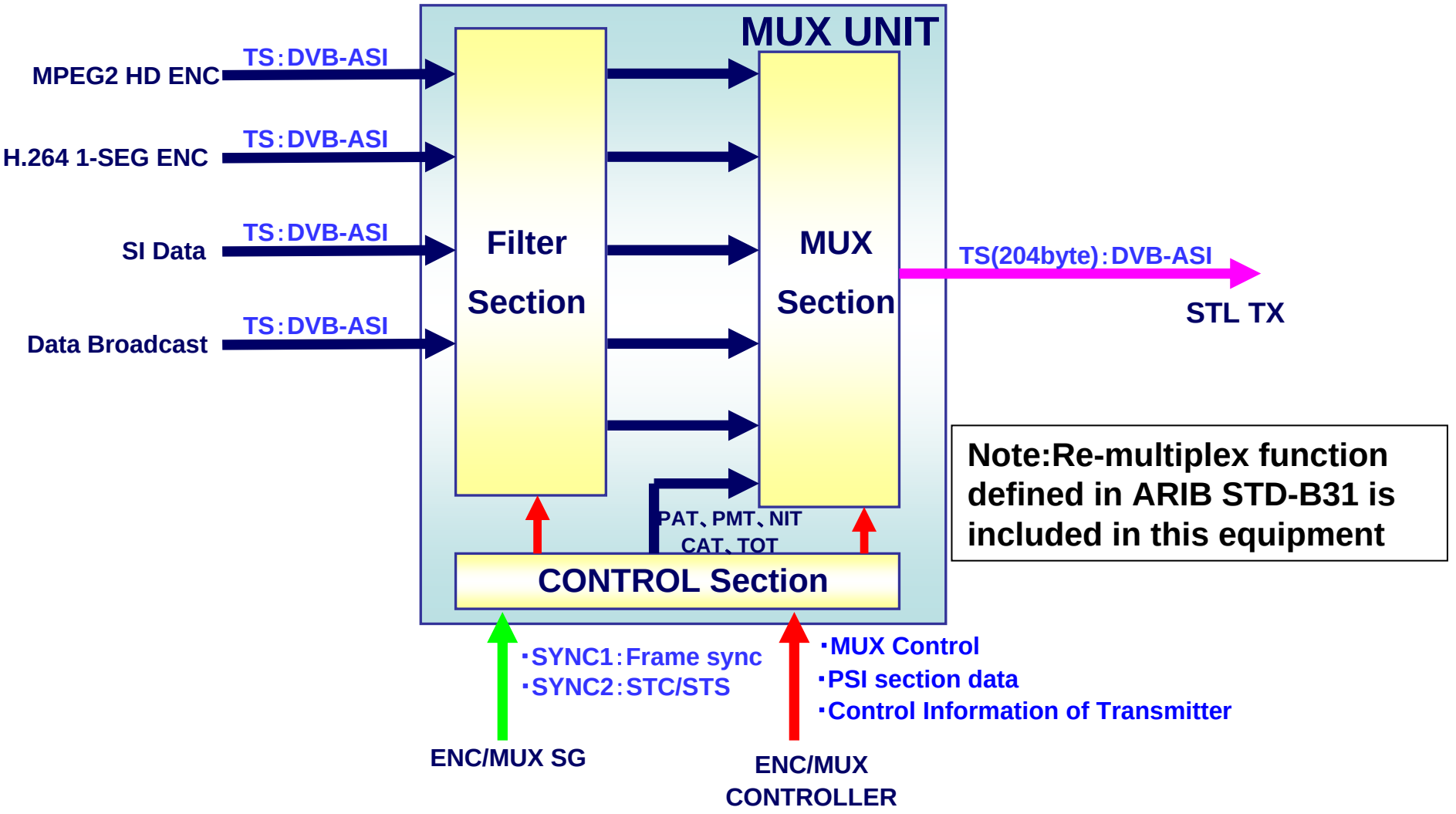
   ⇒ Kinds/contents of PSI are defined in ARIB STD-B10

3. Re-multiplexing to generate Broadcast TS signal(See next page)

   ⇒ Broadcast TS is defined in ARIB STD-B31

Reference only

An example of Multiplexer of Japanese ISDB-T



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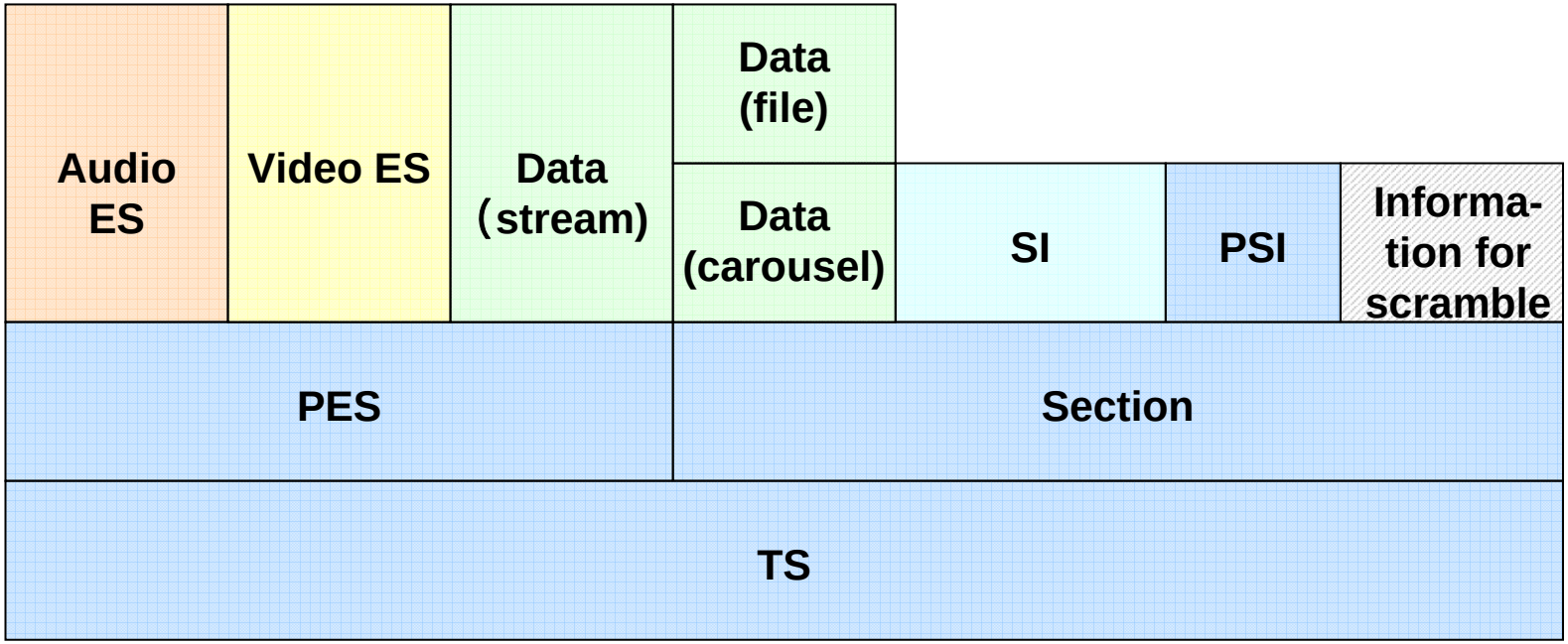
Digital broadcasting & Multiplex system

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

5.1 Multiplexing system

(ARIB STD B32, part 3)

- **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**

MPEG-2 Systems

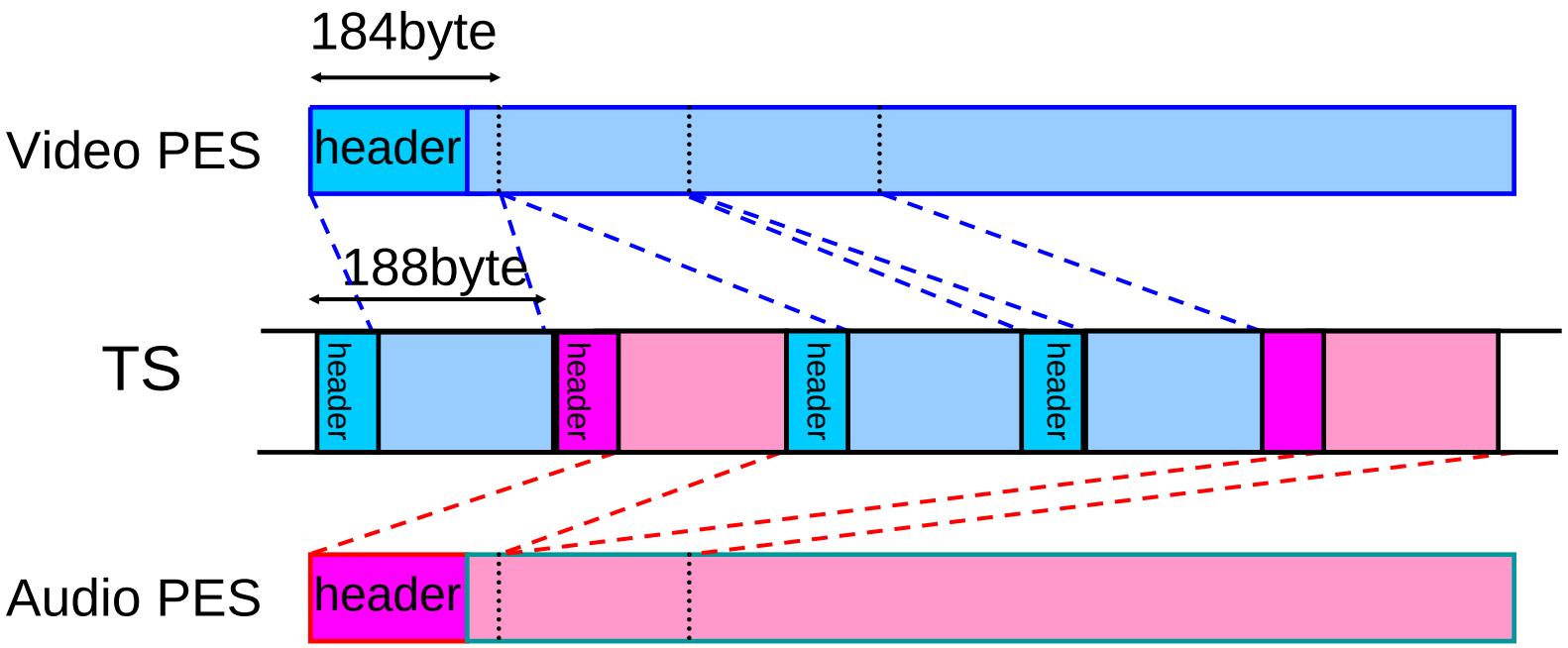
signal format before Multiplexing (ES,PES, section)

- 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

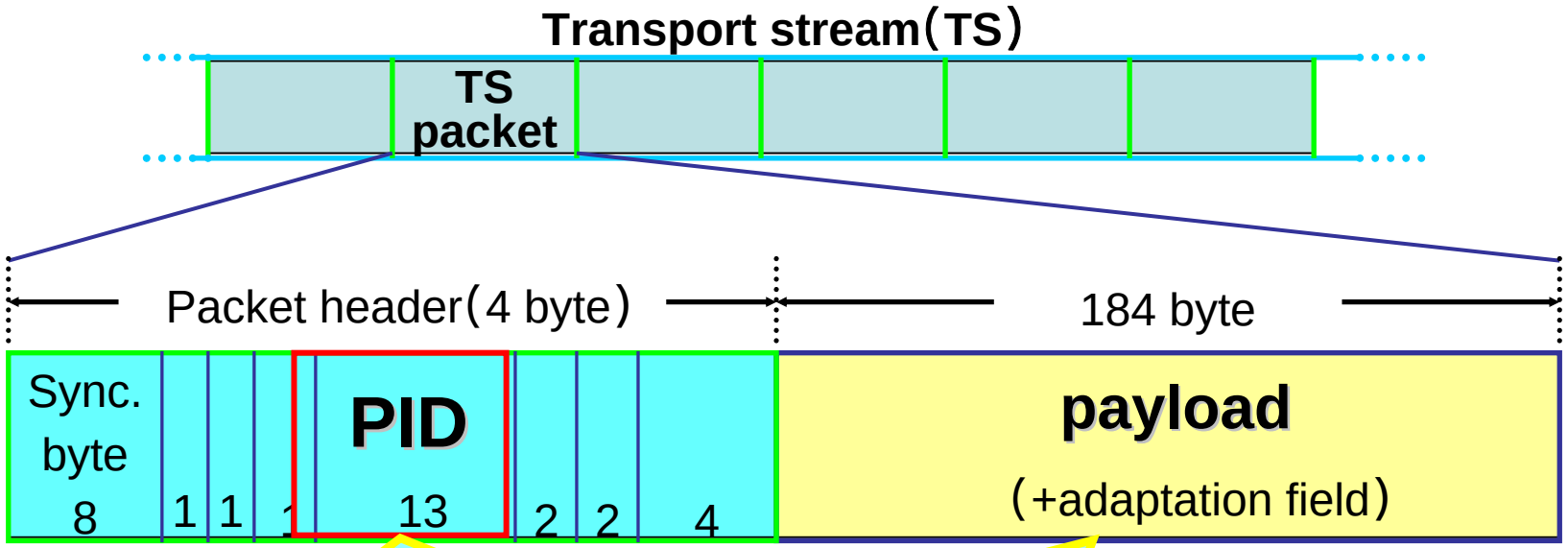
TS multiplexing method

(Example of Video/Audio Multiplexing)



MPEG-2 Systems

header and payload of TS packet

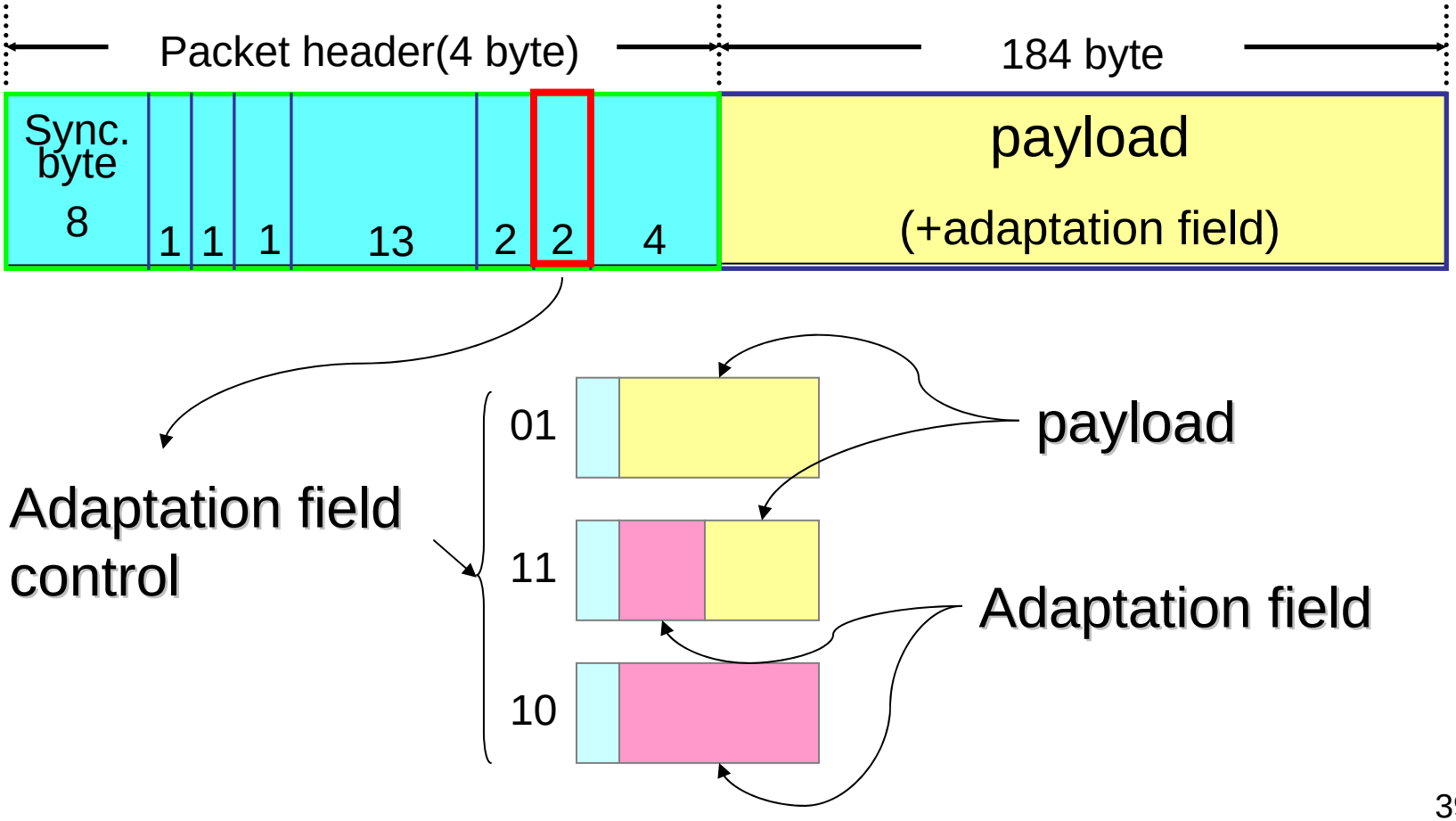


PID（packet identifier)

In payload,
・divided PES（video, audio,etc) or
・section data(PSI,SI,etc)
are stored

MPEG-2 Systems

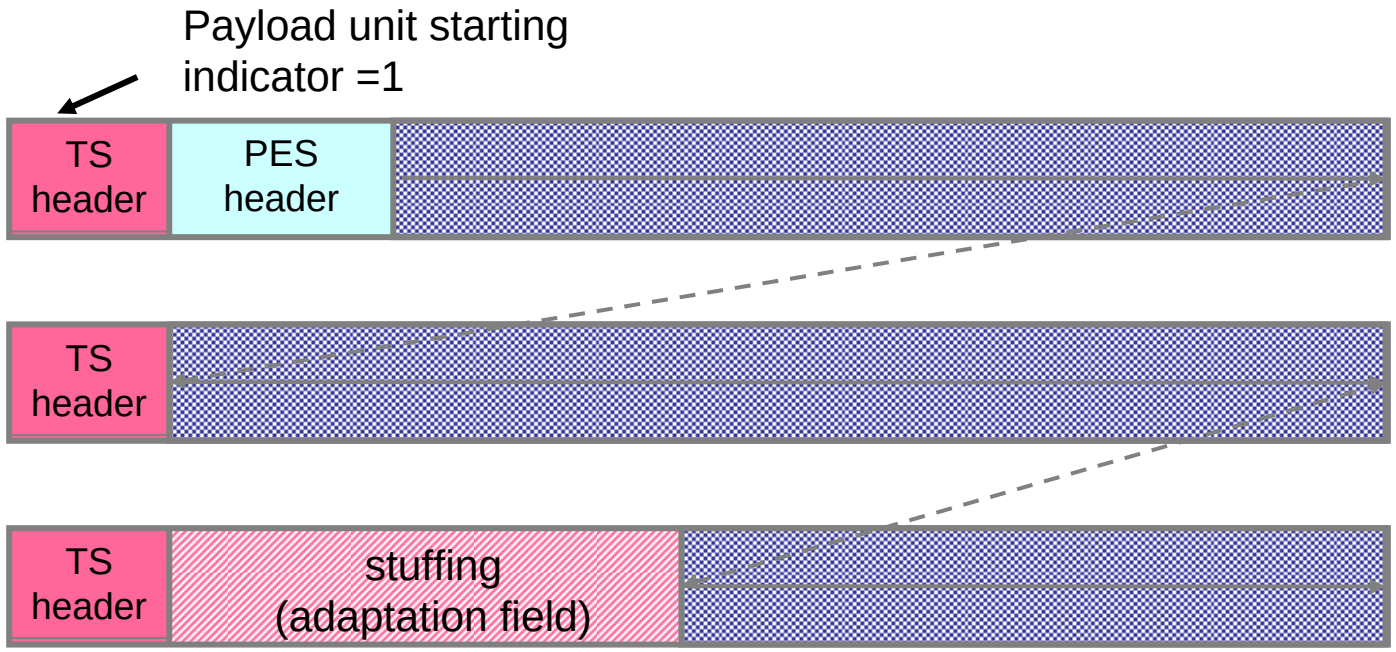
Payload area of TS packet



MPEG-2 Systems

Process to convert from PES to TS

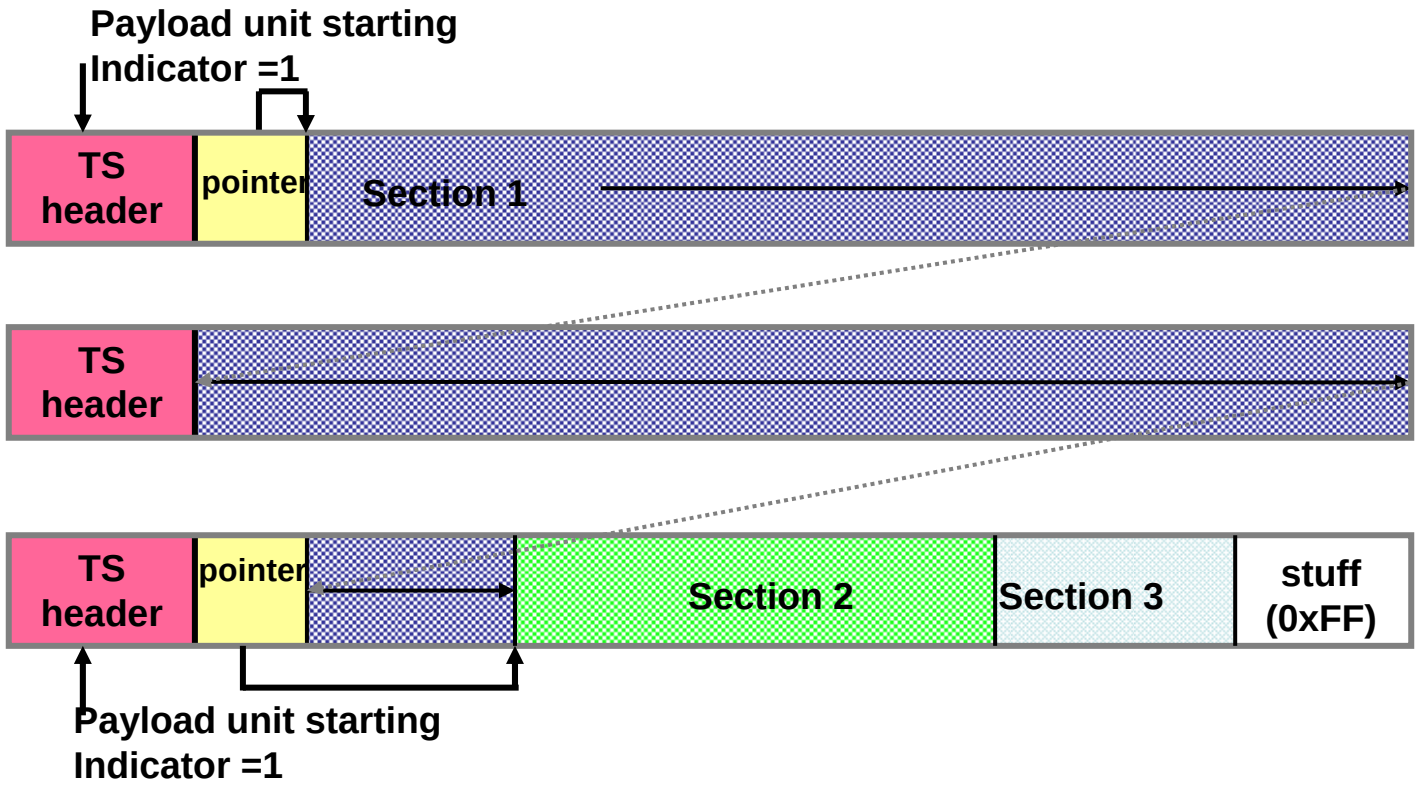
- Only one PES packet is divided into plural TS packets of same PID group
- Payload unit starting indicator “ON” ; start fist byte of PES
- In last TS packet,stuffing data is inserted to adjust the length of TS packet



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)



5.2 Transmission control（PSI）and service information（SI）

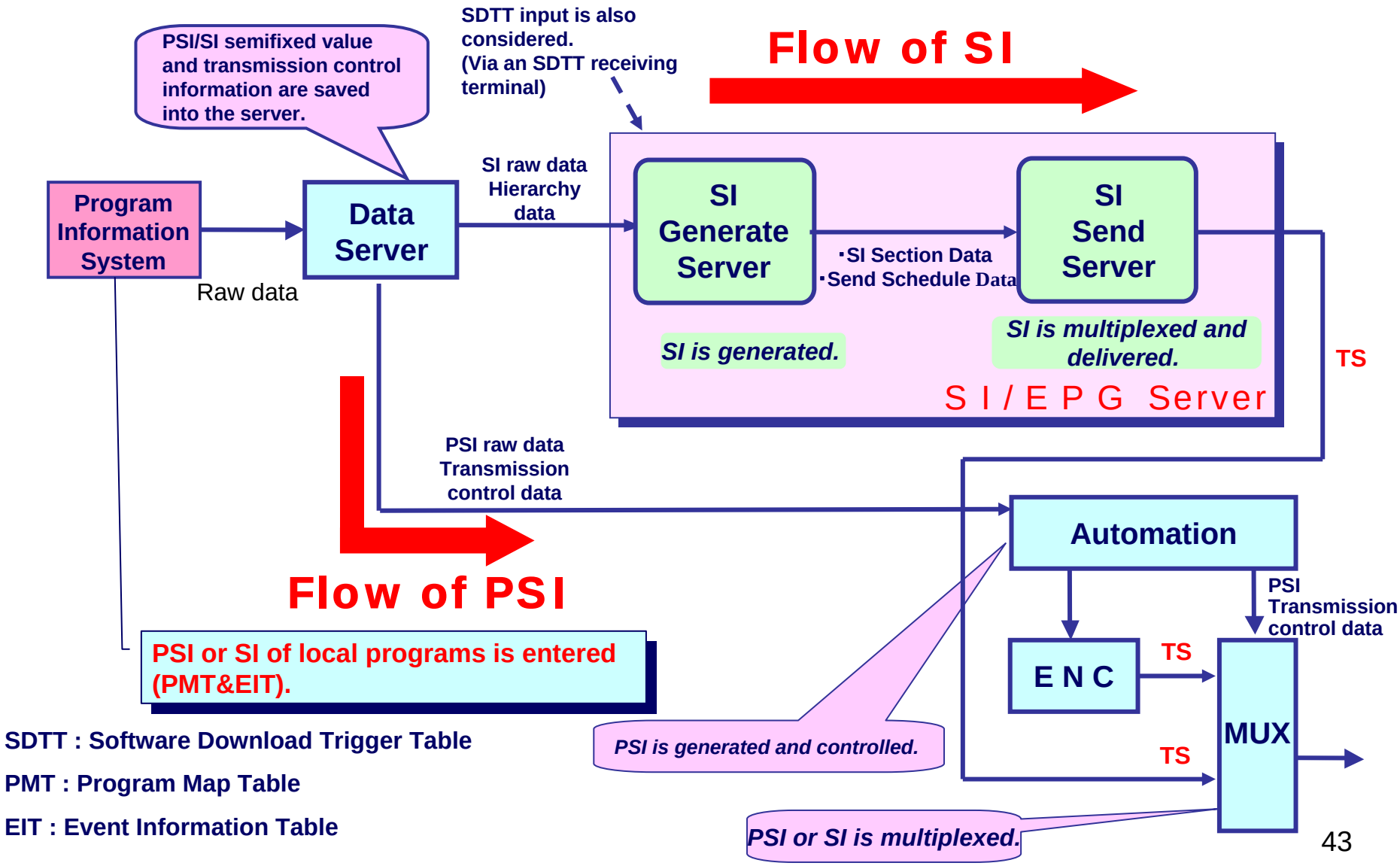
Specifications: **ARIB STD-B32 part 3**

ARIB STD-B10

Operational Guideline: ARIB TR-B14, Volume 4

Reference only

An example of PSI/SI Flow in Studio system



SDTT : Software Download Trigger Table

PMT : Program Map Table

EIT : Event Information Table

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PSI/SI

relationship between PSI and SI

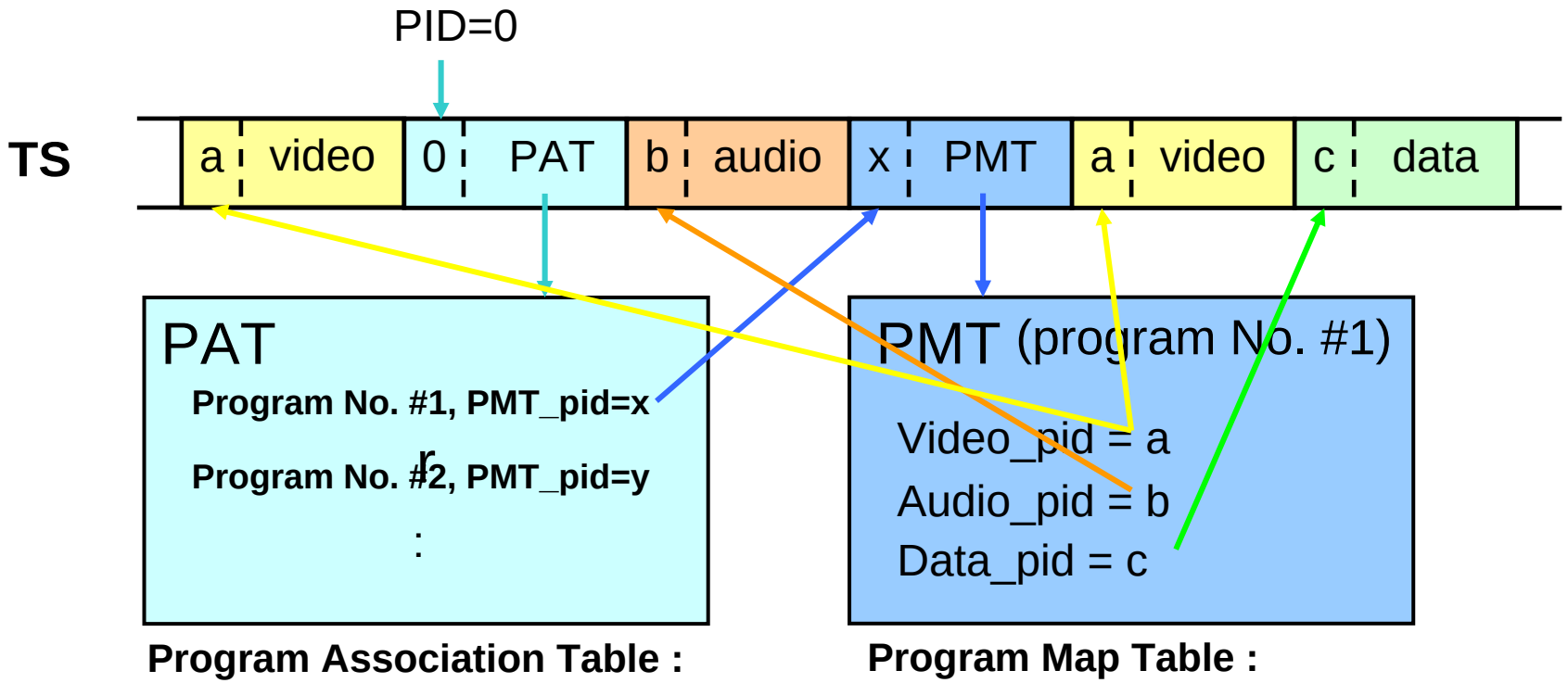
		PSI	SI
function		Signal selection from MPEG-2 TS	Support the program selection
	Support plural TS	Identify by TS_id only	yes（broadcasting for plural TS)
	Time schedule support	none	yes（program）
	Information format	table	table
	Signal format	section	section
	Transmission style	Transmit repeatedly	Transmit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

PSI → SI

Based on PSI, extend for broadcast service

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

  (note) for One-seg, PMT is fixed value
  - 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 the rule 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)

  (note) In digital terrestrial broadcasting, Only ECM is used for RMP.

PSI/SI

Table and section

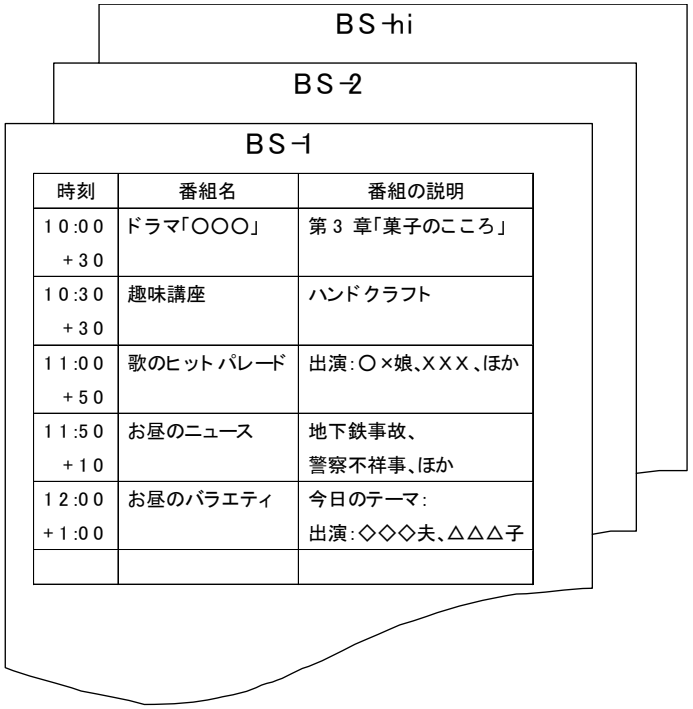
- Information of PSI/SI is called table
  - table
    - Whole information for specific function
    - Function of table is identified by table_id
    - A set of sub tables
  - Sub table
    - Information for specific matter in table
    - Table _id extension designates the kind of information

- 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

Function of SI

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

Image of EPG(Digital Satellite Broadcasting)



時刻	番組名	番組の説明
10:00 +30	ドラマ「○○○」	第３章「菓子のこころ」
10:30 +30	趣味講座	ハンドクラフト
11:00 +50	歌のヒットパレード	出演：○×娘、×××、ほか
11:50 +10	お昼のニュース	地下鉄事故、 警察不祥事、ほか
12:00 +1:00	お昼のバラエティ	今日のテーマ： 出演：◇◇◇夫、△△△子

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SI table and its functions(1)

(ARIB STD-B10, Part 1, Table 4-1)

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	

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

END of Seminar 8

Thank you for your attention