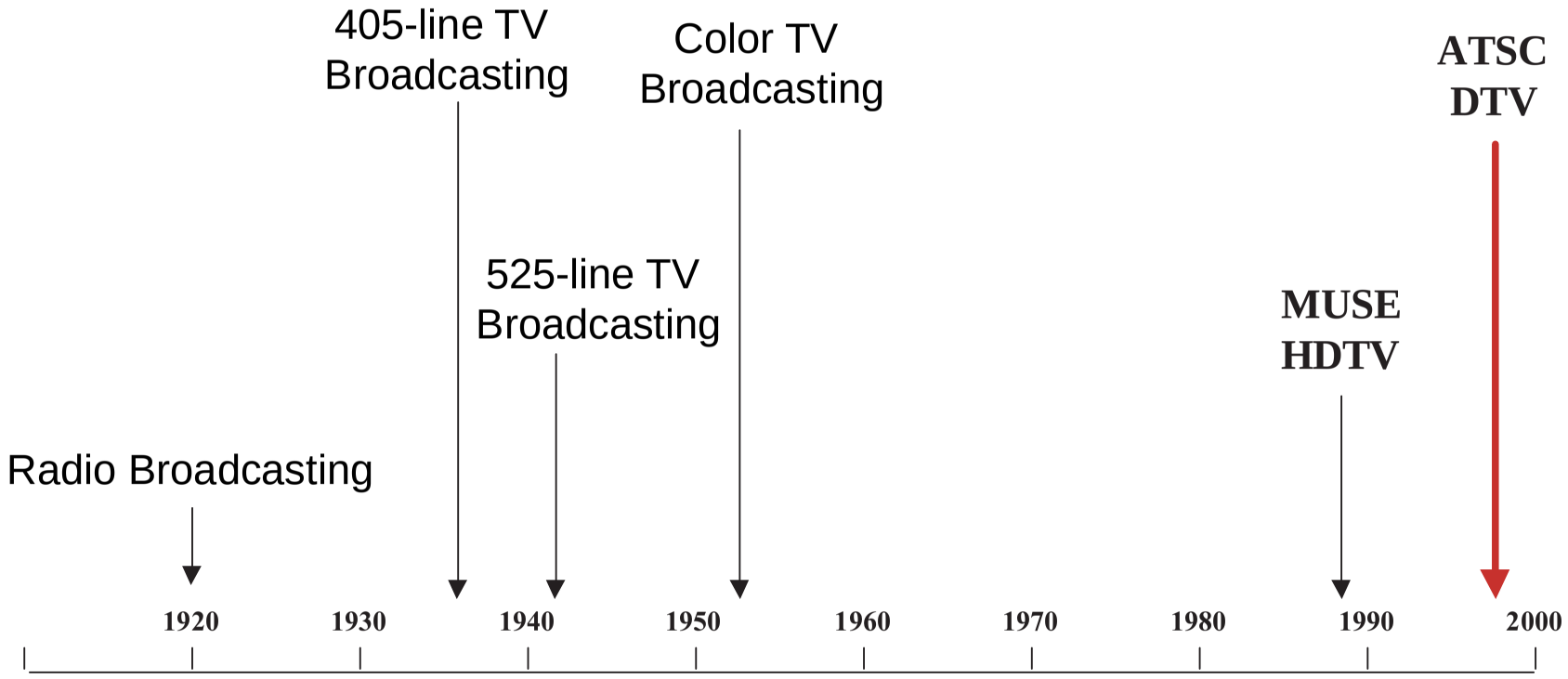
8. DIGITAL SYSTEM

Overview

Broadcasting Chronology



What Is Digital TV?

¥ Major Features of DTV

— High quality screen clarity 5 times greater than analog TV
— Strong noise immunity
— 5.1 channel high quality audio similar to CD
— Possible to transmit 4 to 6 existing pictures
— Additional services with data transmission

■ Derivative Effects of DTV

Viewer

¥ High quality broadcasting service
- High picture quality/High audio quality/Multi-channel

¥ Additional services
- Various interactive application services
- Possible to apply in PCTV, PC.

Broadcasting Provider and Industry

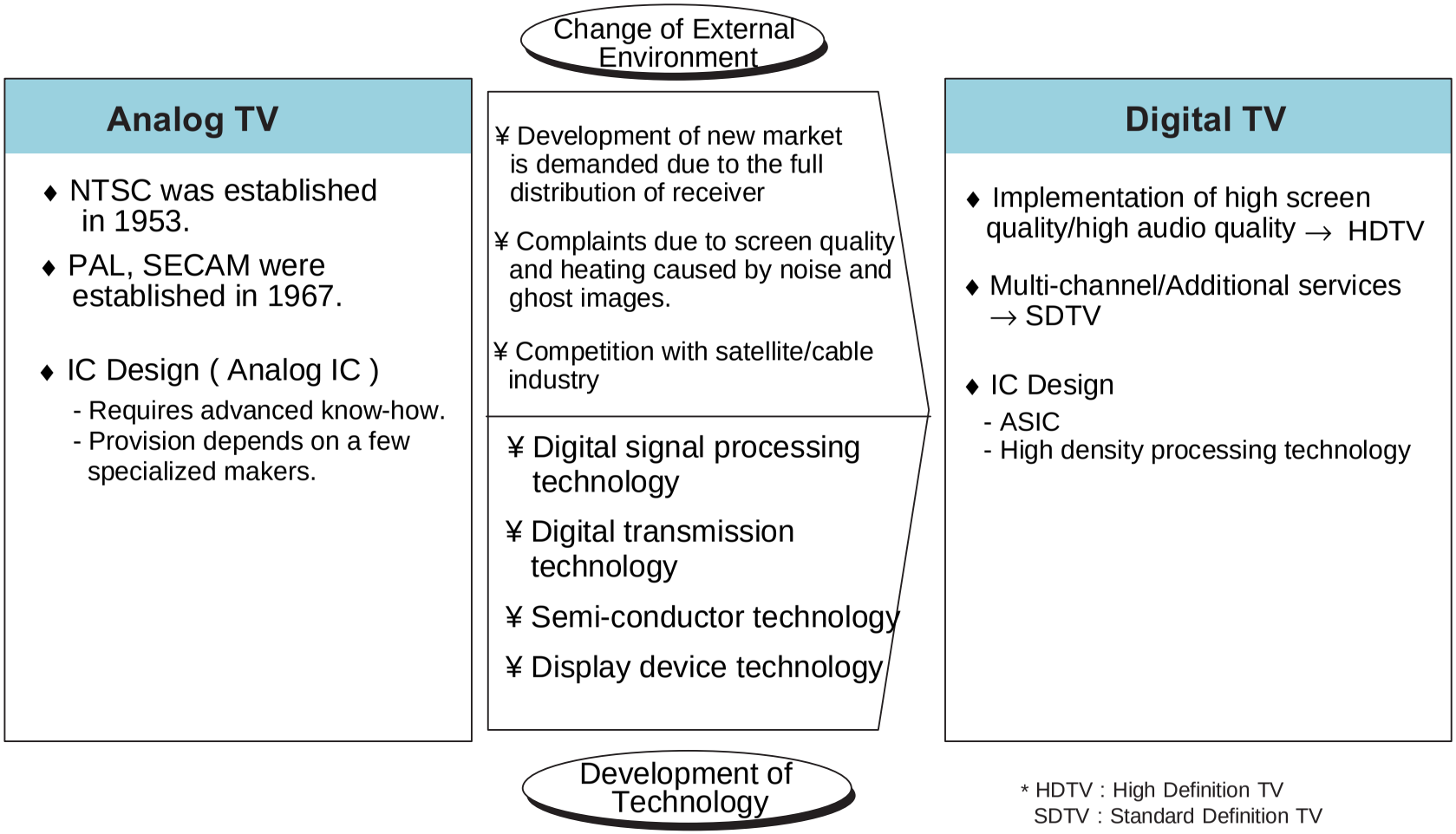
¥ Complex media industry
- Pay per view
- Multi-dimensional application of picture software

¥ Activation of electric and picture industries
- Creation of demand on DTV transmitter/ receiver
- Increase of program supply

National

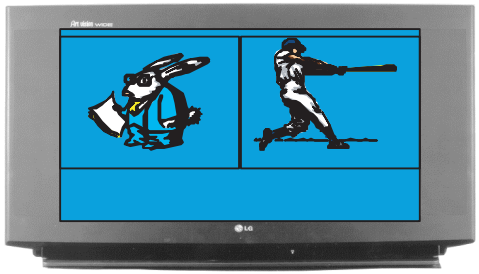
¥Effective utilization of analog frequencies
- Removal of lack of broadcasting channels
- Using as communication channels

Background of the Emergence of Digital TV



* HDTV : High Definition TV
SDTV : Standard Definition TV

Differences of Digital and Analog TVs

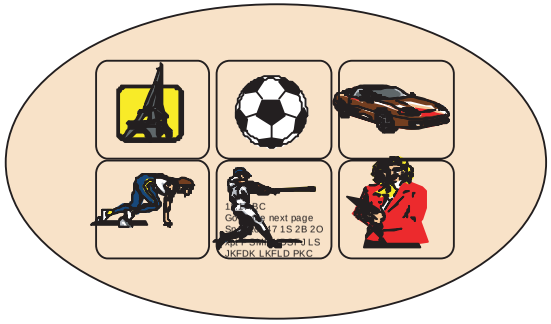


16:9
(Optional,
Defacto)

4:3

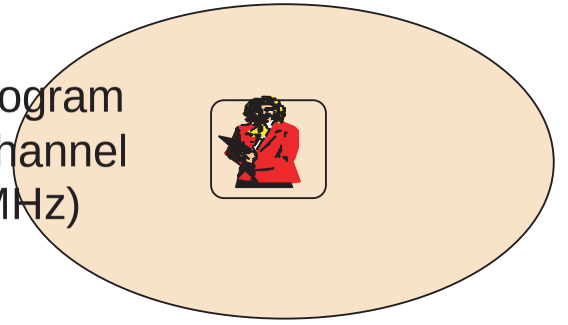
High
Resolution

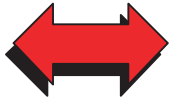
Low
Resolution



4~6 program
/ 1 channel
(6MHz)

1 program
/ 1 channel
(6MHz)





2-Way
Interactive

1-Way
point -to -multi

Viewing Aspect

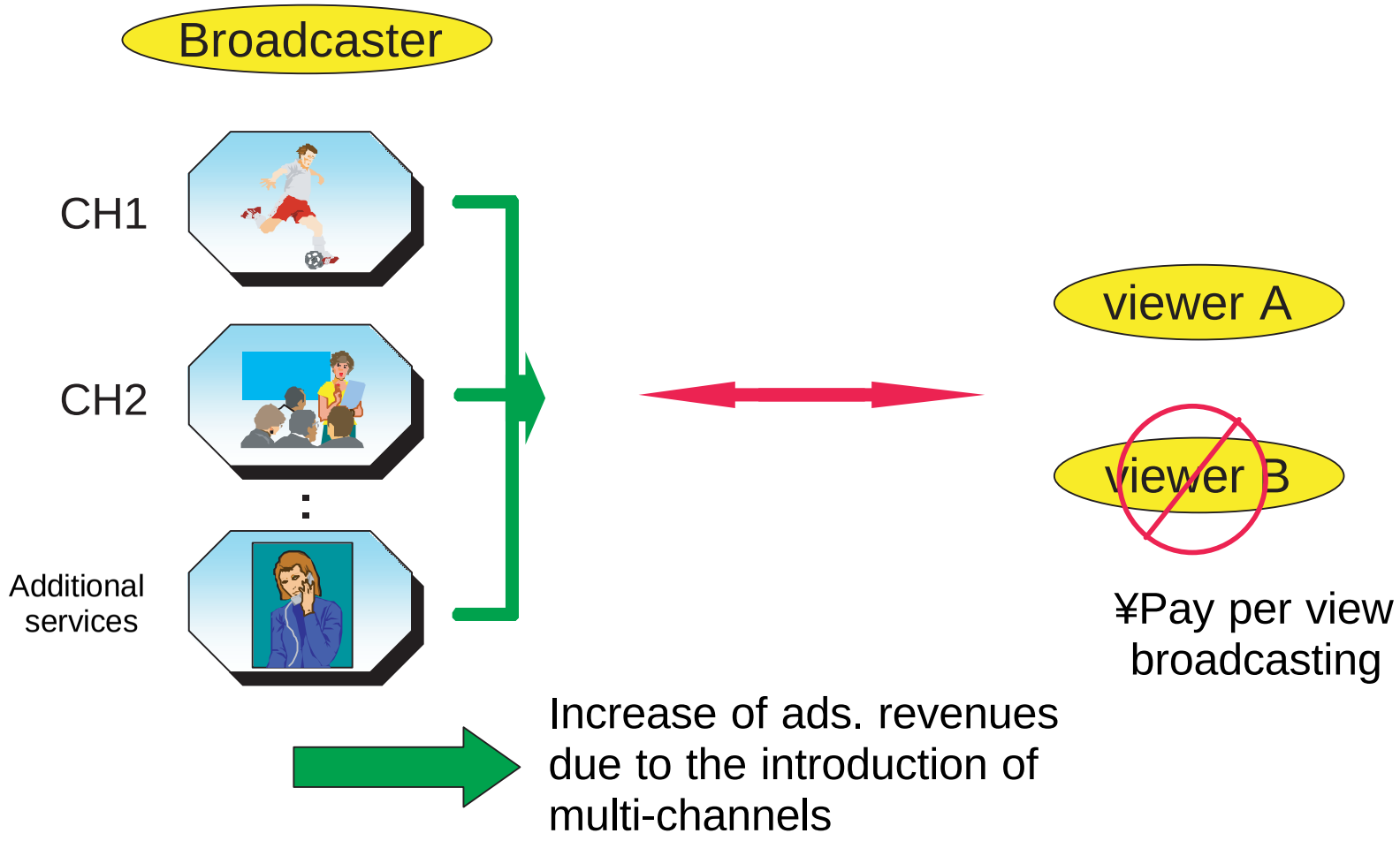
Analog NTSC

- Screen quality: 525 line
- Aspect ratio: 4:3
  - ¥ Audio quality: 2-channel (stereo)

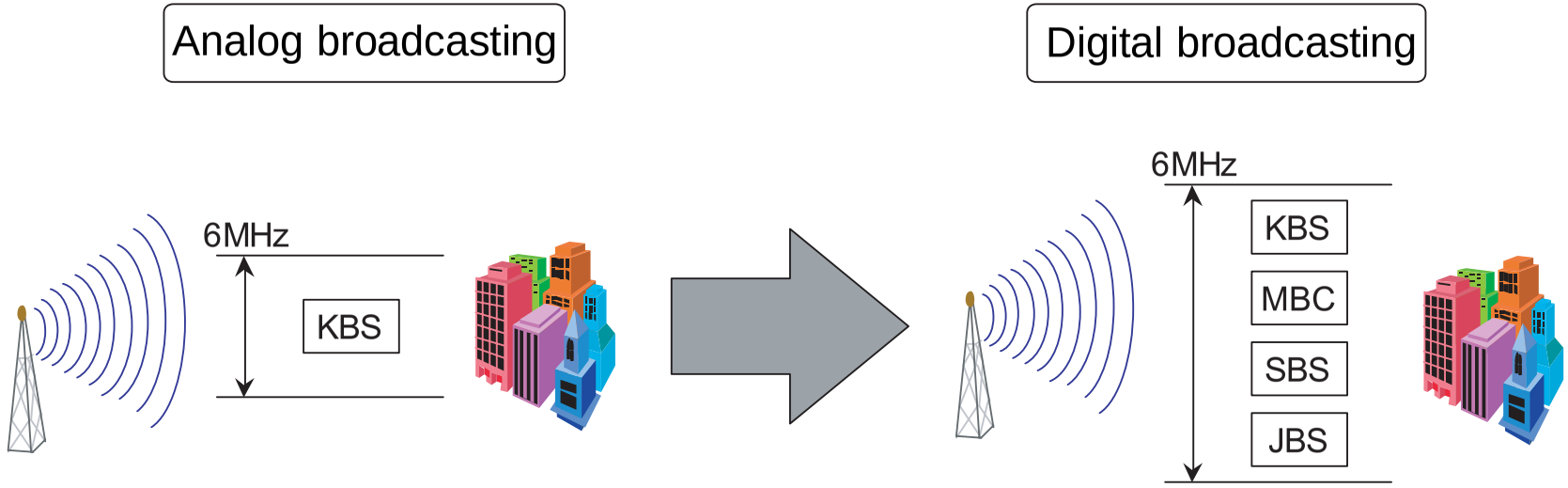
Digital HDTV

- Screen quality: 1080 line
- Aspect ratio: 16:9
  - ¥ Audio quality: 5.1 (surround)

Broadcasting Provider and Industry Aspect

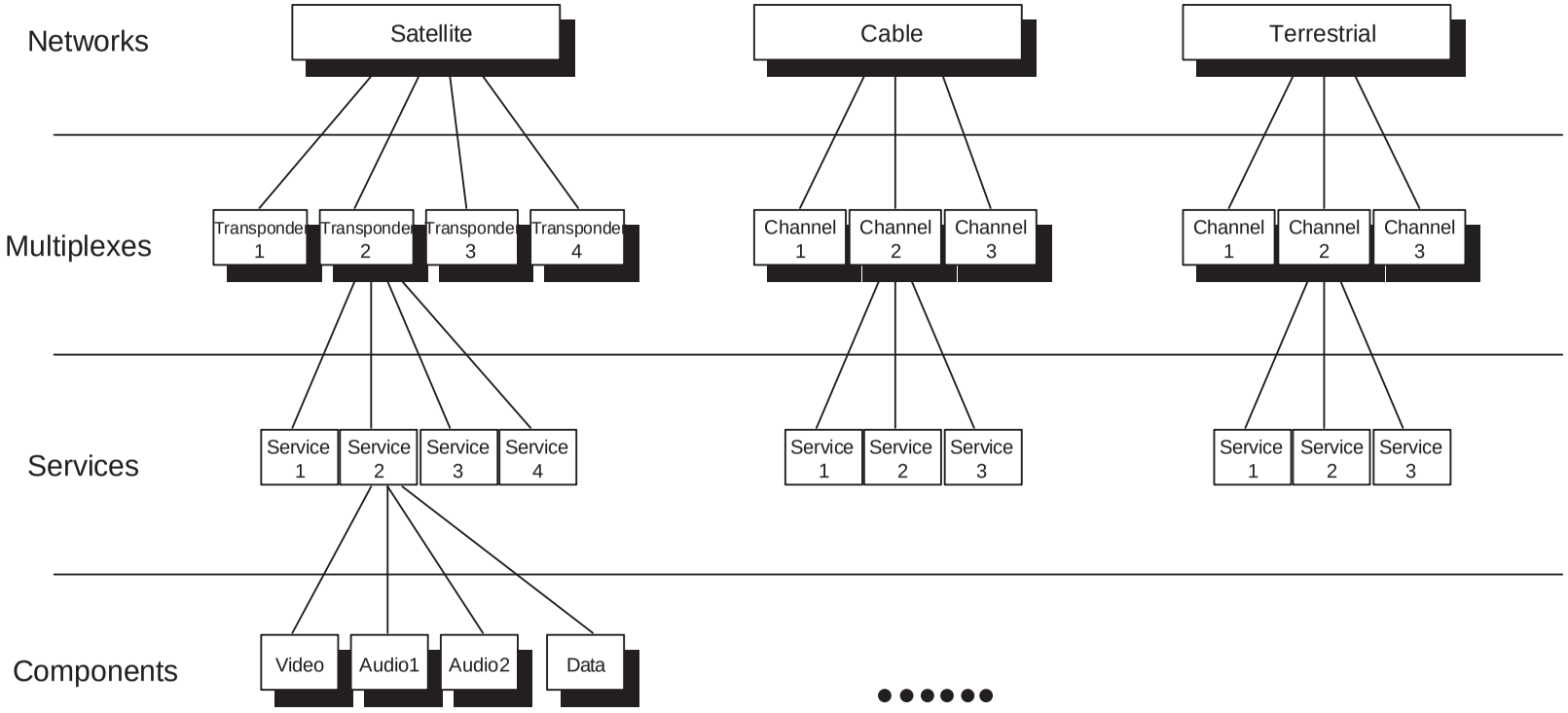


Effective Management of Frequency Resources

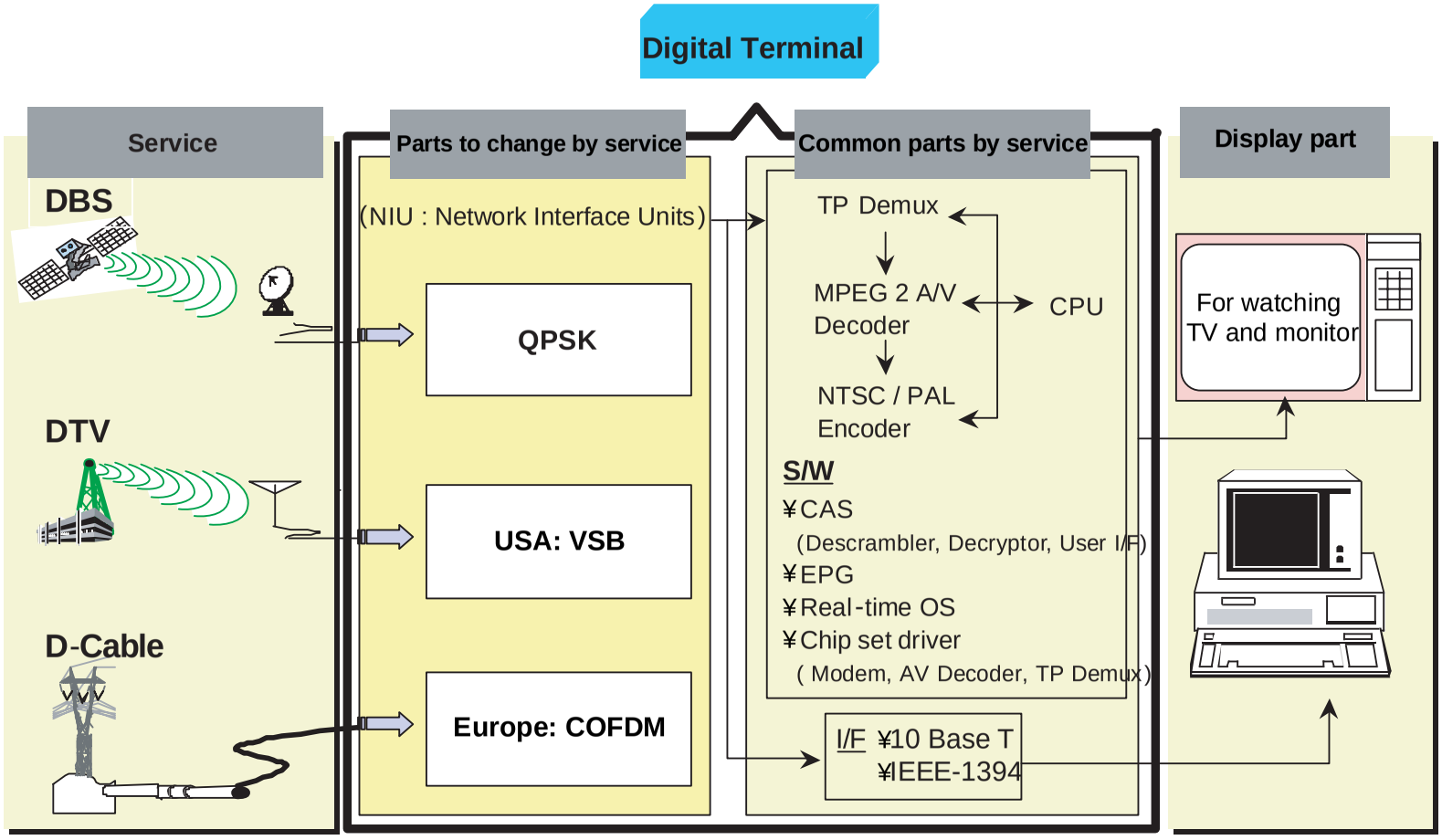


- Drastic improvement of the effectiveness of frequency usage → Utilization of surplus frequencies
- Removal of lack of broadcasting channels → Use of frequency resources for other services

Digital Broadcasting Transmission Service



Digital Receiving System



Digital Satellite Broadcasting

	Europe	USA		JAPAN	
	DVB-S	DirecTV	Primstar	CS	BS(ISDB-S)
Video Format (Active)	Not Specified 720 x 576 704 x 576 544 x 576 480 x 576 352 x 576 352 x 288	720 x 480 704 x 480 544 x 480 480 x 480 352 x 480 352 x 240	720 x 576 720 x 480 704 x 576 704 x 480 544 x 480 528 x 576 528 x 480 480 x 576 352 x 576	704 x 480	1920 x 1080 1280 x 720 720 x 480
Aspect Ratio	4 : 3 16 : 9 2.12 : 1	4 : 3 16 : 9	4 : 3 16 : 9	4 : 3 16 : 9	4 : 3 16 : 9
Frame Rate	Not Specified	29.97	25 29.97	23.98 29.97	29.97 59.94
Video Coding	MPEG2	MPEG2	MPEG2	MPEG2	MPEG2
Audio Coding	MPEG2 BC	MPEG1	AC3	MPEG2 BC	MPEG2 AAC

Digital Broadcasting

	Europe	USA	JAPAN
	DVB-T	ATSC	ISDB-T
Video Format (Active)	Not Specified 720 x 576 704 x 576 544 x 576 480 x 576 352 x 576 352 x 288	1980 x 1080 1280 x 720 704 x 480 640 x 480	1920 x 1080 1280 x 720 720 x 480
Aspect Ratio	4 : 3 16 : 9 2.12 : 1	4 : 3 16 : 9	4 : 3 16 : 9
Frame Rate	Not Specified	29.97 24, 59.94	29.97 59.94
Video Coding	MPEG2	MPEG2	MPEG2
Audio Coding	MPEG2 BC	AC3	MPEG2 AAC

Standardization Organizations in USA

— FCC: Governmental organization that controls communications and broadcasting in USA. Controls standardization for digital TV.

— ACATS: Advisory committee relating to ATV under FCC

— ATSC: Drafts digital TV standards and submits to ACATS

— Grand Alliance (93): Consists of AT&T, General Instrument (VE), Zenith (Modulation), Thomson, Philips (VD), David Sarnoff Research Center (Transport Subsystem), Dolby (AE), and MIT. Creates GA-HDTV standards.

— ATTC: Organization that tests the suggested standards and methods

ATSC Standard

- 19.39 Mb/s data transmission on 6 MHz channel bandwidth

- Adapting MPEG-2 video compression and Dolby AC-3 audio compression

- Two HDTV formats: 1920x1080, 1280x720
  24, 30, 50, 60 Hz
  Progressive scanning for all formats except 1920x1080 60,50 (2:1)

- Various types of SDTV formats: (incl. CCIR 601)

- Receiver can receive signals in all formats

ADVANCED TELEVISION SYSTEMS COMMITTEE

ISO/IEC JTC1/SC29 WG11
MPEG
MOVING PICTURE EXPERTS GROUP

Dolby
Dolby Laboratories

Europe DVB-T Standard Development History

- Established DVB Forum in 1993
- Developed DVB-T Standard in 1996
- Performed test broadcasting in England, France, Germany and Australia in 1996
- ETSI approved DVB-T as standard on February 1997.
- Announced that HDTV would be included in DVB-T on April, 1997.

  Use of MPEG-2 MP@HL

DVB-T Standard

- Video format
  : SDTV (4:3 aspect ratio ,625 lines)
  : HDTV (16:9 aspect ratio,1080 lines) is added.
- Video compression: MPEG-2 MP@ML
  (MPEG-2 MP@HL)
- Audio compression: MPEG-2 BC
  (CD quality, 5.1 channel)
- Transmission
  : COFDM
  : 2k and 8k modes

Japan ISDB-T Standard Development History

— Started HDTV study, with NHK playing a major role, in 1964.

— Established technology guideline oriented to MUSE in 1985

— Started testing HDTV broadcasting using satellites in 1990

— Fully moved to digital broadcasting in 1993

— ARIB created the final ISDB-T specification for video/audio frequency division on September, 1998.

— DTV co-broadcasting started in Tokyo in November, 1998.

— Started commercial service in 2003.

ISDB-T Standard

- Video format

  : SDTV (4:3 aspect ratio, 525 lines)

  : HDTV (16:9 aspect ratio, 108 lines) is added.

- Video compression: MPEG-2

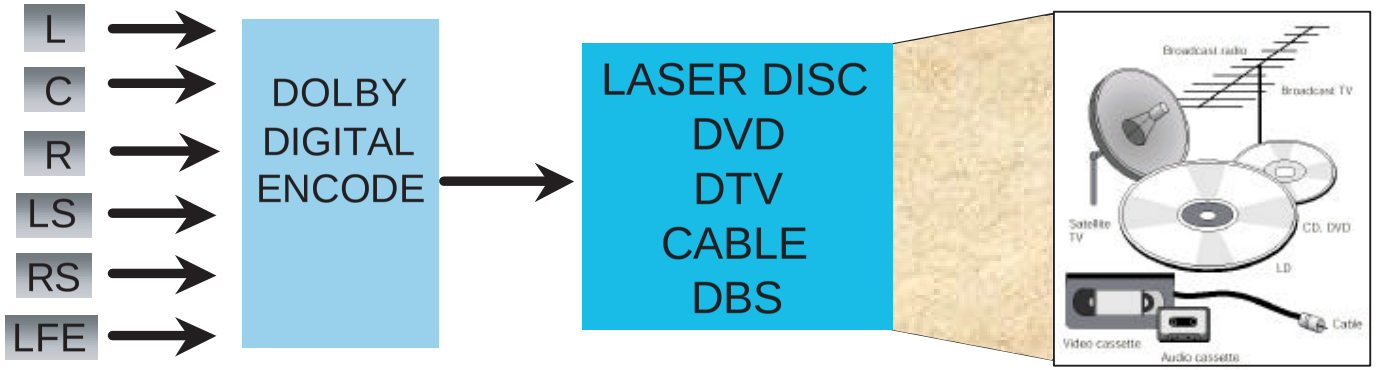
- Audio compression: MPEG-2 AAC

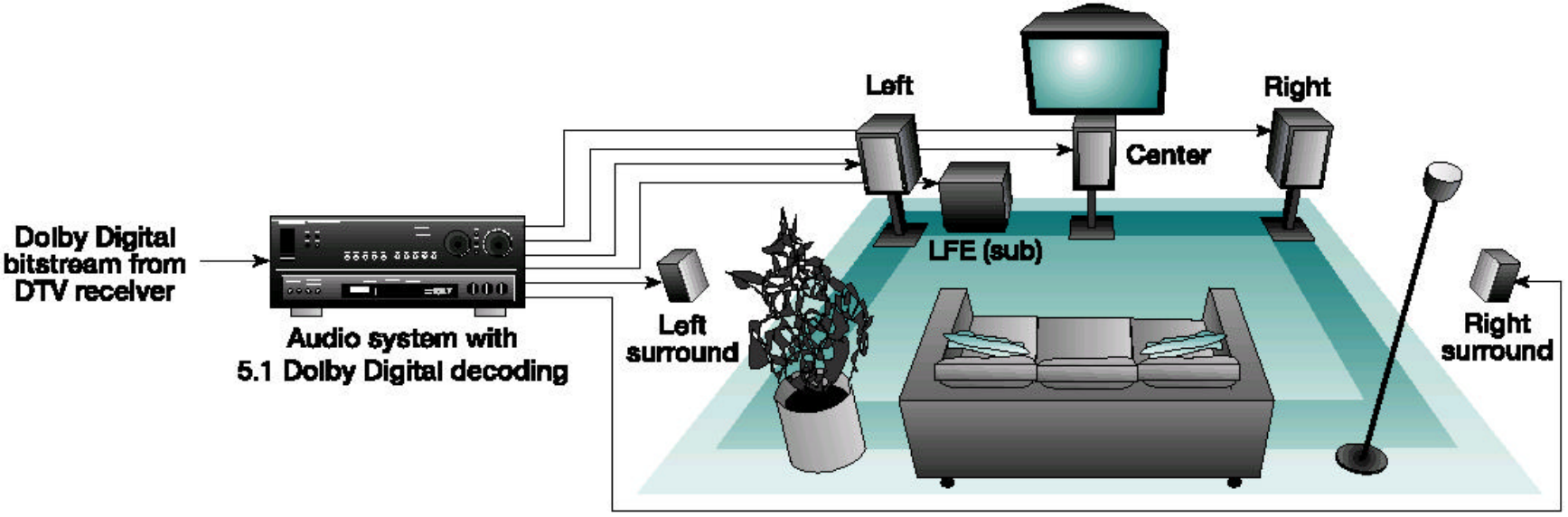
- Transmission

  : BST-OFDM

  : 2k,4k, and 8k modes

Dolby Digital Audio 5.1 Channel



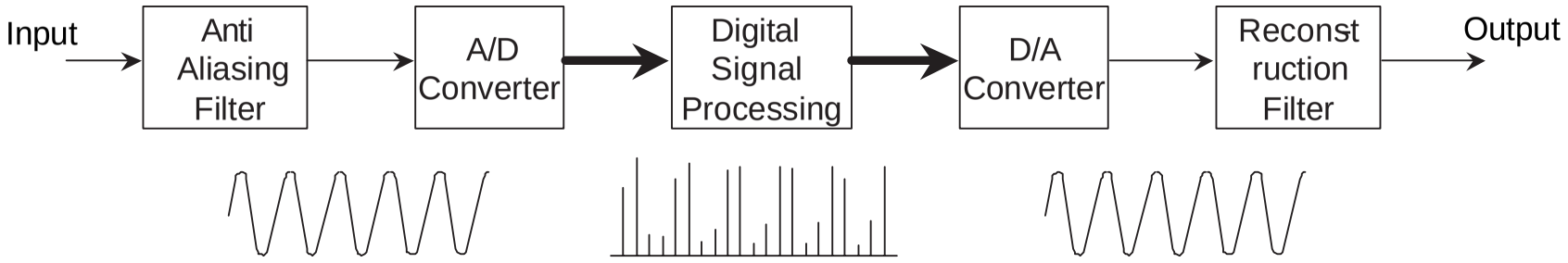


Digital TV Trends for Major Countries

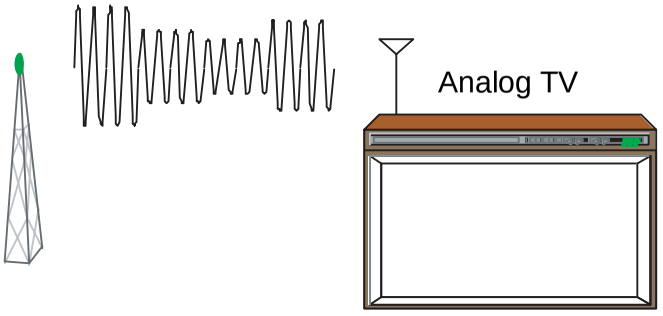
		USA	Japan	Europe	Korea
Environmental	Supervisor	Private corporations (Consortium) and government	Government (Ministry of Postal Service)	Private corporations (Consortium) and government	Government (Ministry of Information and Communication)
	Policy target	¥ High quality ¥ Practical use of broad casting/communication frequencies	¥ Considering mobile environment ¥ Effective use of frequencies	¥ Interactivity service ¥ Additional service ¥ Mobile environment ¥ Effective use of frequencies	¥ High quality ¥ Improvement of SVC quality for the public
	Broadcasting time (Digital started in/ Analog will stop in)	1998 / 2006	2000 / 2010	1998 / 2012 (UK)	2001 /2010
Technological	Broadcasting service	¥ High quality HD ¥ Multi channel SD	¥ High quality HD ¥ Multi channel SD	¥ Multi channel SD	¥ High quality HD ¥ Multi channel SD
	Frequency	6 MHz	6 MHz (Planned)	8 MHz	6 MHz
	Transmission	VSB	BST-OFDM (Planned)	COFDM	VSB
	Video compression	MPEG2	MPEG2 (Planned)	MPEG2	MPEG2
	Audio compression	Dolby AC -3	Undetermined	MPEG Audio	Dolby AC -3
	CAS	N/A	Undetermined	Used	Undetermined

Digital TV Overview

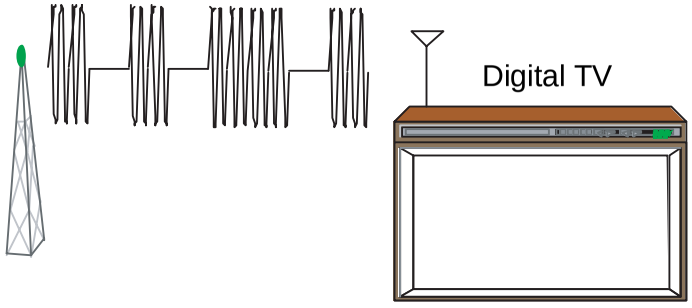
Concept of Digital TV



Analog signals are transmitted from broadcasting station.



The frequency itself is analog signal but includes digital signals.



Presentation of Analog Signal

1) 3 Primary Colors of Light: RGB
The colors that are combined to best depict other colors on the color coordinate.

2) Y (R-Y) (B-Y)
Pure brightness element (Y) is differentiated from color signal (R-Y, B-Y) to depict the bright ness faithfully humans most respond to. The differentiation is represented as the following formula:

$Y = 0.299R + 0.587G + 0.114B$
(Formula given from the characteristics of human vision)
$R-Y = 0.701R - 0.587G - 0.114B$
$B-Y = -0.299R -0.587G + 0.886$

3) YUV
Scaled signal of (R-Y) and (B-Y) used in creating composite signal, which prevents over-modulation due to exaggerated of a color signal. Because amplitude is reduced, S/N is degraded.

$U = 0.493 (B-Y)$
$V = 0.887 (R-Y)$

4) YIQ
(R-Y) and (B-Y) are rotated by 33 degrees to present color signal with sensitive (orange-cyan) and insensitive (green-magenta) axes.

$Q = \cos33^*U + \sin33^*V$
$I = \cos123^*U + \sin123^*V$

5) YC
Color signals for which phase was modulated.
$C = I^*\cos(Fs-57drg) + Q^*\sin(Fs-57dgr)$
$I = 1.5MLPF[I]$
$Q = 0.5MLPF[Q]$

6) Composite
Sum of YC, color bust, and synchronization signal

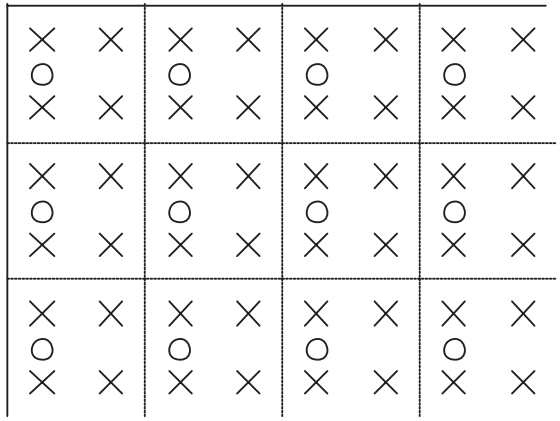
Presentation of Digital Signal

ITU - R BT.601

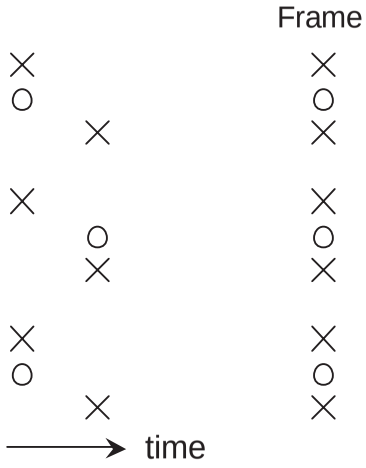
~Y = 0.299R + 0.587G + 0.114B	~Y is analog brightness signal (1Vp-p). R, G, and B are gamma-corrected analog signals (1Vp-p).
~Cr = 0.500R - 0.419G -0.081B	~Cr is an analog color signal. V signal is scaled so that R coefficient becomes 0.500. Signal range is -0.500 ~ +0.500.
~Cb= -0.169R -0.331G + 0.500B	~Cb is an analog color signal. U signal is scaled so that B coefficient becomes 0.500. Signal range is -0.500 ~ +0.500.
Y = 219*~Y + 16	Digital brightness signal. The range is [16~235].
Cr = 224*~Cr +128	Digital color difference signal. The range is [14~240]
Cb= 224*~ Cb+128	Digital color difference signal. The range is [14~240]

Sampling of Video Signal

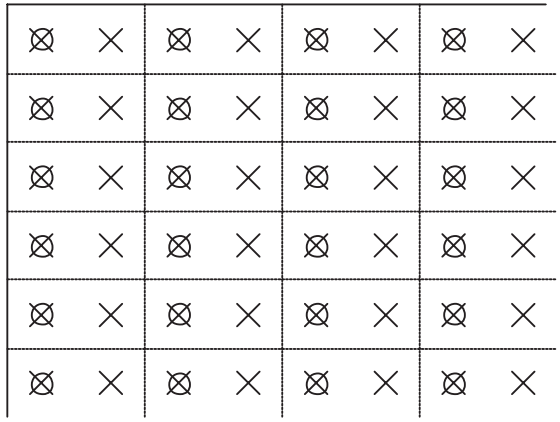
4:2:0 format sampling(Color signal bandwidth is 1/4 of brightness.)



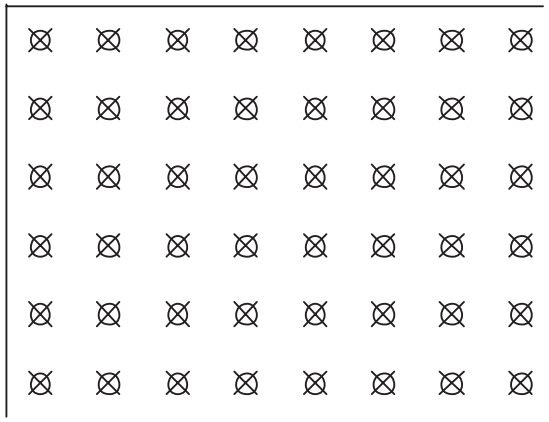
Vertical location of 4:2:0 format



4:2:2 format sampling(Color signal bandwidth is 1/2 of brightness.)



4:4:4 format sampling



Video Encoding and Transmission Technology

What Is MPEG?

- Moving Picture Experts Group: Establishes standards for moving picture compression
- MPEG Types
  - — MPEG1: MPEG compression standard for a moving picture to be saved in a CD. 1-channel video and audio is specified. (0.5 --- 1.8Mbps)
  - — MPEG2: MPEG standard for broadcasting. Multi channel video and audio is specified. (4 ---15Mbps ,MP@ML; For 4:2:2 sample, up to 20 --- 50Mbps are supported.)
  - — MPEG3: MPEG standard for high screen quality. It is absorbed into MPEG2 since it has a little technological difference from MPEG2.
  - — MPEG4: MPEG standard for communication. Defines specifications for replaying moving pictures in the speed of low frequency. (2 --- 64Kbps; Scaleable encoding, Error resilience, Object Oriented)

MPEG1 Vs. MPEG2

MPEG-1

¥ ISO/IEC 11172-1: Standard for synchronization/multiplexing of video/audio signal
¥ ISO/IEC 11172-2: Standard for progressive scan video targeted for video-on-CD.
¥ ISO/IEC 11172-3: Standard for audio
¥ ISO/IEC 11172-4: Standard for analysis/demodulation for compatibility testing
¥ ISO/IEC 11172-5: Technical report for s/w application

MPEG-2

¥ ISO/IEC 13818-1/ITU-T H.222: Standard for synchronization/multiplexing of video/audio signal
¥ ISO/IEC 13818-2/ITU-T H.262: Standard for interlaced video encoding
¥ ISO/IEC 13818-3: Standard for MPEG-1 compatible multi channel and incompatible high compression
¥ ISO/IEC 13818-5: Technical support for s/w application
¥ ISO/IEC 13818-6: System Extensions - Client-server protocol for digital storage media command and control (DSM-CC)
¥ ISO/IEC 13818-7: Enhanced audio encoding architecture for multi channel
¥ ISO/IEC 13818-8: Video, extension to 10-bit input samples (Removed)
¥ ISO/IEC 13818-9: Definitions for MPEG-2 real-time transmission timing
¥ ISO/IEC 13818-10: Conformance Extensions - Additions to DSM-CC, 13814-4.

MPEG Theory

— Basic algorithm for video compression is DCT transformation.

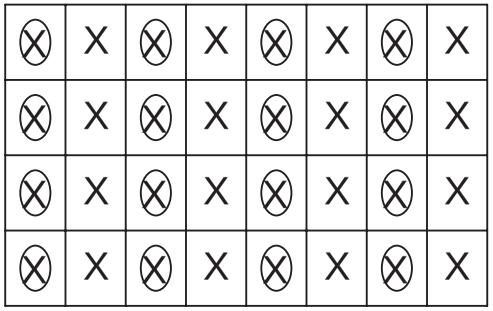
— Quantity of data is reduced by quantum process and various encoding processes.

— Only motions are saved to reduce quantity of data.

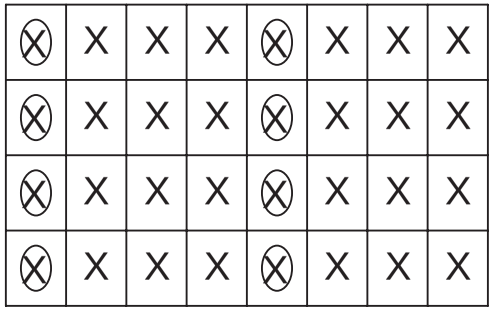
— Sampling method was changed:

4:2:2 -------> 4:2:0

4:2:0 Sampling



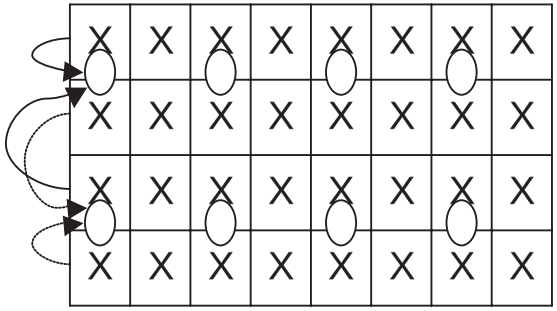
4:2:2



4:1:1

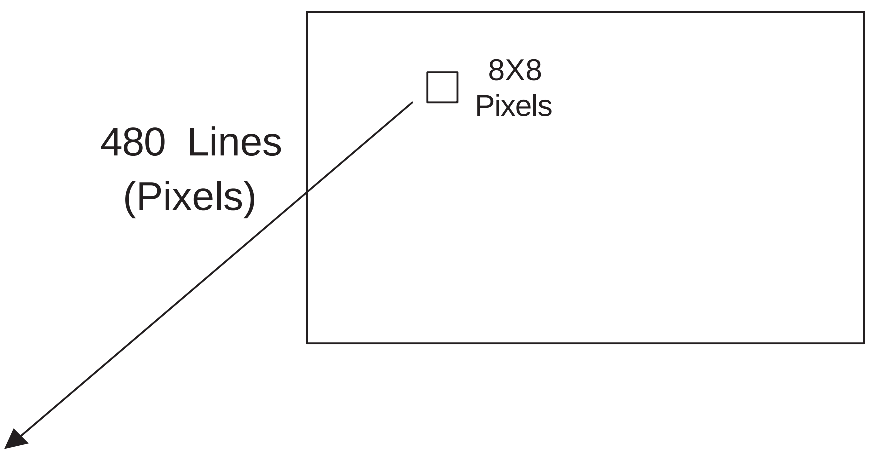
X 1 Luminance Sample Y

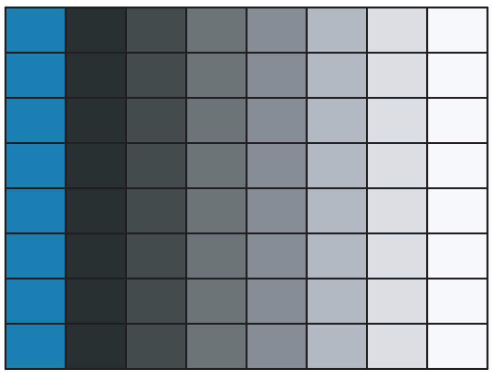
⬯ 2 Chrominance Samples Cb, Cr



4:2:0

DCT (Discrete Cosine Transform)





Picture

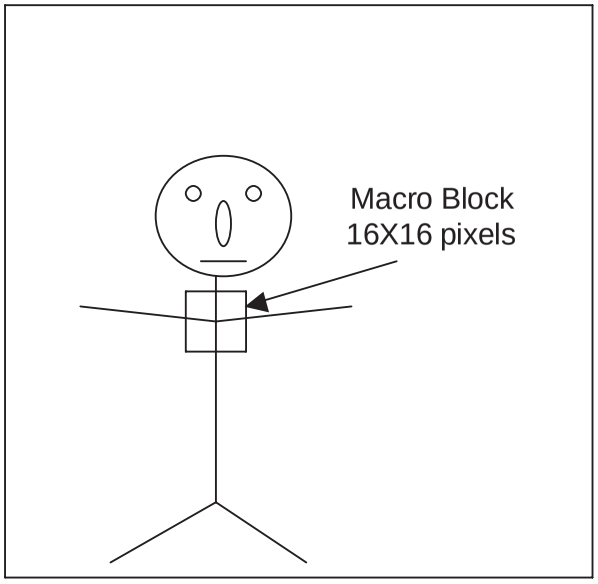
0	12.5	26.0	37.5	50.0	62.5	75.0	87.5
0	12.5	26.0	37.5	50.0	62.5	75.0	87.5
0	12.5	26.0	37.5	50.0	62.5	75.0	87.5
0	12.5	26.0	37.5	50.0	62.5	75.0	87.5
0	12.5	26.0	37.5	50.0	62.5	75.0	87.5
0	12.5	26.0	37.5	50.0	62.5	75.0	87.5
0	12.5	26.0	37.5	50.0	62.5	75.0	87.5
0	12.5	26.0	37.5	50.0	62.5	75.0	87.5

Sample Values

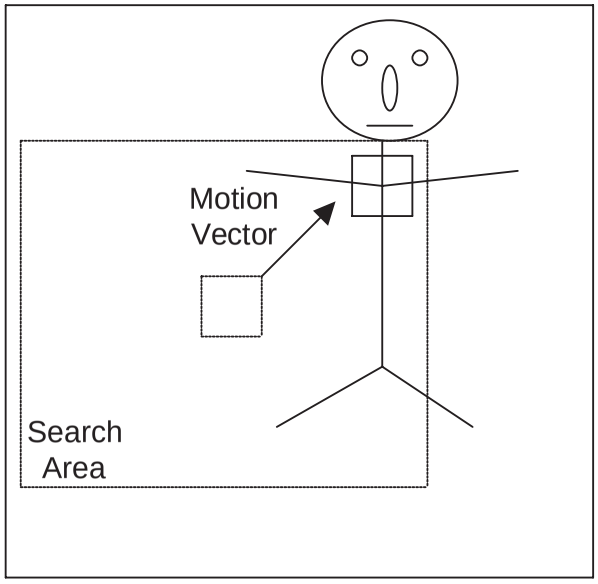
43.8	-40	0	-4.1	0	-1.1	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

DCT Coefficients

Motion Estimation

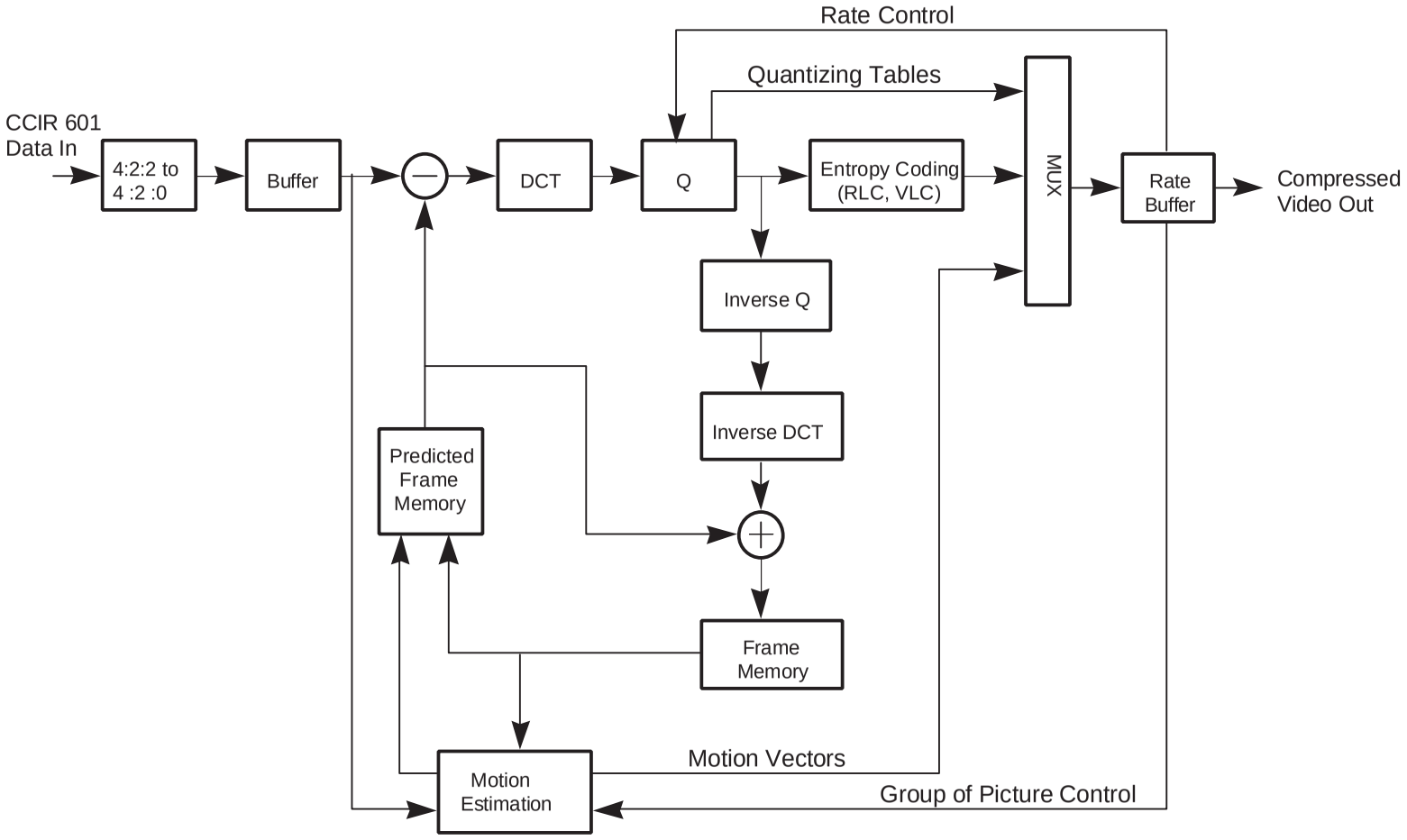


Frame N



Frame N +1

MPEG Video Compression



MPEG Profile

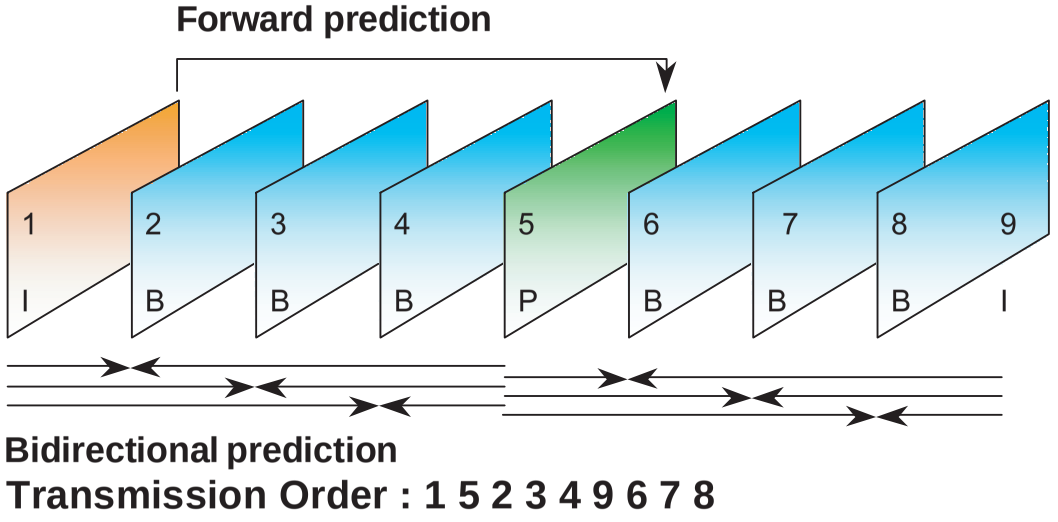
LEVEL / PROFILE	SIMPLE	MAIN	SNR	SPATIAL	HIGH
HIGH		4:2:0 1920 x 1152 80 Mb/s I,P,B			4:2:0 , 4:2:2 1920 x 1152 100 Mb/s I,P,B
HIGH-1440		4:2:0 1440 x 1152 60 Mb/s I,P,B		4:2:0 1440 x 1152 60 Mb/s I,P,B	4:2:0 , 4:2:2 1440 x 1152 80 Mb/s I,P,B
MAIN	4:2:0 720 x 576 15 Mb/s I,P	4:2:0 720 x 576 15 Mb/s I,P,B	4:2:0 720 x 610 50 Mb/s I,P,B 4:2:0 720 x 576 15 Mb/s I,P,B		4:2:0 , 4:2:2 720 x 576 20 Mb/s I,P,B
LOW		4:2:0 352 x 288 4 Mb/s I,P,B	4:2:0 352 x 288 4 Mb/s I,P,B		

3 Picture Types

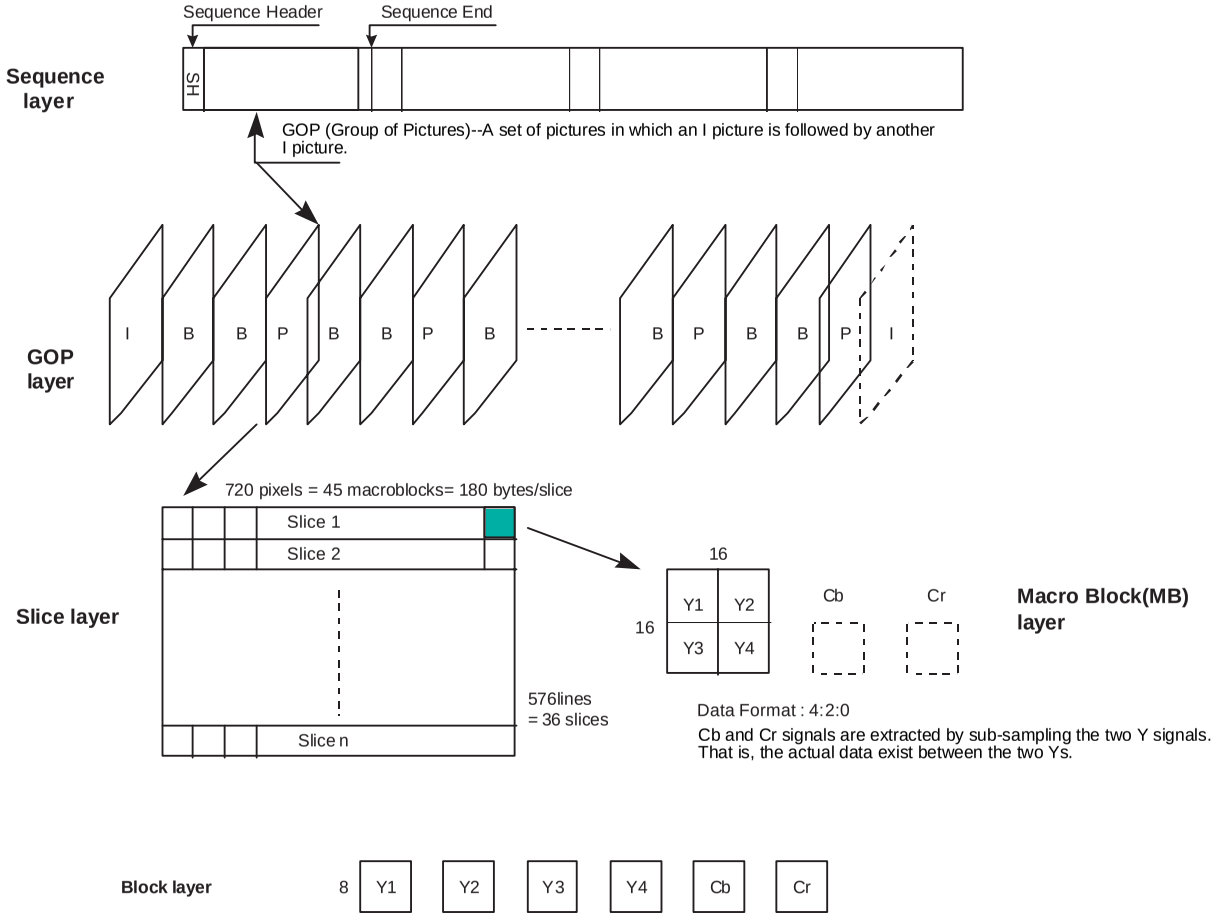
① I-Picture (Intra picture) - Picture that does not reference other pictures. Provides access point that decoding for encoded sequence starts. (It becomes the base picture.)

② P-Picture (Predicted picture) - It is compensated with motion compensated prediction in reference to the existing I-Picture or P-Picture. It becomes the base picture as I-Picture It has a higher compression rate than I-Picture because it does not compress all information but picture-difference information.

③ B-Picture (Bidirectionally-predicted picture) - It is compressed with the highest compression rate of the three types, but it does not become the base picture. The following figure shows the relation of the 3 picture types.

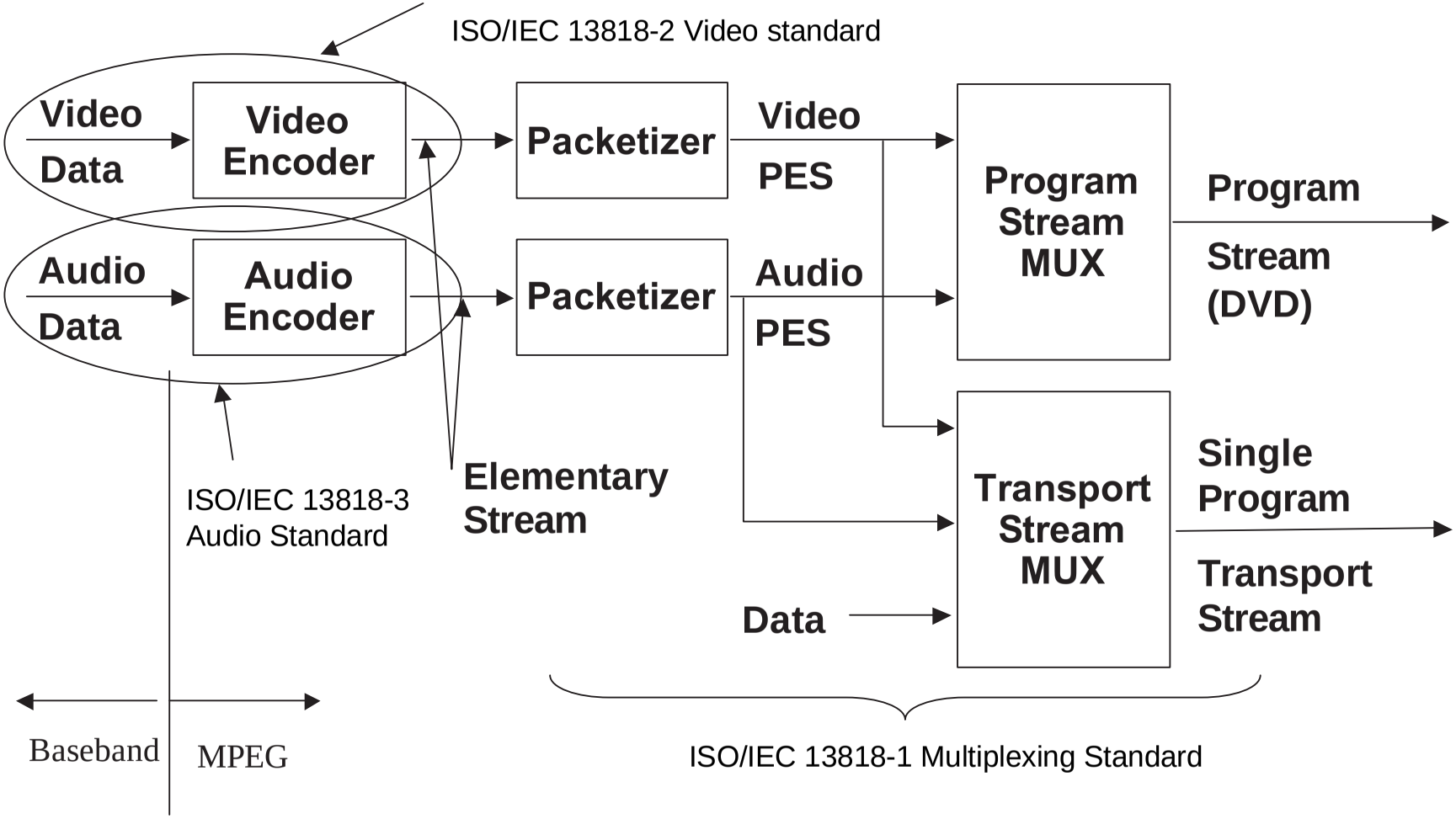


Hierarchy

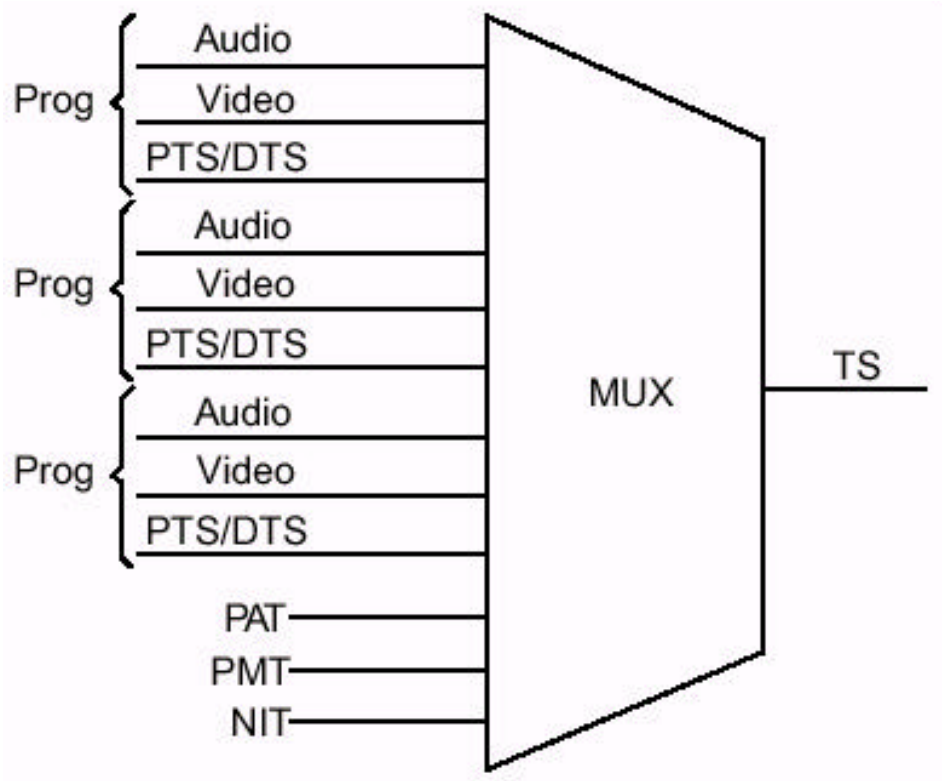

Sequence Header
Sequence End
Sequence layer
HS
GOP (Group of Pictures)--A set of pictures in which an I picture is followed by another I picture.
GOP layer
I B B P B B P B
B P B B P I
720 pixels = 45 macroblocks= 180 bytes/slice
Slice 1
Slice 2
Slice n
Slice layer
576lines
= 36 slices
16
16
Y1 Y2
Y3 Y4
Cb
Cr
Macro Block(MB) layer
Data Format : 4:2:0
Cb and Cr signals are extracted by sub-sampling the two Y signals.
That is, the actual data exist between the two Ys.
Block layer
8
Y1
Y2
Y3
Y4
Cb
Cr

MPEG System Architecture

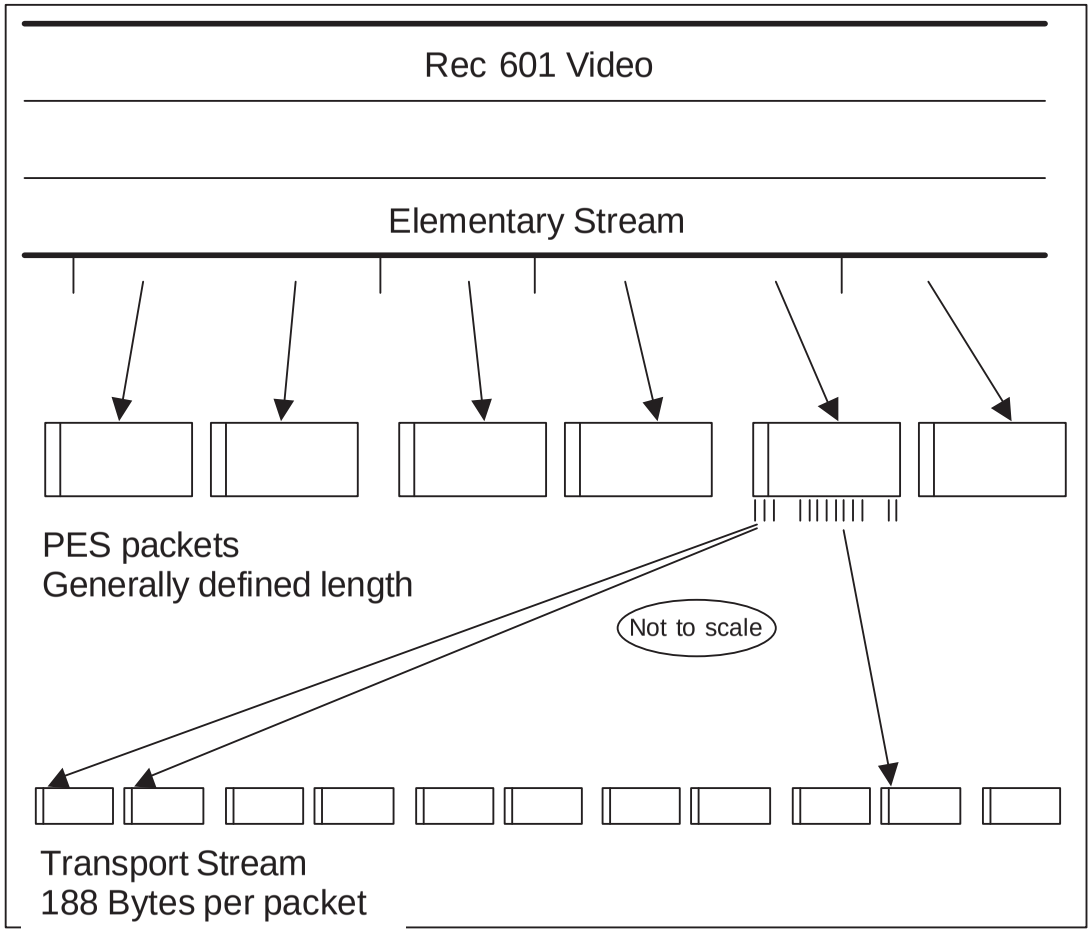
MPEG-2 System Multiplexing



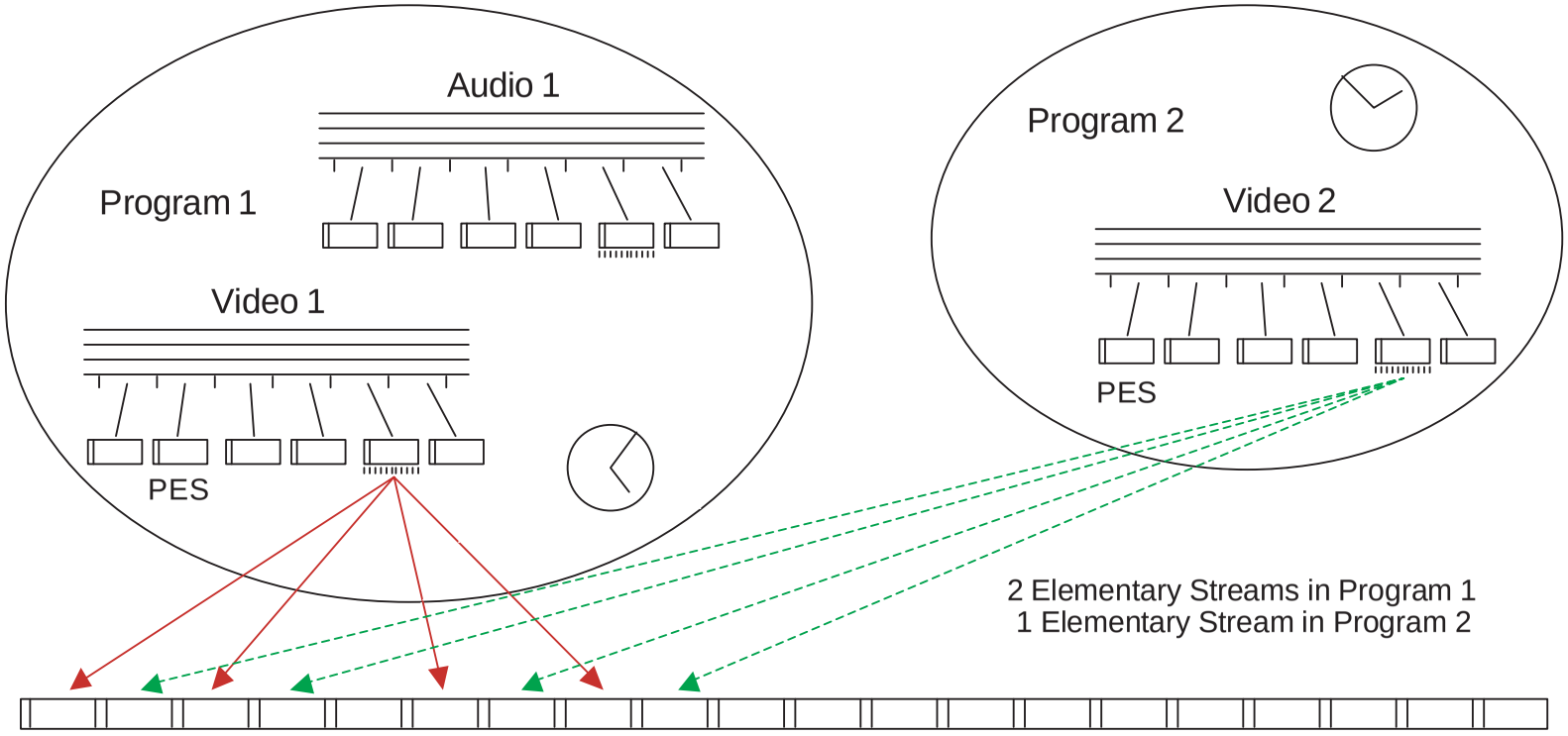
Mux


Prog
Audio
Video
PTS/DTS
Prog
Audio
Video
PTS/DTS
Prog
Audio
Video
PTS/DTS
PAT
PMT
NIT
MUX
TS

Transport stream formation



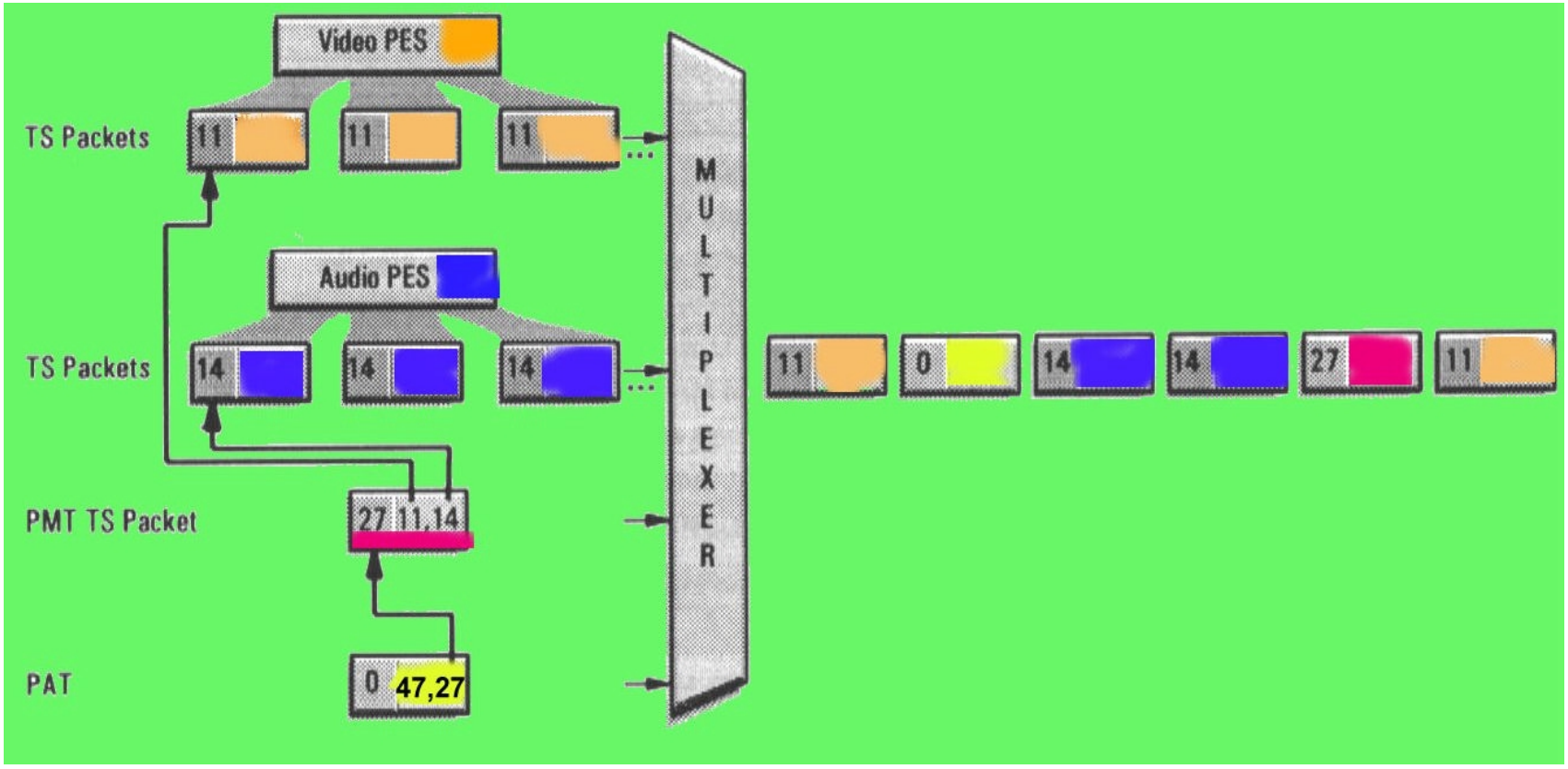
Multi -Program Transport stream



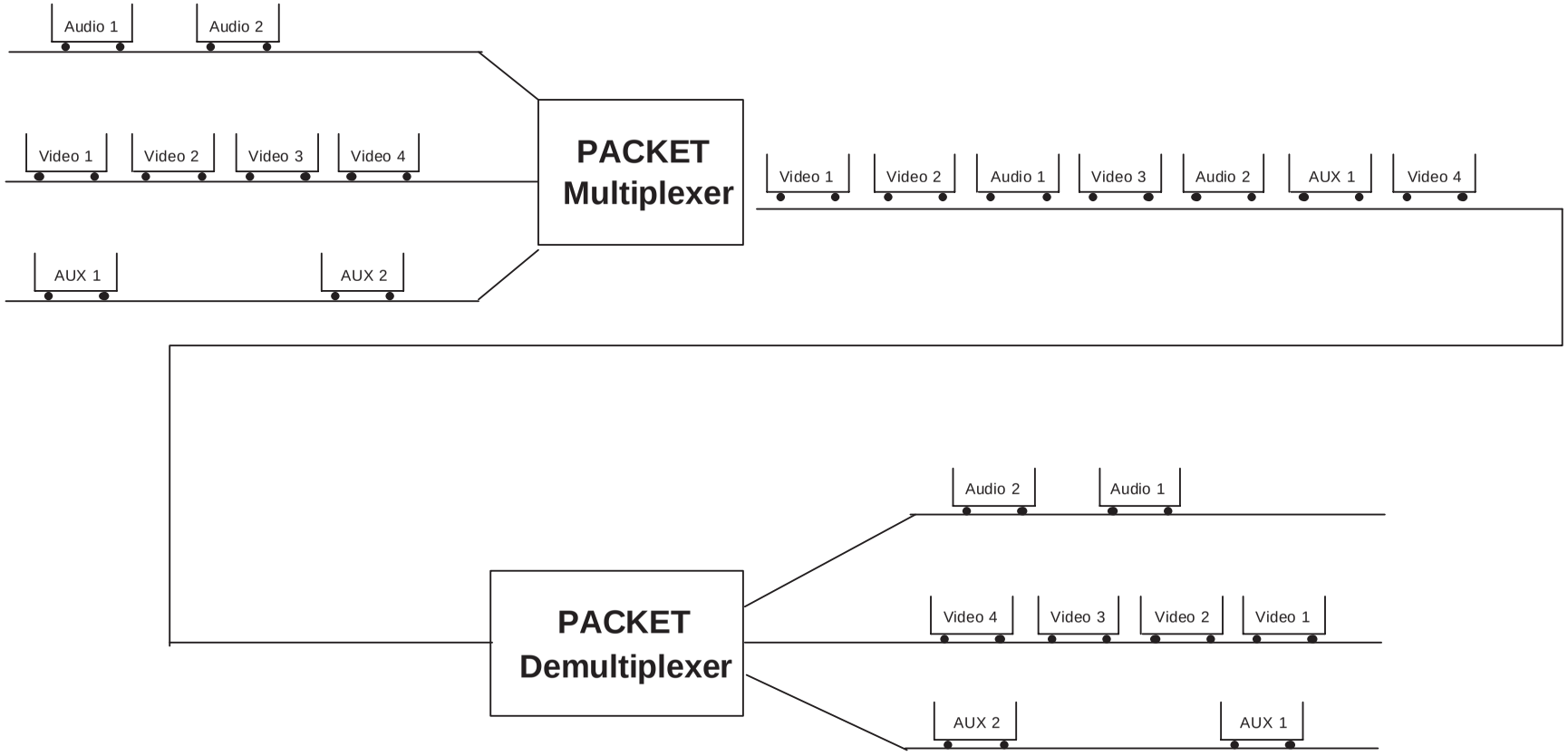
2 Program Transport Stream

Each program has a separate reference clock

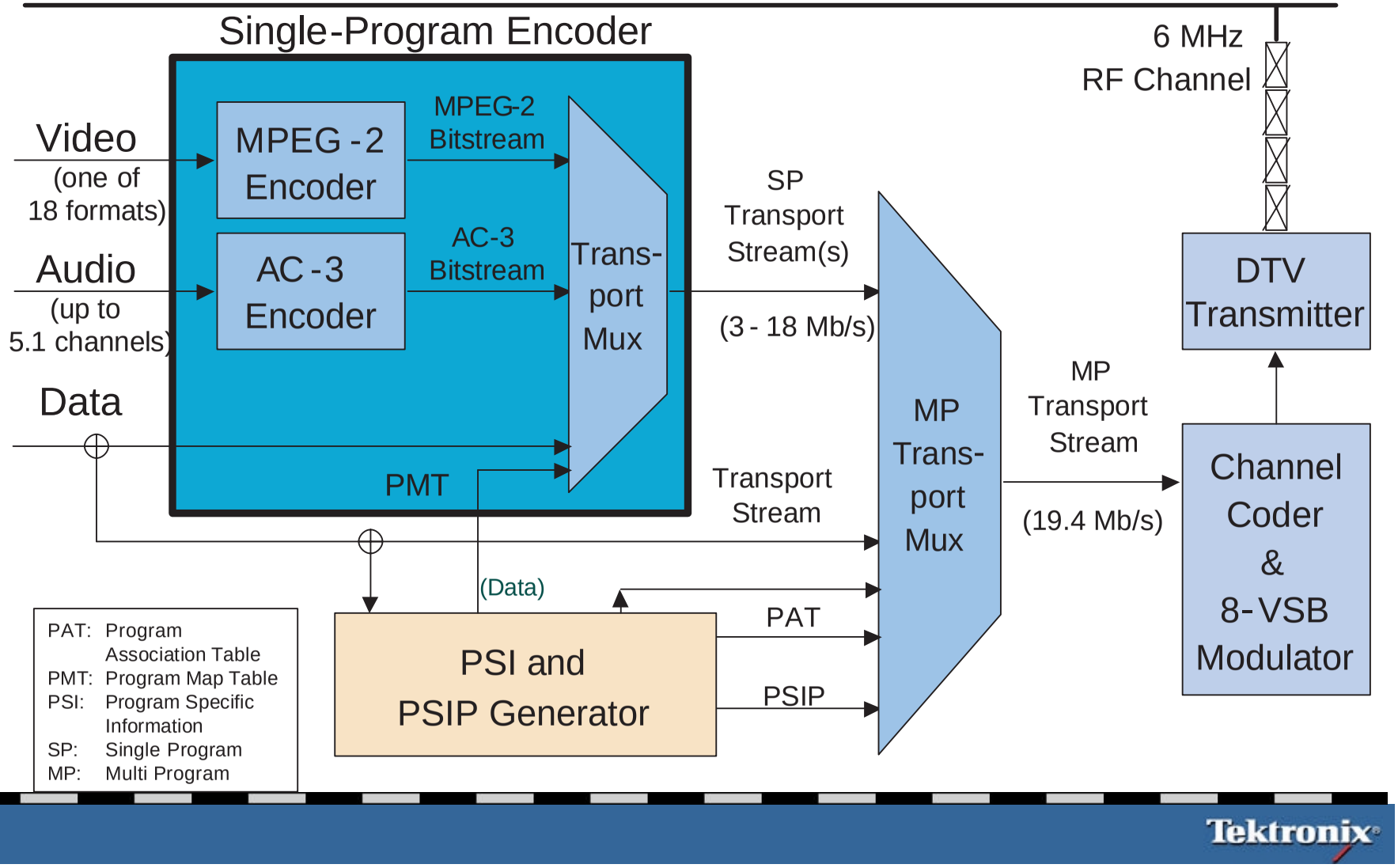
Mux


Video PES
TS Packets
11
11
11
Audio PES
TS Packets
14
14
14
PMT TS Packet
27 11,14
PAT
0 47,27
MULTIPLEXER
11
0
14
14
27
11

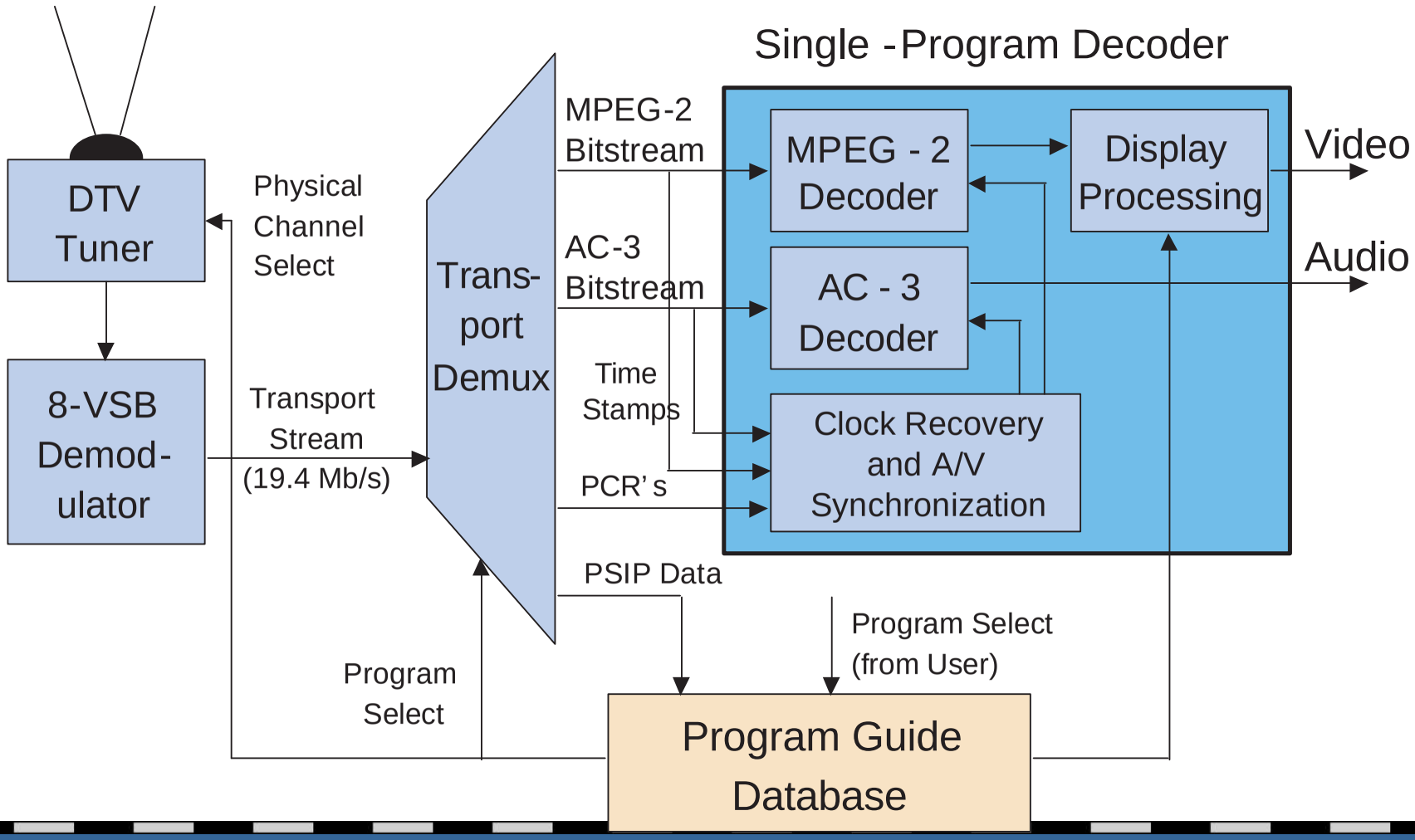
Packet Multiplexing & DeMultiplexing



ATSC Transmission System



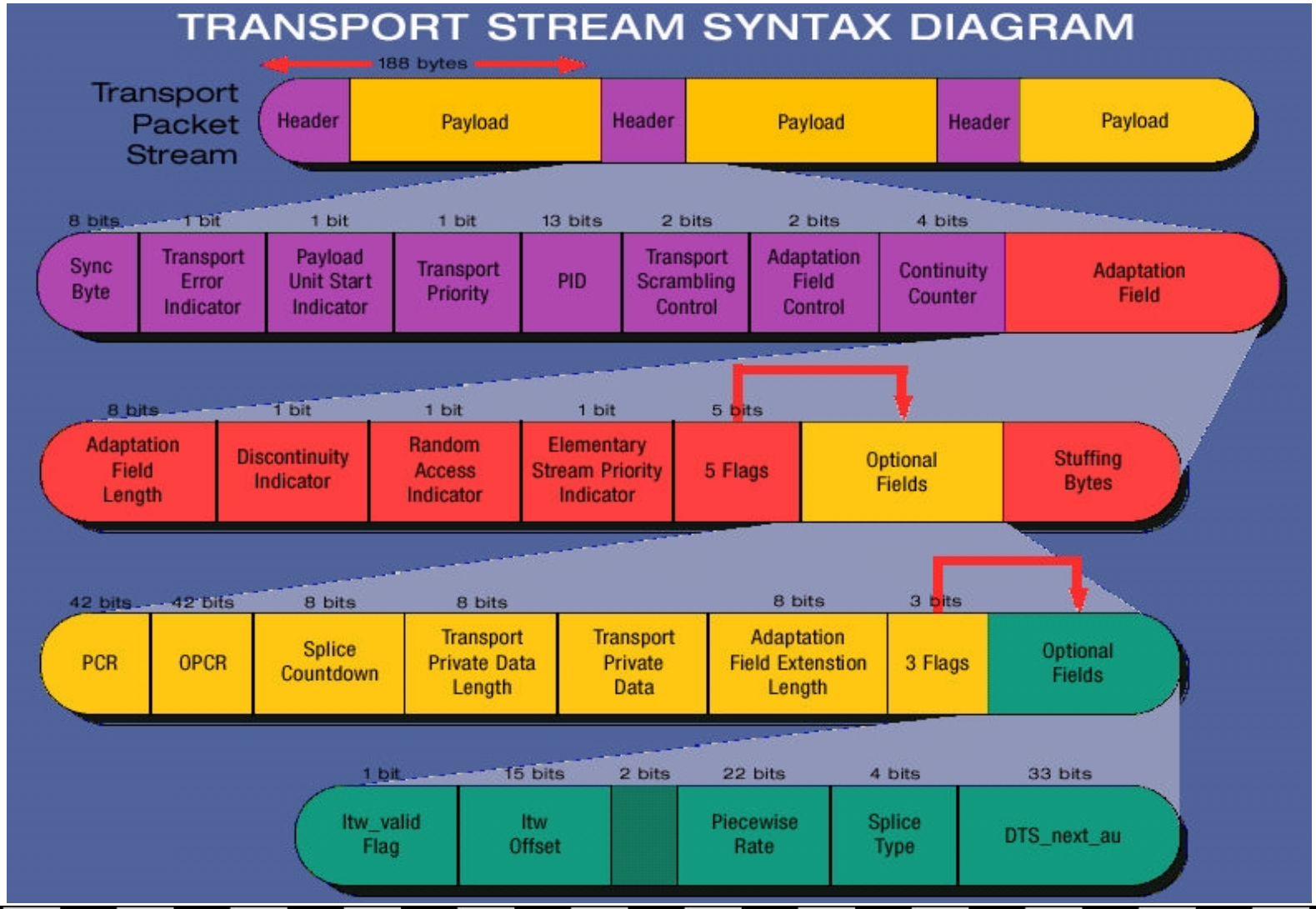
ATSC Decoder



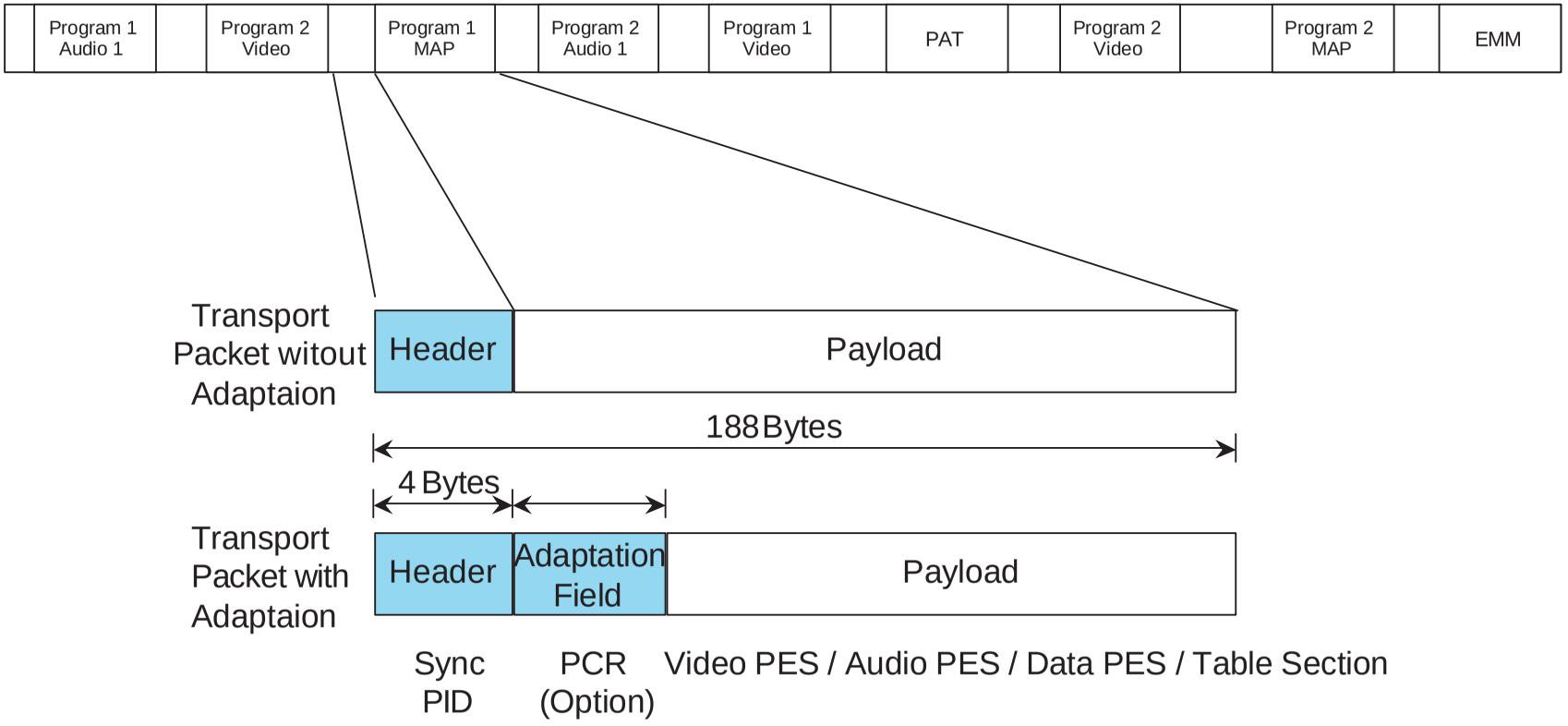
Transport Stream Syntax

ISO/IEC 13818-1 transport packet

Syntax	No. of bits
transport_packet(){	
sync_byte	8
transport_error_indicator	1
payload_unit_start_indicator	1
transport_priority	1
PID	13
transport_scrambling_control	2
adaptation_field_control	2
continuity_counter	4
if(adaptation_field_control=='10' || adaptation_field_control=='11'){	
adaptation_field()	
}	
if(adaptation_field_control=='01' || adaptation_field_control=='11'){	
for (i=0;i<N;i++){	
data_byte	8
}	
}	


TRANSPORT STREAM SYNTAX DIAGRAM
188 bytes
Transport Packet Stream
Header
Payload
Header
Payload
Header
Payload
8 bits
1 bit
1 bit
1 bit
13 bits
2 bits
2 bits
4 bits
Sync Byte
Transport Error Indicator
Payload Unit Start Indicator
Transport Priority
PID
Transport Scrambling Control
Adaptation Field Control
Continuity Counter
Adaptation Field
8 bits
1 bit
1 bit
1 bit
5 bits
Adaptation Field Length
Discontinuity Indicator
Random Access Indicator
Elementary Stream Priority Indicator
5 Flags
Optional Fields
Stuffing Bytes
42 bits
42 bits
8 bits
8 bits
8 bits
3 bits
PCR
OPCR
Splice Countdown
Transport Private Data Length
Transport Private Data
Adaptation Field Extenstion Length
3 Flags
Optional Fields
1 bit
15 bits
2 bits
22 bits
4 bits
33 bits
ltw_valid Flag
ltw Offset
Piecewise Rate
Splice Type
DTS_next_au

Transport Stream Architecture

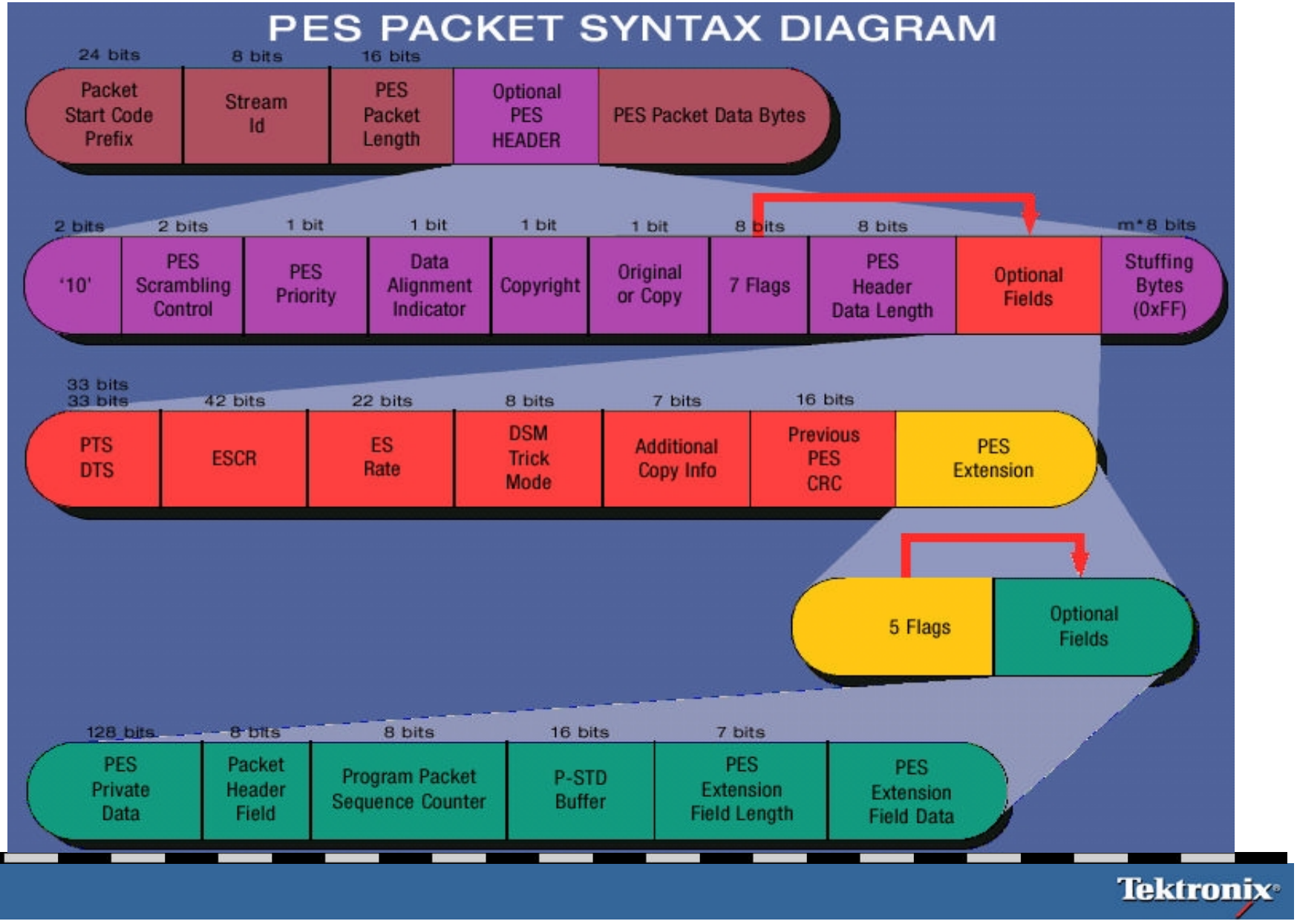


Packetized Elementary Stream

¥ Has a variable length packet equal to or larger than 64KB, PTS, and DTS.

¥ Packet is discarded if the information has an error.

¥ Includes information for packet data type, packetization format, and timing info for ES data decoding and replay.


PES PACKET SYNTAX DIAGRAM
24 bits
8 bits
16 bits
Packet Start Code Prefix
Stream Id
PES Packet Length
Optional PES HEADER
PES Packet Data Bytes
2 bits
2 bits
1 bit
1 bit
1 bit
1 bit
8 bits
8 bits
m*8 bits
'10'
PES Scrambling Control
PES Priority
Data Alignment Indicator
Copyright
Original or Copy
7 Flags
PES Header Data Length
Optional Fields
Stuffing Bytes (0xFF)
33 bits
33 bits
42 bits
22 bits
8 bits
7 bits
16 bits
PTS DTS
ESCR
ES Rate
DSM Trick Mode
Additional Copy Info
Previous PES CRC
PES Extension
5 Flags
Optional Fields
128 bits
8 bits
8 bits
16 bits
7 bits
PES Private Data
Packet Header Field
Program Packet Sequence Counter
P-STD Buffer
PES Extension Field Length
PES Extension Field Data
Tektronix

PTS&DTS

- PTS : Presentation Time Stamp
- DTS : Decoding Time Stamp

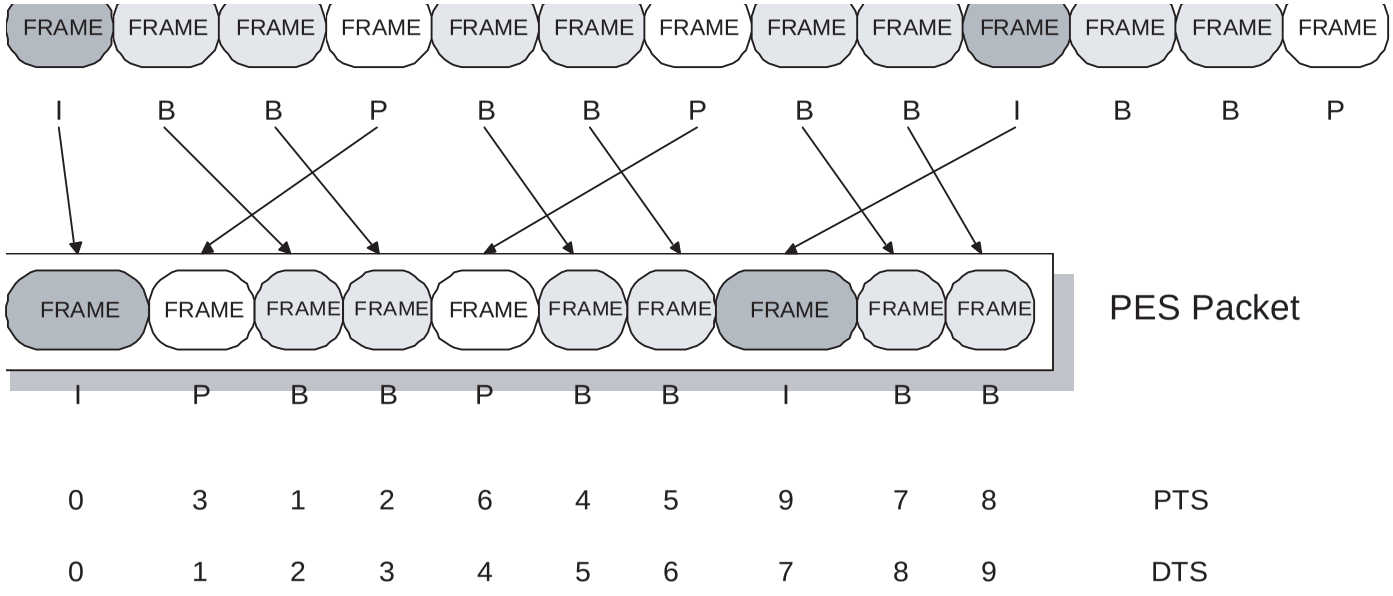
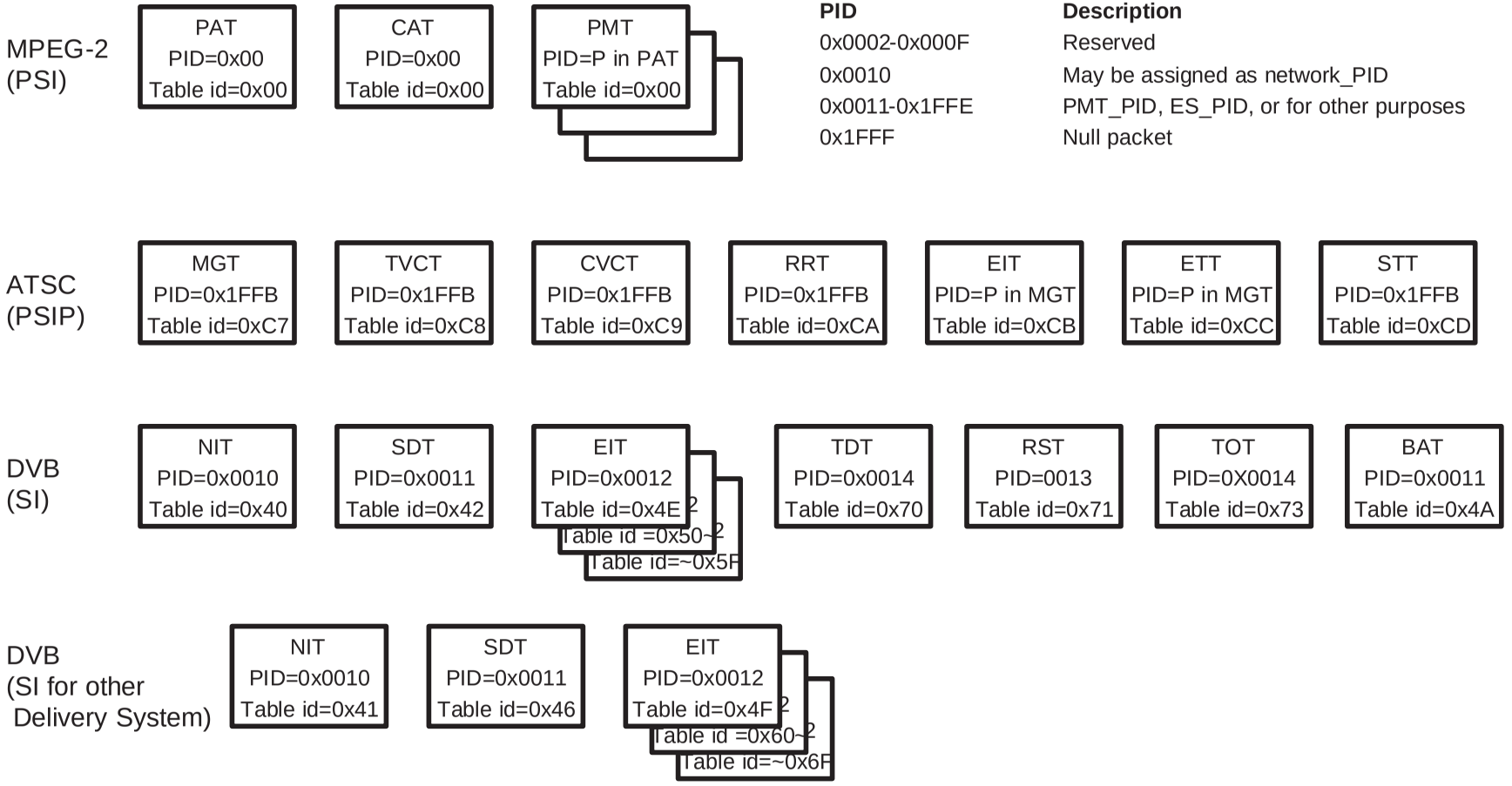


Table Architecture

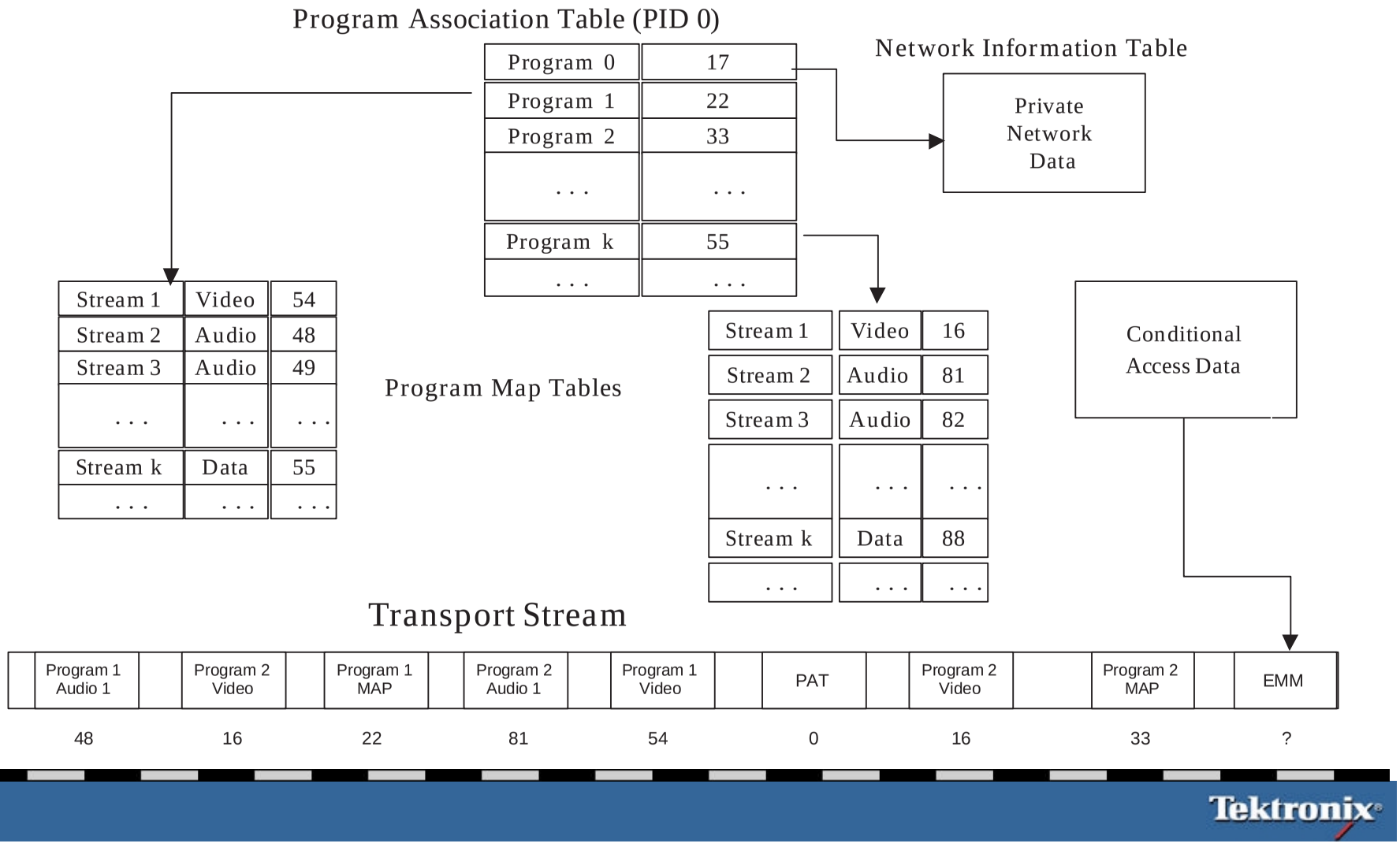
Table Architecture

- PSI (Program Specification Information)
  : Common standard for both of ATSC and DVB
- PSIP (Program and System Information Protocol)
  : Standard for ATSC (USA/Korea)
- SI (Service Information)
  : Standard for DVB (Europe)
- Major PSI Tables
  - PAT (Program Association Table): Has the PID of PMT.
  - PMT (Program Map Table): Has the PID of elementary stream for each program.
  - CAT (Conditional Access Table)
    : Has the information for receiving pay-per-view broadcasting.

Other Tables



PSI : Program Specific Information



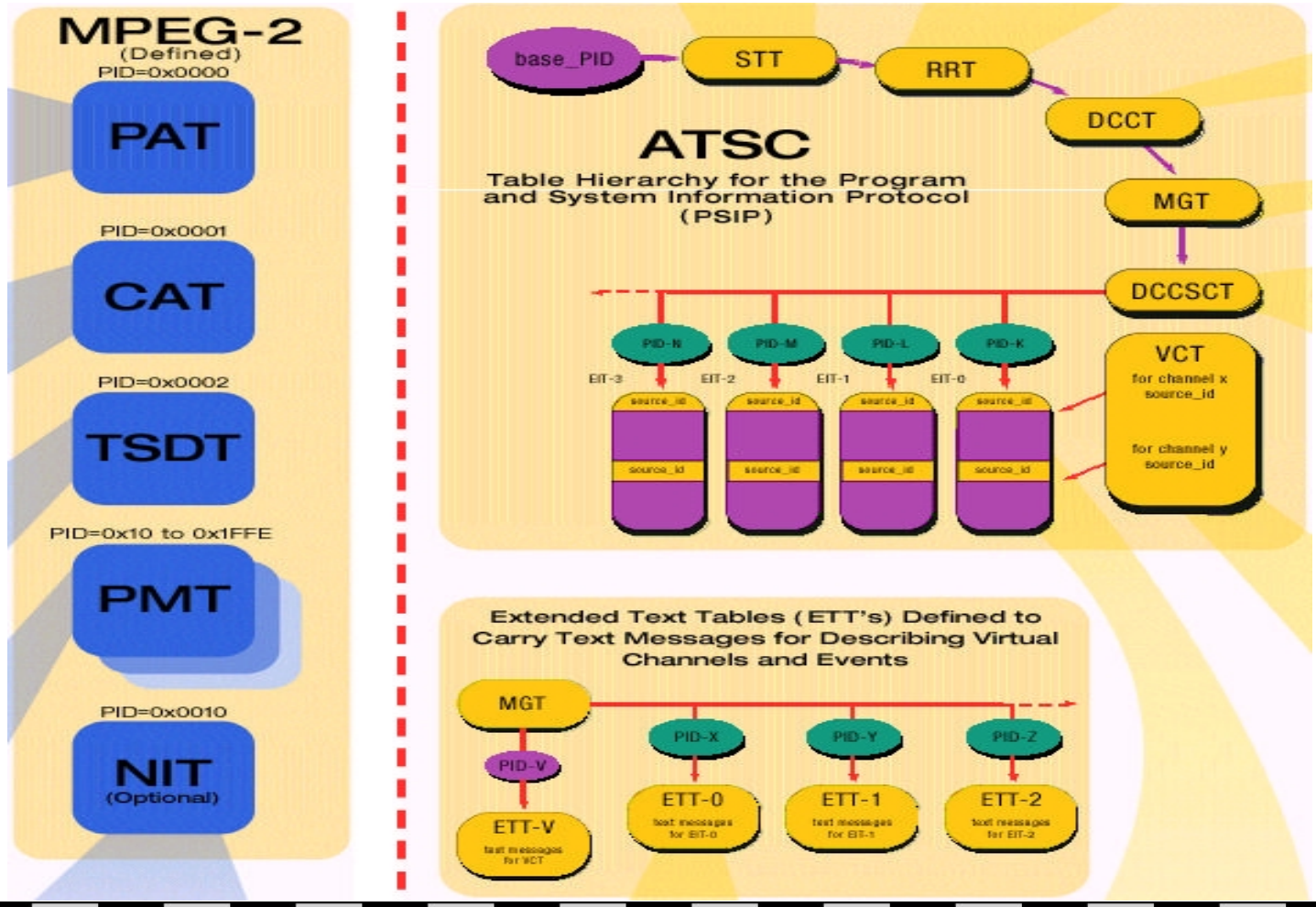
PSI: Basic Information for Channel Selection

- Program Association Table (PAT)
  - PID = 0, must be present in every transport stream
- Program Map Table (PMT)
  - PID values assigned by transmission system (DVB, ATSC, etc.)
- Conditional Access Table (CAT)
  - PID = 1 (EMM = entitlement management message)
- Network Information Table (NIT)
  - PID values assigned by transmission system
  - DVB considers this part of System Information (SI)
- Null Packets
  - PID = 8191 ($1FFF_{hex}$)

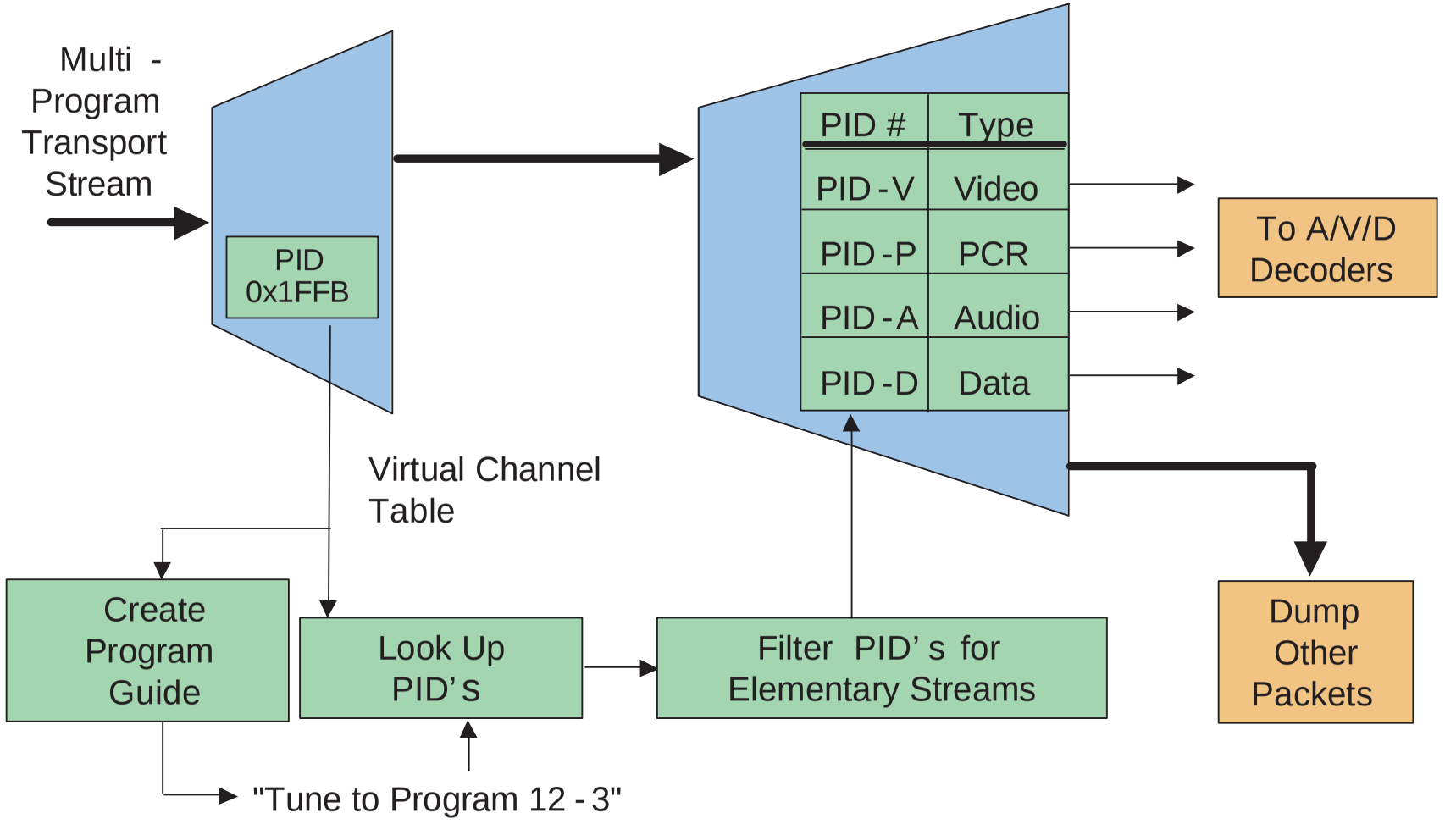
ATSC PSIP table

- T3/S8-193 (A/65): Standardized as T3-442 after approval by T3.
- Consists of an array of system information (SI) and program guide (PG) tables. It is transmitted with transport stream.
- Provides information for channel tuning, multi program selection, and data broadcasting guide to DTV decoder.
- A set of PSIP data is transmitted for each PTC (Physical Transmission Channel).
- Standards for North American digital broadcasting and digital cable broadcasting:

  - Broadcasting: TVCT, MGT, RRT, STT, EIT, ETT
  - Cable: CVCT, MGT, RRT,STT


MPEG-2
(Defined)
PID=0x0000
PAT
PID=0x0001
CAT
PID=0x0002
TSDT
PID=0x10 to 0x1FFE
PMT
PID=0x0010
NIT
(Optional)
base_PID
STT
RRT
DCCT
ATSC
Table Hierarchy for the Program and System Information Protocol (PSIP)
MGT
DCCSCT
PID-N
PID-M
PID-L
PID-K
EIT-3
EIT-2
EIT-1
EIT-0
source_id
VCT
for channel x source_id
for channel y source_id
Extended Text Tables (ETT's) Defined to Carry Text Messages for Describing Virtual Channels and Events
MGT
PID-V
ETT-V
PID-X
PID-Y
PID-Z
ETT-0
ETT-1
ETT-2

ATSC PSIP tuning example



PSIP Decoding Process

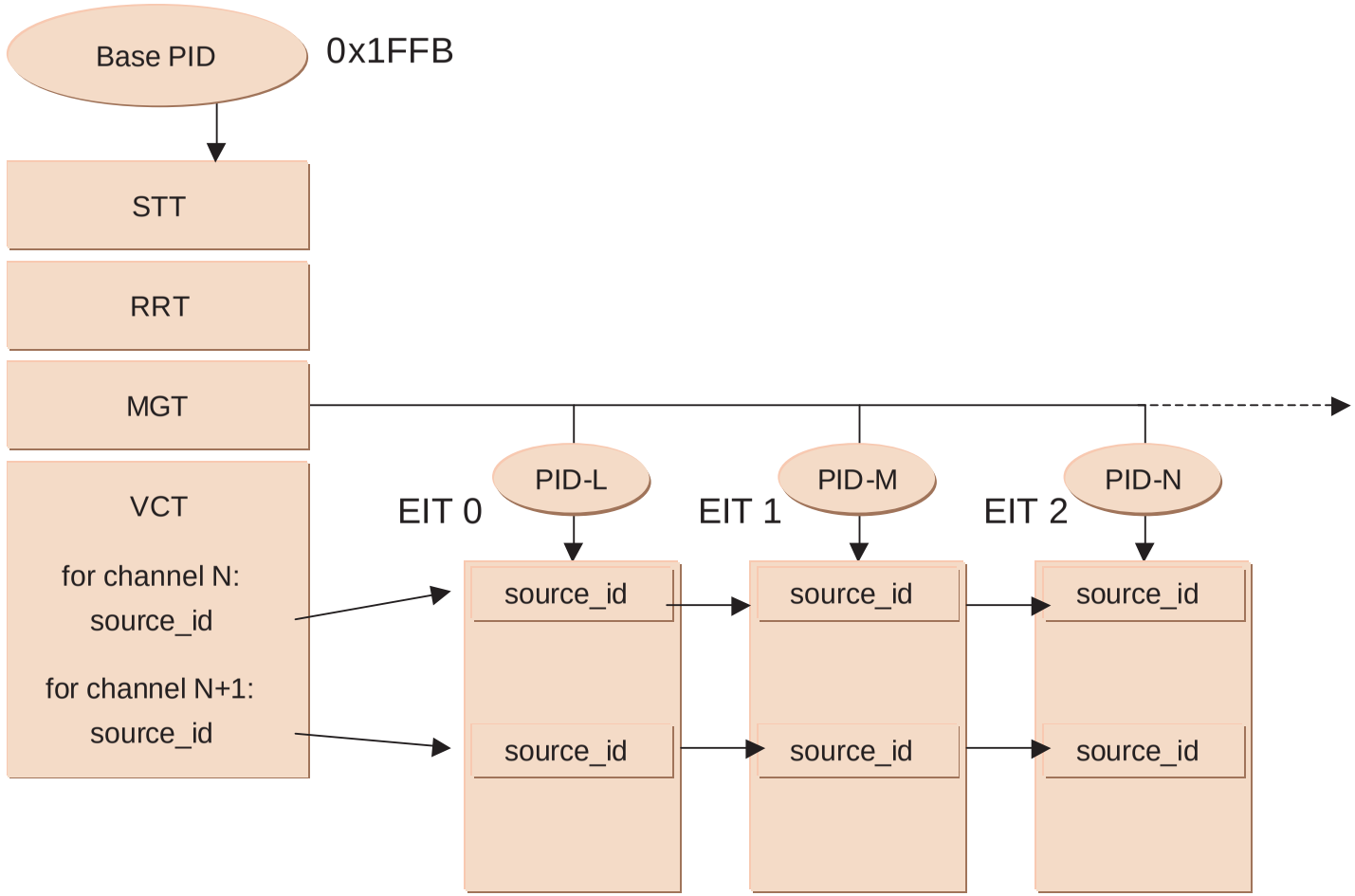


Table ID Ranges and Values

Table ID Value (hex)	Tables	PID
	ISO/IEC 13818-1 Sections:	
0x00	PROGRAM ASSOCIATION TABLE (PAT)	0
0x01	CONDITIONAL ACCESS TABLE (CAT)	1
0x02	TS PROGRAM MAP TABLE (PMT)	per PAT
0x03 - 0x3F	[ISO Reserved]	
	User Private Sections:	
0x40 - 0x7F	[User Private for other systems]	
0x80 - 0xBF	[User Private]	
	Other documents:	
0xC0 - 0xC6	[Used in other systems]	
	PSIP Tables:	
0xC7	MASTER GUIDE TABLE (MGT)	0x1FFB
0xC8	TERRESTRIAL VIRTUAL CHANNEL TABLE (TVCT)	0x1FFB
0xC9	CABLE VIRTUAL TABLE CHANNEL (CVCT)	0x1FFB
0xCA	RATING REGION TABLE (RRT)	0x1FFB
0xCB	EVENT INFORMATION TABLE (EIT)	per MGT
0xCC	EXTENDED TEXT TABLE (ETT)	per MGT
0xCD	SYSTEM TIME TABLE (STT)	0x1FFB
0xCE - 0xD2	[Reserved for future ATSC use]	
0xD3	DIRECTED CHANNEL CHANGE TABLE (DCCT)	0x1FFB
0xD4	DIRECTED CHANNEL CHANGE SELECTION CODE TABLE (DCCSCT)	0x1FFB
0xD5	[Reserved for future ATSC use]	
0xD6 - 0xD8	[Used in other systems]	
0xD9 - 0xDF	[Reserved for future ATSC use]	
0xE0 - 0xE5	[Used in other systems]	
0xE6 - 0xFE	[Reserved for future ATSC use]	
0xFF	**Inter-message Filler**	

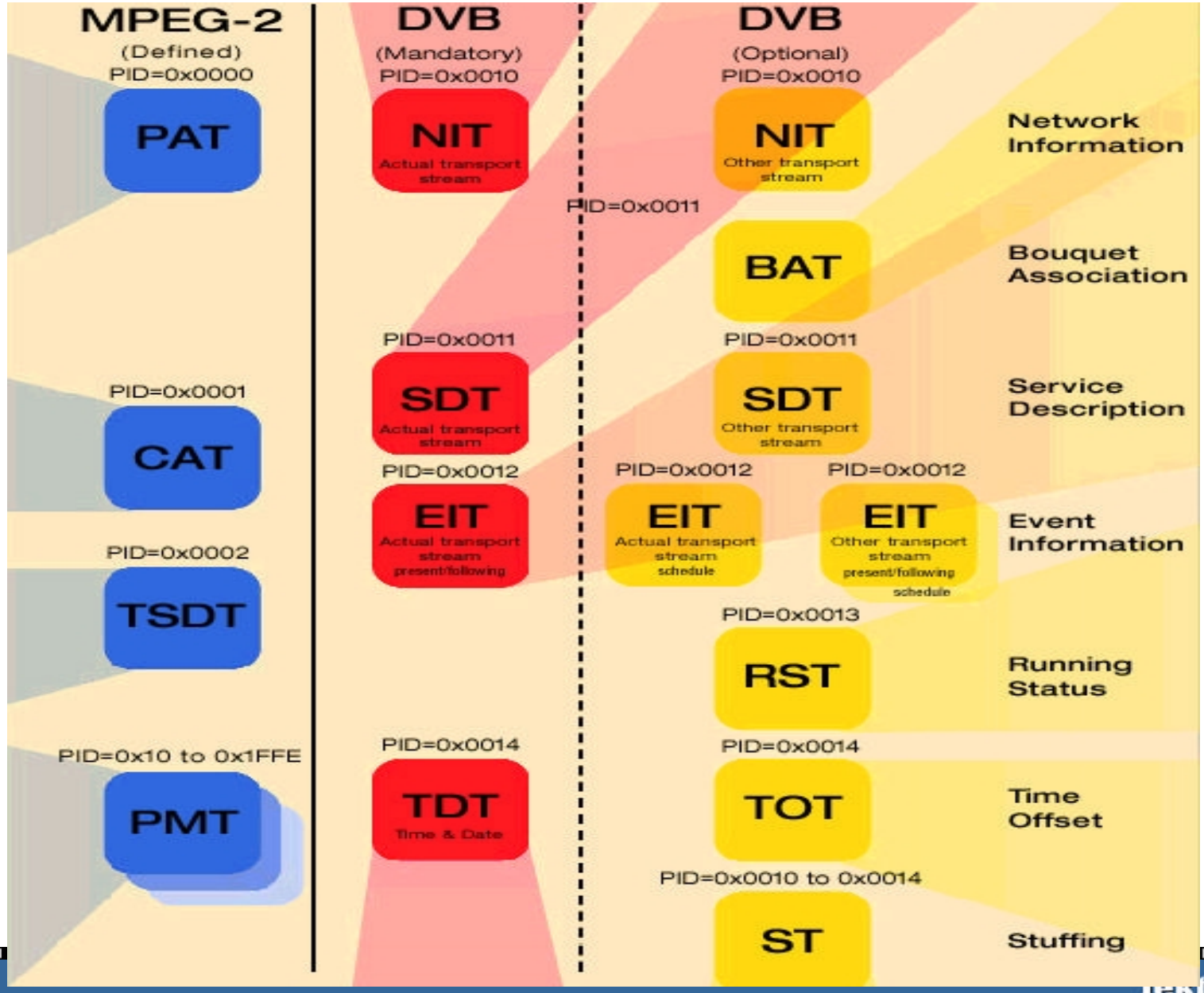
Table Timing Intervals

Table Type	PID	Max Interval
PAT	0x0	100 ms
CAT	0x1	100 ms
TSDT	0x2	100 ms
MGT	0x1FFB	150 ms
TVCT	0x1FFB	400 ms
CVCT	0x1FFB	400 ms
STT	0x1FFB	1000 ms
RRT	0x1FFB	60000 ms
PMT	ALL	500 ms
EIT	ALL	500 ms

Stream Type Assignments

Value	Description
0x00	ITU-T | ISO/IEC reserved
0x01 - 0x7F	As specified in Table 2.29 (Stream type assignments) of ISO/IEC 13818-1
0x80	[Used in other systems]
0x81	ATSC A/53 audio
0x82 - 0x84	[Used in other systems]
0x85	UPID (ATSCA/57 Program/Episode/Version Identification)
0x86 - 0xBF	Reserved
0xC0 - 0xFF	User Private

DVB SI table


MPEG-2
(Defined)
PID=0x0000
PAT
PID=0x0001
CAT
PID=0x0002
TSDT
PID=0x10 to 0x1FFE
PMT
DVB
(Mandatory)
PID=0x0010
NIT
Actual transport stream
PID=0x0011
SDT
Actual transport stream
PID=0x0012
EIT
Actual transport stream present/following
PID=0x0014
TDT
Time & Date
DVB
(Optional)
PID=0x0010
NIT
Other transport stream
Network Information
PID=0x0011
BAT
Bouquet Association
PID=0x0011
SDT
Other transport stream
Service Description
PID=0x0012
EIT
Actual transport stream schedule
PID=0x0012
EIT
Other transport stream present/following schedule
Event Information
PID=0x0013
RST
Running Status
PID=0x0014
TOT
Time Offset
PID=0x0010 to 0x0014
ST
Stuffing

PID Allocation for DVB SI

Table	PID Value
PAT	0x0000
CAT	0x0001
TSDT	0x0002
reserved	0x0003 to 0x000F
NIT,ST	0x0010
SDT, BAT, ST	0x0011
EIT, ST	0x0012
RST, ST	0x0013
TDT, TOT, ST	0x0014
network synchronization	0x0015
reserved for future use	0x0016 to 0x001B
inband signalling	0x001C
measurement	0x001D
DIT	0x001E
SIT	0x001F

Allocation of table_id Values

Value	Description
0x00	program_association_section
0x01	conditional_access_section
0x02	program_map_section
0x03	transport_stream_description_section
0x04 to 0x3F	reserved
0x40	network_information_section - actual_network
0x41	network_information_section - other_network
0x42	service_description_section - actual_transport_stream
0x43 to 0x45	reserved for future use
0x46	service_description_section - other_transport_stream
0x47 to 0x49	reserved for future use
0x4A	bouquet_association_section
0x4B to 0x4D	reserved for future use
0x4E	event_information_section - actual_transport_stream, present/following
0x4F	event_information_section - other_transport_stream, present/following
0x50 to 0x5F	event_information_section - actual_transport_stream, schedule
0x60 to 0x6F	event_information_section - other_transport_stream, schedule
0x70	time_date_section
0x71	running_status_section
0x72	stuffing_section
0x73	time_offset_section
0x74 to 0x7D	reserved for future use
0x7E	discontinuity_information_section
0x7F	selection_information_section
0x80 to 0xFE	user defined
0xFF	reserved

Stream Type Assignments

Value	Description
0x00	ITU-T | ISO/IEC reserved
0x01	ISO/IEC 11172-2 Video
0x02	ITU-T Rec. H.262 | ISO/IEC 13818-2 Video or ISO/IEC 11172-2 constrained parameter video stream
0x03	ISO/IEC 11172-3 Audio
0x04	ISO/IEC 13818-3 Audio
0x05	ITU-T Rec. H.222.0 | ISO/IEC 13818-1 private_sections
0x06	ITU-T Rec. H.222.0 | ISO/IEC 13818-1 PES packets containing private data
0x07	ISO/IEC 13522 MHEG
0x08	Annex A - DSM CC
0x09	ITU-T Rec. H.222.1
0x0A	ISO/IEC 13818-6 type A
0x0B	ISO/IEC 13818-6 type B
0x0C	ISO/IEC 13818-6 type C
0x0D	ISO/IEC 13818-6 type D
0x0E	ISO/IEC 13818-1 auxiliary
0x0F - 0x7F	ITU-T Rec. H.222.0 | ISO/IEC 13818-1 reserved
0x80 - 0xFF	User private

ETSI TR 101290 - Table Timing Intervals

Table Type	PID	Max/Min
PAT	0x00	500 ms
TSDT	0x02	10000 ms [1]
NIT actual	0x10	10000 / 25 ms
NIT other	0x10	10000 / 25 ms
SDT actual	0x11	2000 / 25 ms
SDT other	0x11	10000 / 25 ms
BAT	0x11	10000 / 25 ms
EIT actual present-following	0x12	2000 / 25 ms [2]
EIT other present-following	0x12	10000 / 25 ms [2]
TOT	0x14	30000 / 25 ms
TDT	0x14	30000 / 25 ms
PMT	ALL	500 ms

[1] ETSI TR 101 211, TSDT interval defined in section 4.1.9

[2] ETSI TR 101 211, Additional EIT Actual/Other Schedule intervals defined for:
-DVB Satellite/Cable in section 4.4.1
-DVB Terrestrial in section 4.4.2

MEMO