AVTransport

MPEG-2 Transport

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The MPEG-2 Standard

- **ISO/IEC 13818 – 1994**
- **Source Coding**
  - Video (Partie 2)
  - Audio (Partie 3)
  - Advanced Audio Coding (AAC, Partie 7)
- **Transport**
  - Error-free environments (PS)
  - Error-prone environments (TS)
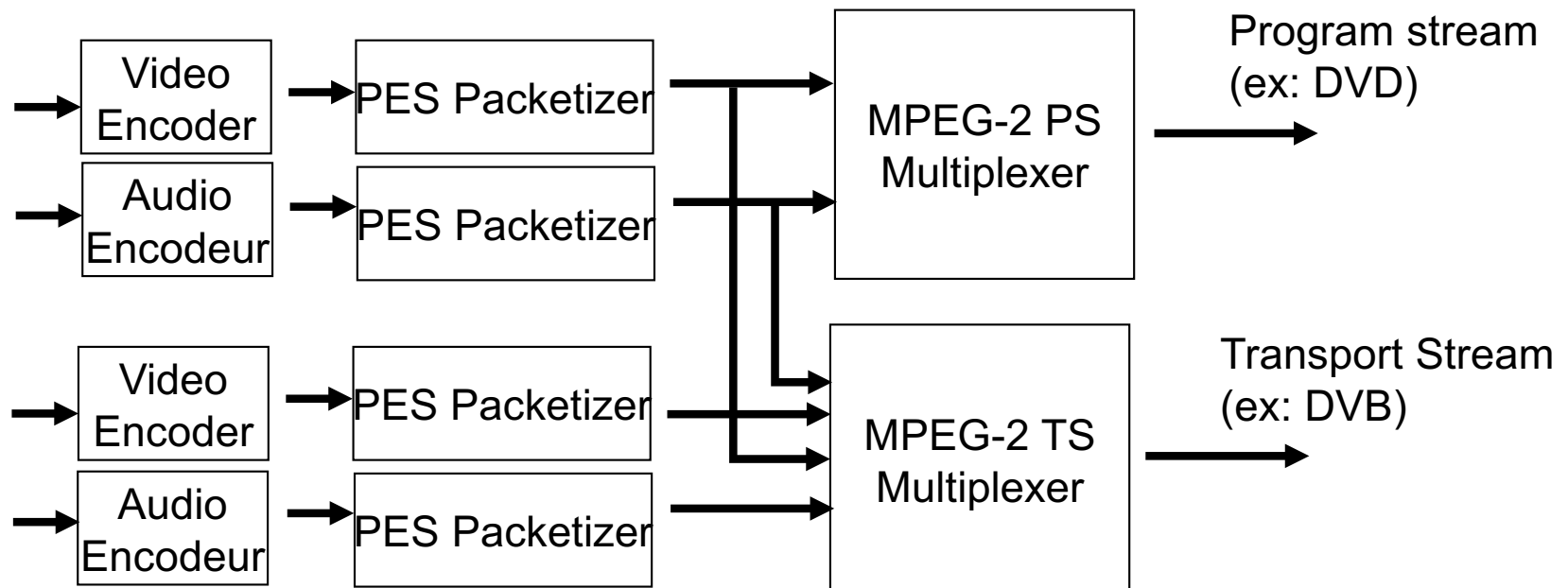 - Controle (DSM-CC)

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MPEG-2 Broadcasting

- **Packetized Elementary Streams (PES)**
  - Media: audio, video, subtitles
  - Data: interactive services, program guide, IP traffic
- **2 multiplexing modes:**
  - Program Stream (MPEG-2 PS)
  - Transport Stream (MPEG-2 TS)

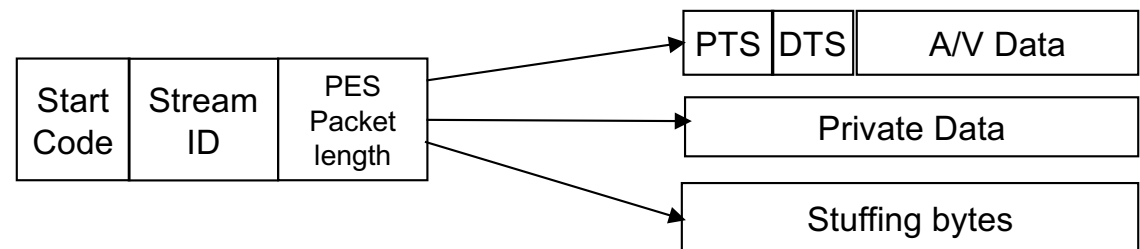# MPEG-2 Transport Stream

- **MPEG-2 TS = multiplexing format**
  - For several TV channels
    - N * (Video + Audio(s) + Data) with different time bases
  - Special Case: one program
    - Single Program Transport Stream (SPTS)
- **1 transport stream = sequence of transport packets**
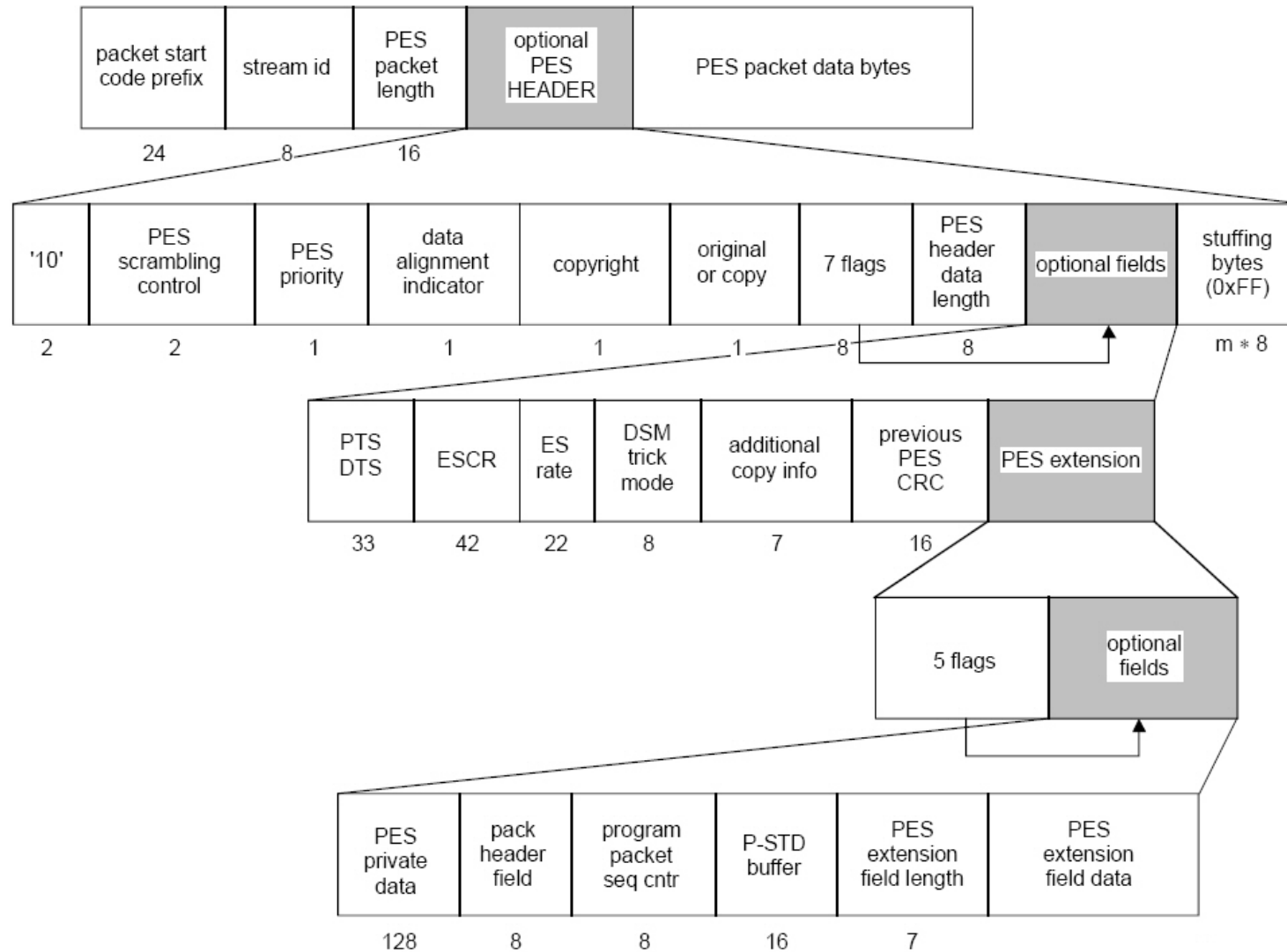 - Fixed size (188 bytes)
    - Helps integration with error correction tools
  - Detection of data packet starts
  - Synchronization after packet loss
- **Two ways of transporting data**
  - Sections: meta data, EPG, etc…
    - Carousel
  - PES Packets: audio, video
    - PTS+DTS, Clock
    - RAP, Size

Start Code	Stream ID	PES Packet length

PTS	DTS	A/V Data

Private Data

Stuffing bytes

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MPEG-2 PES

MPEG-2 Transport Stream
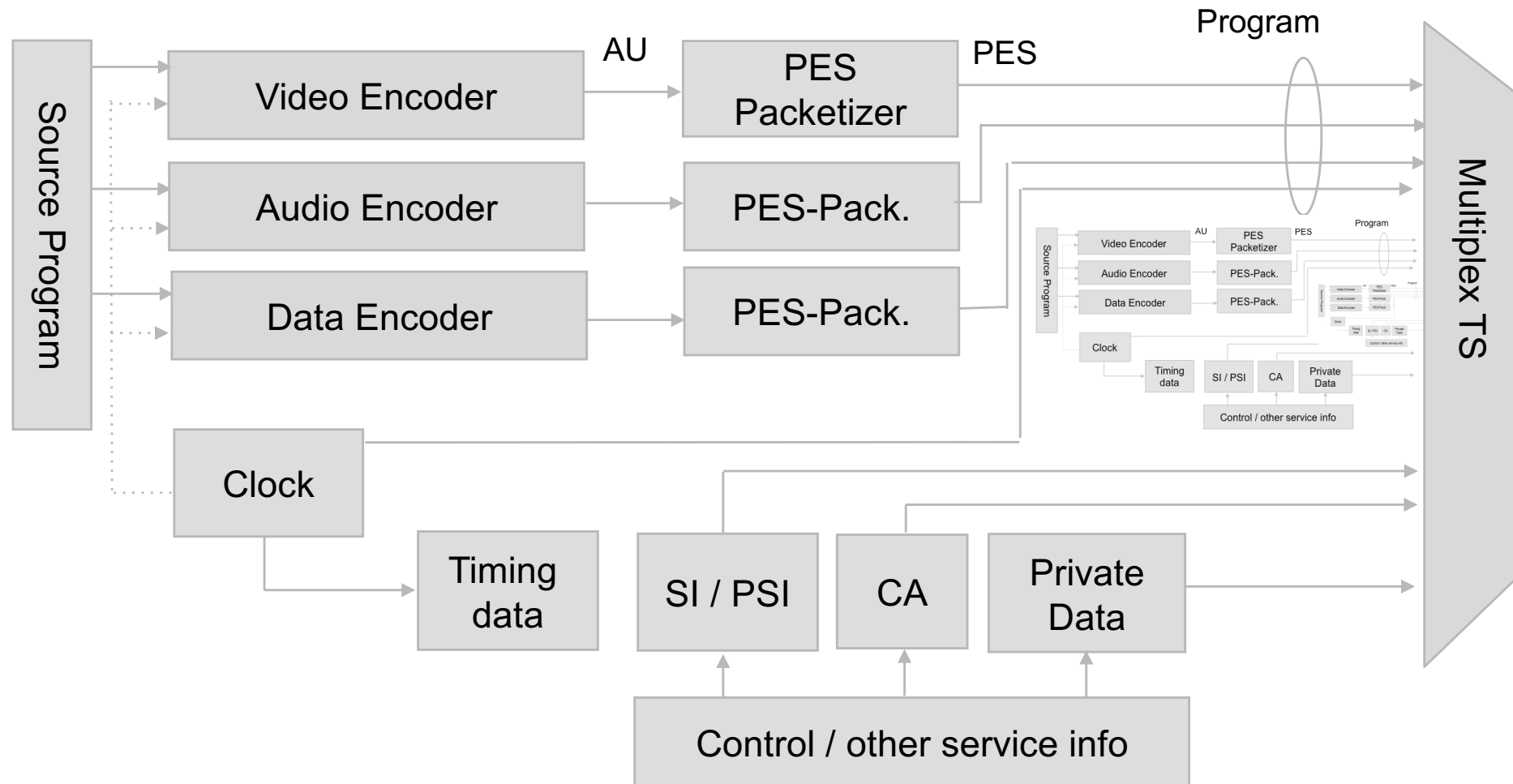
MPEG-2 TS –Sections
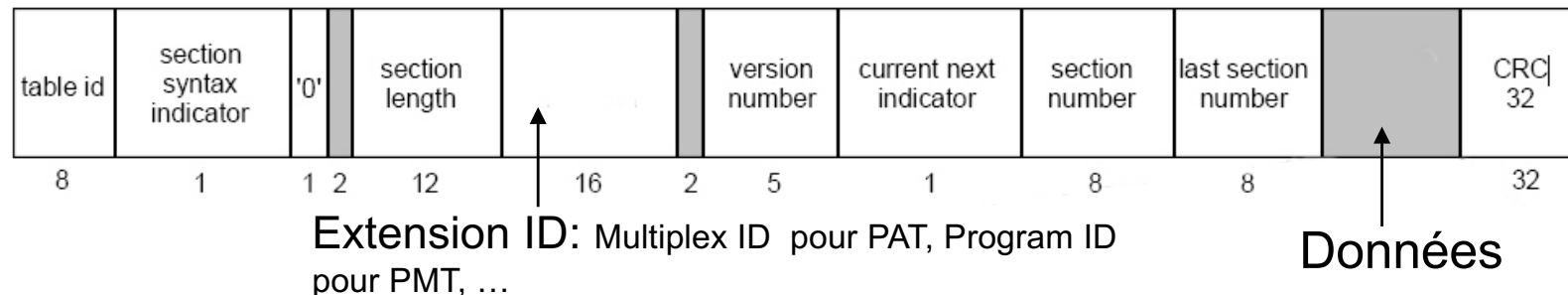
- **Data Transport**
  - Data Blocs or « tables », of any type
  - No real-time constraint
  - Supports data repetition or update (carousel)
    - Version number
- **Table fragmentation: sections**
  - Maximum size: 1024 or 4096 bytes
  - Current and total fragments: 8-bit
    - Max 256 sections / table
      - 1 table < 256 KB or 1 MB
  - Transport integrity: CRC32
- **Table Multiplexing**
  - TableID
  - Allows sending of different tables on a single PID

table id	section syntax indicator	'0'		section length			version number	current next indicator	section number	last section number		CRC 32
8	1	1	2	12	16	2	5	1	8	8		32

Extension ID: Multiplex ID pour PAT, Program ID pour PMT, …

Données

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MPEG-2 TS – Le paquet TS

- **Fixed packet size**
  - 188 bytes
- **Header 4 bytes:**
  - Synchronization word (1 byte): synchronization recovery when losses
  - Error flag: if errors are still present in the TS packet
  - Packet Identifier (PID): packet destination
    - (13 bits: max 8192 destinations)
  - Start flag: PES or Section first byte in this packet
- **Scrambling indicator**
- **Adaptation Field**
  - For header extensions
  - Random Access Point (RAP) indication
  - Clock (PCR)

TS Header

Sync Word	Error flag	Start Flag	priority	PID	Scrambling	AF	CC
8 bits 0x47	1 bit	1 bit	1 bit	13 bits	2 bits	2 bits	4 bits

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188 bytes

Transport packet stream

| header | payload | header | payload | header | payload |

sync byte	transport error indicator	payload unit start indicator	transport priority	PID	transport scrambling control	adaptation field control	continuity counter	adaptation field
8	1	1	1	13	2	2	4	

adaptation field length	discontinuity indicator	random access indicator	elementary stream priority indicator	5 flags	optional fields	stuffing bytes
8	1	1	1	5		

PCR	OPCR	splice countdown	transport private data length	transport private data	adaptation field extension length	3 flags	optional fields
42	42	8	8		8	3	

ltw_valid flag	ltw offset		piecewise rate	splice type	DTS_next_au
1	15	2	22	4	33

TISO5910-95/d19

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MPEG-2 TS Timing

- **Each program carries a clock**
  - Program Clock Reference (PCR)
  - PES Timestamps relate to this clock
- **Constraints:**
  - PCR shall be send often to compensate receiver clock drifts
    - MPEG-2 <100 ms
    - DVB: < 40 ms (i.e. once per frame @ 25 Hz)
- **Consequence**
  - At constant rate D, time between PCR_i and PCR_{i+1} is:
  $$PCR_{interpolate} = PCR_i + BitsSincePCR_i / D$$
  - Interpolation allowed even if VBR

Program and Streams

- **Program Association Table**
  - Identifies a multiplex (ID 16 bits)
  - Lists all programs
    - Program Number (16 bit)
    - PID carrying PMT
      - If PID= 0, NIT
- **Program Map Table**
  - PID carrying the PCR
    - Not always a media stream !
  - Program Descriptors
    - Protection systems, interactive apps …
  - Lists all streams
    - PID: where stream data is carried in the multiplex
    - streamType: type of media compression
    - Stream descriptors
      - Language, coding parameters, demux parameters, …

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MPEG-2 TS: Core Concepts

- **TS, PES**
- **PID**
  - Indicates where the data goes
    - Allows filtering of packet for non viewed programs
  - **Does not indicate PES/section or coding type**
  - Reserved PID
    - Some PSI data
    - Program Assocation Table (PAT)
    - Conditional Acces Table (CAT)
    - Transport Stream Description Table (TSDT)
    - User-reserved: Other standard bodies (DVB, ATSC, …)
- **Stream Type**
  - One per PID at any point in time
    - But may change if PMT changes !
  - Indicates coding type
  - Implies transport type (PES or Sections)
- **PSI "Program Service Information"**
  - Multiplex description
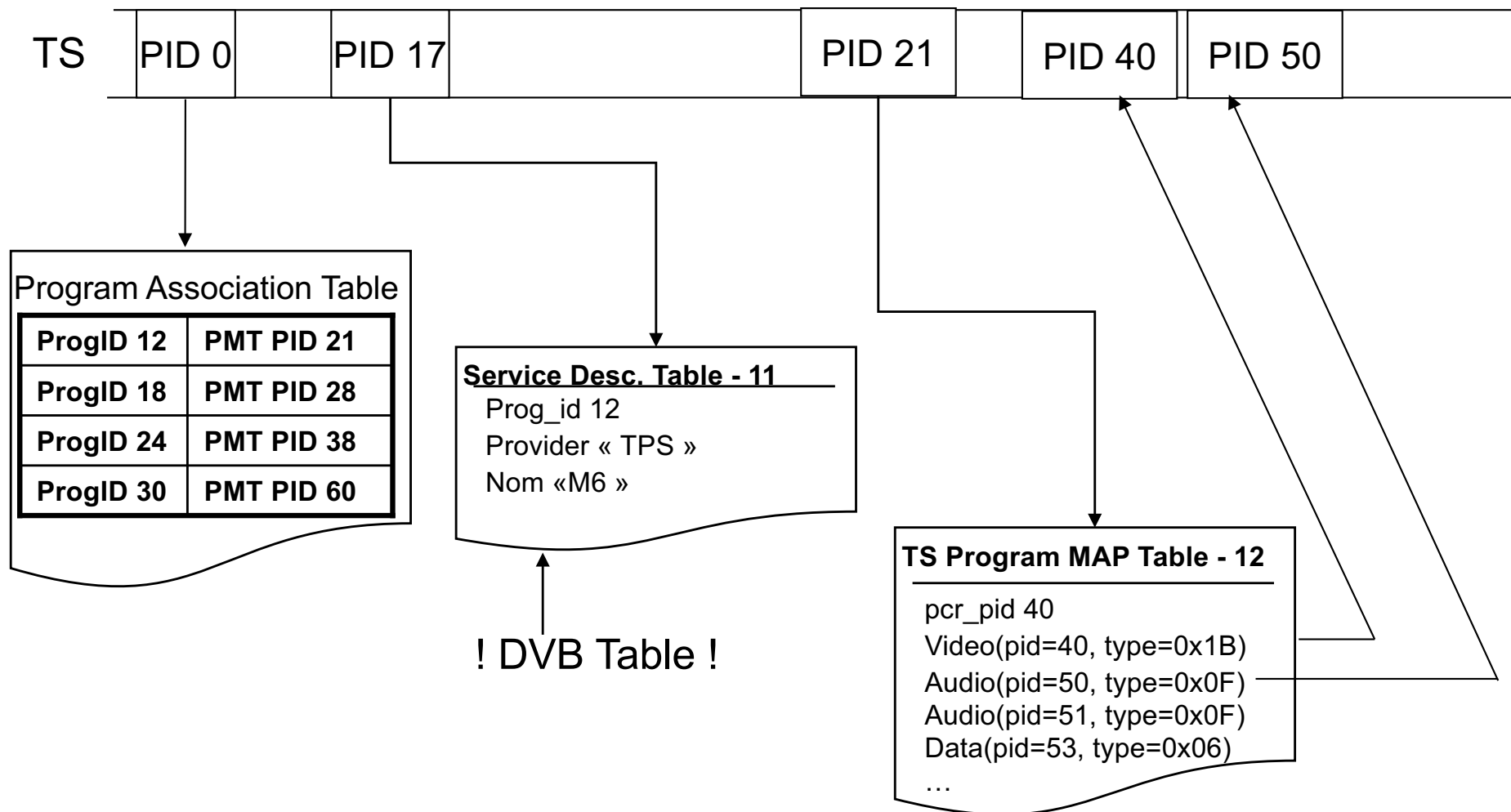 - Program description
  - Stream Descripion

Valeur du PID	Description
0x0000	Program Association Table (PAT)
0x0001	Conditional Access Table (CAT)
0x0002	Transport Stream Description Table (TSDT)
0x0003	IPMP Control Table
0x0004 – 0x000F	Valeurs réservées
0x0010 – 0x1FFE	Valeurs utilisables pour: -Network information table (NIT) -Program Map Table (PMT) -PID des flux élémentaires
0x1FFF	Paquet vide

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MPEG-2 TS: streamType

Valeur	Stream Type
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	ITU-T Rec. H.222.0 | ISO/IEC 13818-1 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	ITU-T Rec. H.222.0 | ISO/IEC 13818-1 auxiliary
0x0F	ISO/IEC 13818-7 Audio with ADTS transport syntax

Valeur	Stream Type
0x10	ISO/IEC 14496-2 Visual
0x11	ISO/IEC 14496-3 Audio with the LATM transport Syntax as defined in ISO/IEC 14496-3/AMD-1
0x12	ISO/IEC 14496-1 SL-packetized stream or FlexMux stream carried in PES packets
0x13	ISO/IEC 14496-1 SL-packetized stream or FlexMux stream carried in ISO/IEC14496_sections
0x14	ISO/IEC 13818-6 Synchronized Download Protocol
0x15	Metadata carried in PES packets
0x16	Metadata carried in metadata_sections
0x17	Metadata carried in ISO/IEC 13818-6 Data Carousel
0x18	Metadata carried in ISO/IEC 13818-6 Object Carousel
0x19	Metadata carried in ISO/IEC 13818-6 Synchronized Download Protocol
0x1A	IPMP stream (defined in ISO/IEC 13818-11, MPEG-2 IPMP)
0x1B	AVC video stream as defined in ITU-T Rec. H.264 | ISO/IEC 14496-10 Video
0x1C-0x7E	ITU-T Rec. H.222.0 | ISO/IEC 13818-1 Reserved
0x7F	IPMP stream
0x80-0xFF	User Private

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MPEG-2 TS: multiplex tune-in

TS | PID 0 | PID 17 | PID 21 | PID 40 | PID 50

Program Association Table

ProgID 12	PMT PID 21
ProgID 18	PMT PID 28
ProgID 24	PMT PID 38
ProgID 30	PMT PID 60

Service Desc. Table - 11
Prog_id 12
Provider « TPS »
Nom «M6 »

! DVB Table !

TS Program MAP Table - 12

pcr_pid 40
Video(pid=40, type=0x1B)
Audio(pid=50, type=0x0F)
Audio(pid=51, type=0x0F)
Data(pid=53, type=0x06)
…

MPEG-2 TS: Scrambling

- **Scrambling may happen:**
  - At PES payload level
  - At some sections payload level
  - At TS packet level
    - Most common use case
    - **PES headers are scrambled**
- **Exceptions**
  - PAT: required to get list of programs
  - PMT: required to get protection system used
  - NIT/TSDT: infrastructure management

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Descripteurs MPEG-2

descriptor_tag	TS	PS	Identification
0	n/a	n/a	reserved
1	n/a	X	forbidden
2	X	X	video_stream_descriptor
3	X	X	audio_stream_descriptor
4	X	X	hierarchy_descriptor
5	X	X	registration_descriptor
6	X	X	data_stream_alignment_descriptor
7	X	X	target_background_grid_descriptor
8	X	X	video_window_descriptor
9	X	X	CA_descriptor
10	X	X	ISO_639_language_descriptor
11	X	X	system_clock_descriptor
12	X	X	multiplex_buffer_utilization_descriptor
13	X	X	copyright_descriptor
14	X		maximum_bitrate_descriptor
15	X	X	private_data_indicator_descriptor
16	X	X	smoothing_buffer_descriptor
17	X		STD_descriptor
18	X	X	IBP_descriptor
19-26	X		Defined in ISO/IEC 13818-6
27	X	X	MPEG-4_video_descriptor
28	X	X	MPEG-4_audio_descriptor
29	X	X	IOD_descriptor
30	X		SL_descriptor
31	X	X	FMC_descriptor
32	X	X	external_ES_ID_descriptor
33	X	X	MuxCode_descriptor

descriptor_tag	TS	PS	Identification
34	X	X	FmxBufferSize_descriptor
35	X		multiplexbuffer_descriptor
36	X	X	content_labeling_descriptor
37	X	X	metadata_pointer_descriptor
38	X	X	metadata_descriptor
39	X	X	metadata_STD_descriptor
40	X	X	AVC video descriptor
41	X	X	IPMP_descriptor (defined in ISO/IEC 13818-11, MPEG-2 IPMP)
42	X	X	AVC timing and HRD descriptor
43	X	X	MPEG-2_AAC_audio_descriptor
44	X	X	FlexMuxTiming_descriptor
45	X	X	MPEG-4_text_descriptor
46	X	X	MPEG-4_audio_extension_descriptor
47	X	X	auxiliary_video_stream_descriptor
48	X	X	SVC extension descriptor
49	X	X	MVC extension descriptor
50	X	n/a	J2K video descriptor
51	X	X	MVC operation point descriptor
52	X	X	MPEG2_stereoscopic_video_format_descriptor
53	X	X	Stereoscopic_program_info_descriptor
54	X	X	Stereoscopic_video_info_descriptor
55-63	n/a	n/a	Rec. ITU-T H.222.0	ISO/IEC 13818-1 Reserved
64-255	n/a	n/a	User Private

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| Syntax | No. of bits | Mnemonic |

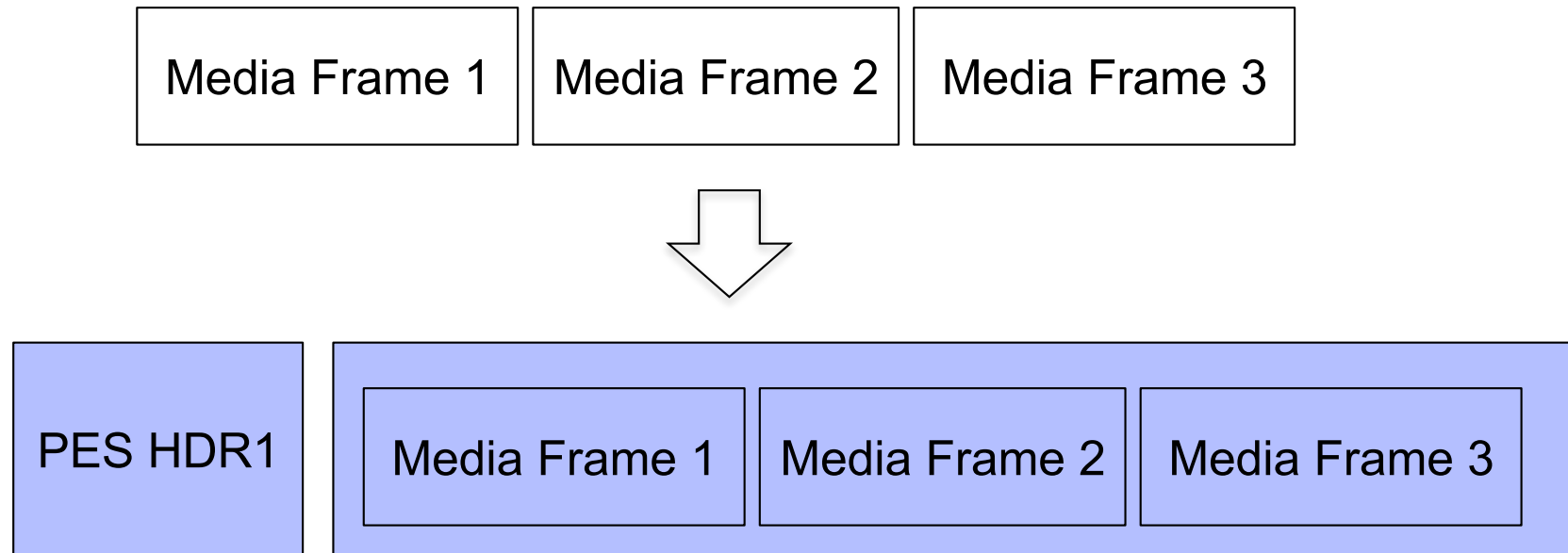# Random Access in TS

■ **RAP Random Access Point**

■ **MPEG-2 TS random access**

- First locate PAT
- Then locate CAT if present
- Finally locate PMT(s)
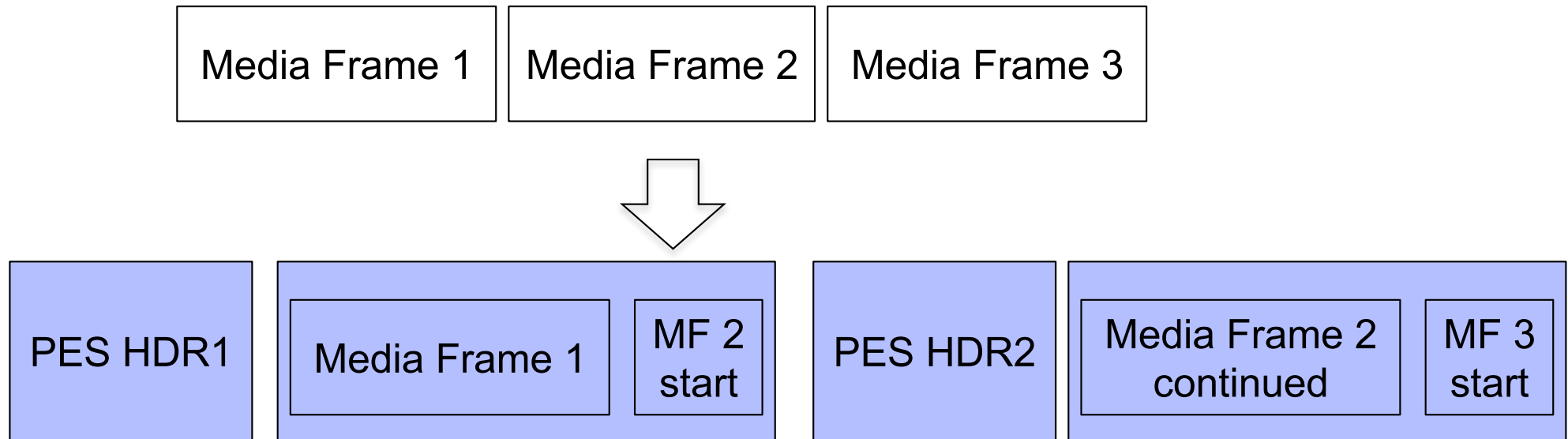- Required for demuxer+decoder(+descrambler) setup

■ **Media**

- May be signaled in adaptation field
- Audio
  – Each AU is a RAP
    - Exceptions about to de deployed with MPEG-H Audio
- Video
  – Intra frames (MPEG-2), IDR (AVC or HEVC) and CRA/BLA (HEVC)
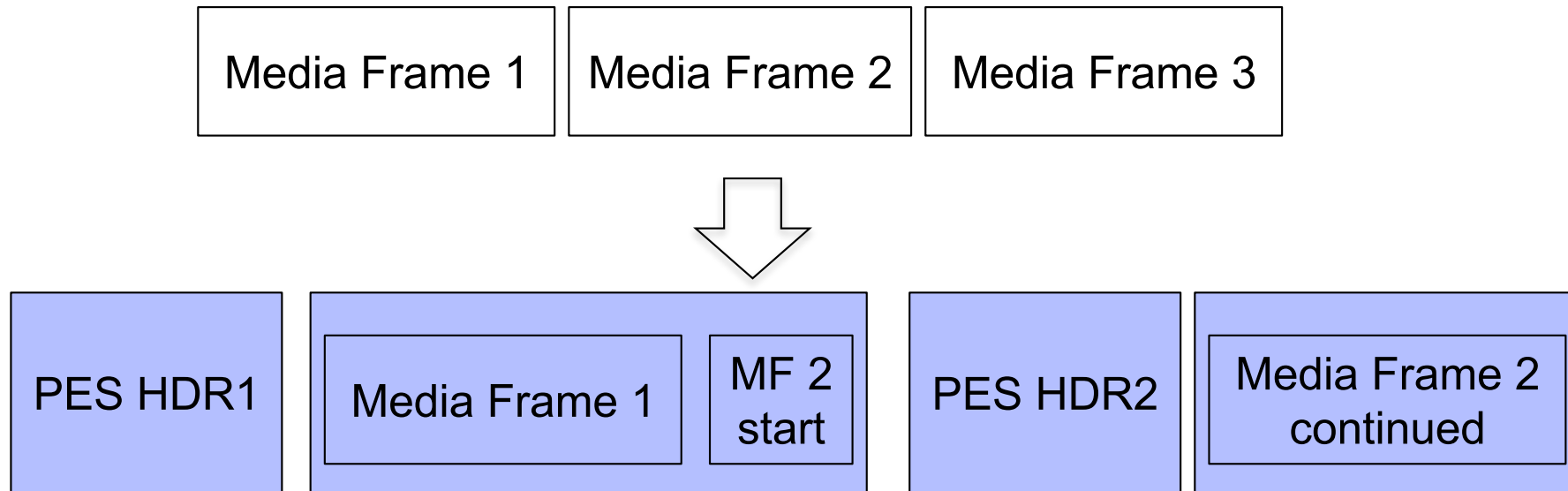
MPEG-2 Packetization Ex #1

Media Frame 1	Media Frame 2	Media Frame 3

⬇

PES HDR1	Media Frame 1	Media Frame 2	Media Frame 3

- **PES HDR1**
  - PTS/DTS of Frame 1
  - Size: sum of 3 frames
- **Timing of frames 2, 3 ?**
  - Interpolation !
  - Requires understanding the media (sample rate, samples/frame, …)
- **Frames sizes for 1, 2, 3 ?**
  - Requires bitstream parsing !
  - Start code and other framing mechanisms

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MPEG-2 Packetization Ex #2

Media Frame 1 | Media Frame 2 | Media Frame 3

PES HDR1 | Media Frame 1 | MF 2 start | PES HDR2 | Media Frame 2 continued | MF 3 start

- **PES HDR2**
  - PTS/DTS of frame 3 (i.e of the first frame that starts in the packet)
- **Timing of frame 2**
  - Interpolation !
  - Requires understanding the media (sample rate, samples/frame, …)
- **Size of frames 1, 2, 3 ?**
  - Requires bitstream parsing !
  - Start code and other framing mechanisms
  - Requires storing parsing context between 2 PES packets

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MPEG-2 Packetization Ex #3

Media Frame 1	Media Frame 2	Media Frame 3

PES HDR1	Media Frame 1	MF 2 start	PES HDR2	Media Frame 2 continued

- **PES HDR2**
  - **No PTS/DTS** (the frame does not start in this PES packet)
- **Timing of frame 2**
  - Interpolation !
  - Requires understanding the media (sample rate, samples/frame, …)
- **Size of frames 1, 2, 3 ?**
  - Requires bitstream parsing !
  - Start code and other framing mechanisms
  - Requires storing parsing context between 2 PES packets

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MPEG-2 Packetization

■ **Alignment PES/frame**

- • May be indicated in adaptation field
- • May match various media bitstream syntax elements:
  - — Frame start
  - — Frame start or slice start
  - — Component Subset (SVC or MVC)

■ **In real-life**

- • DVB/ATSC/ISDB: Video aligned, 1 frame per PES
  - — DVB allows N complete frames / PES
  - — And allows other configurations "if supported" ☺
- • Audio : usually not aligned
- • Cf ETSI TS 101 154

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AVC / HEVC Packetization

■ **NAL units produced by encoder**

■ **Bitstream format before PES packetization**

- Start-code 0x00000001 (or 0x000001)

- NAL data

- emulation prevention bytes for start codes

  — Avoids NALU data to be interpreted as a start code

  — 0x0000xx with x in {1,2,3} sequences in NALs

    - Replaced 0x0000030x

■ **PES packet inspection**

- By looking through start code (idem for MPEG-2 video)

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Audio Packetization

- **MP3**
  - Sync word in the header of MP3 AU
  - Frame size in the header of MP3 AU
- **AAC Format ADTS**
  - Sync word
  - Frame size and other info (channels, sample rate)
  - AU AAC payload
- **Warning, no emulation prevention**
  - Fake start codes may happen
  - Verify info coherence (channels, sample rate)
  - Check stream coherence
    - position + Header(N).size = Valid Header(N+1)

PES to TS Packetization

PES HDR1
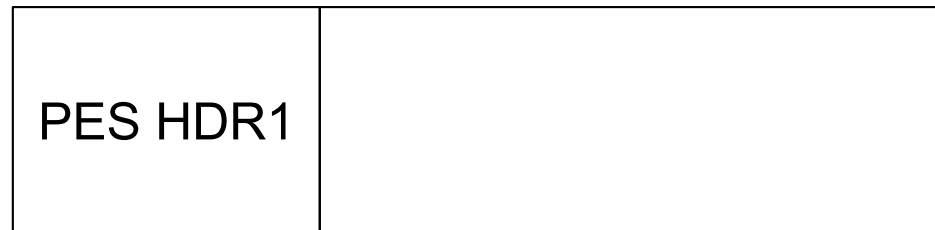
<= N x 184 bytes

AF : yes
Payload Start Indicator = 1

| TS HDR #1 | A F | PES HDR | Data … |

PCR
Random Acces Point
…

AF: no (most of the time)

| TS HDR #k | Data … |

AF: yes with padding

| TS HDR N | A F | PAD 0xFF | Data End |
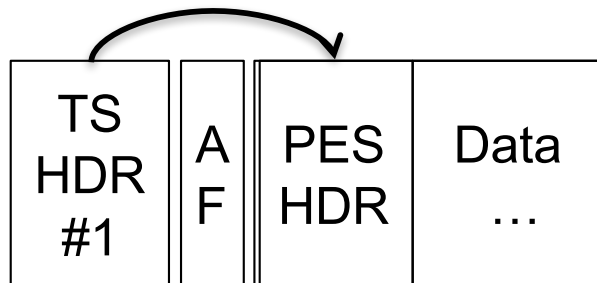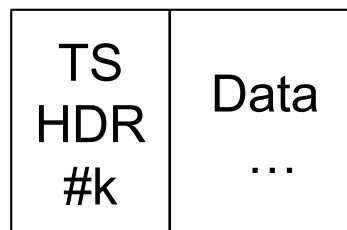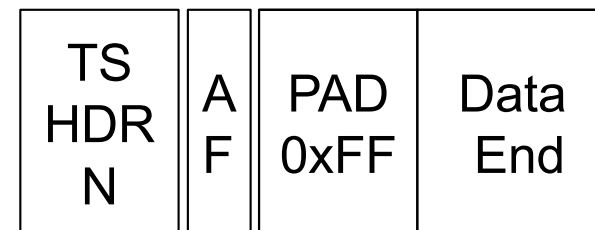
Padding size

Section to TS Packetization

PSI HDR
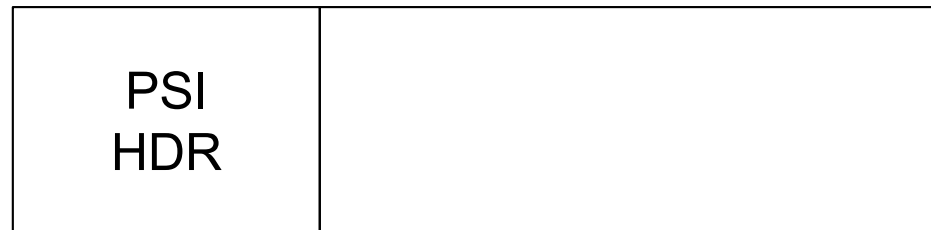
<= N x 184 bytes

Payload Start Indicator = 1

| TS HDR #1 | PRT | data prev | Section HDR | Data ... |

AF: yes with padding

| TS HDR N | A F | PAD 0xFF | Data End |
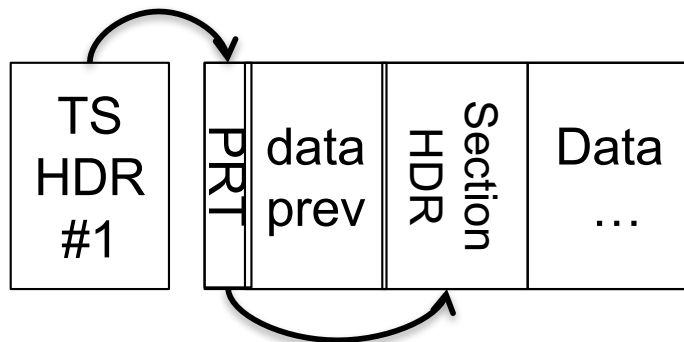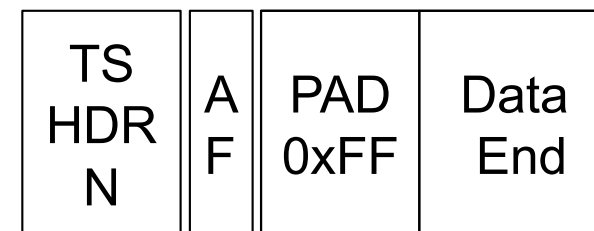
Padding size

- **Pointer_field**
  - 1 byte if payload start Indicator = 1
  - Gives number of bytes before next section (PSI) header

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Timing model and decoder

- **Transport Stream System Target Decoder (T-STD)**
  - Hypothetical model describing data transfer rates in the demultiplexer and decoder(s)

$$t(i) = \frac{PCR(i'')}{system\_clock\_frequency} + \frac{i - i''}{transport\_rate\,(i)}$$

$$transport\_rate(i) = \frac{((i' - i'') \times system\_clock\_frequency)}{PCR(i') - PCR(i'')}$$

i-th byte of Transport Stream

RX_1 Rbx_1 $A_1(j)$ $td_1(j)$ Video

TB_1 — MB_1 — EB_1 — D_1 — O_1 — $P_1(k)$ / $tp_1(k)$

j-th access unit

k-th presentation unit

t(i)

RX_n $A_n(j)$ $td_n(j)$ Audio

TB_n — B_n — D_n — $P_n(k)$ / $tp_n(k)$

RX_{sys} R_{sys}

TB_{sys} — B_{sys} — D_{sys} — System control

TISO5810-95/d06
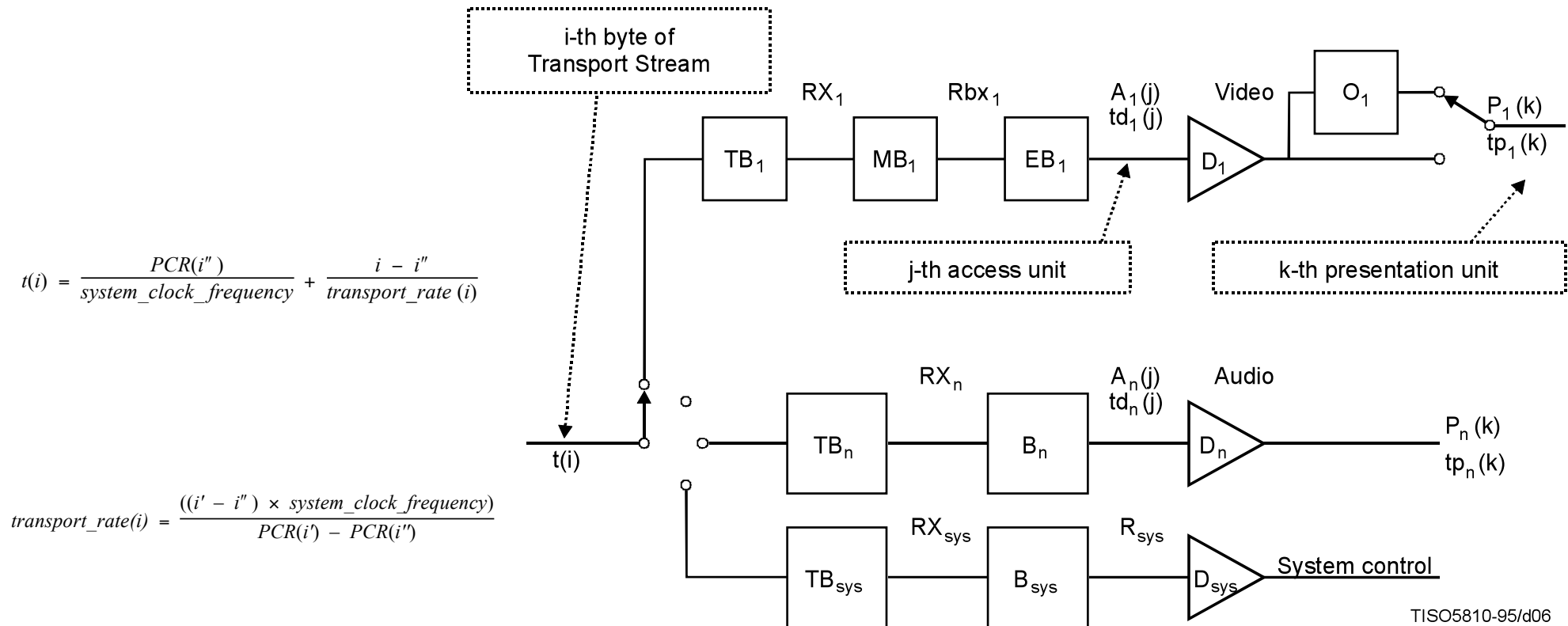
T-STD Constraints

■ **Max fetch rate from buffers**

- $Rx_n <= R_{MAX}$, specified for each media type
- Video: depends on Profile/Level
- Audio, DATA: depends on number of channels
  - MPEG-1/2, Systems: 2 Mbps
  - AAC: up to 33 Mbps

■ **Buffer Sizes**

- Transport Buffer size: 512 bytes
- ES Buffer Size given per media type
  - AAC: < 51 kBytes
  - MPEG-1/2: 3584 bytes
  - Systems: 1536 Bytes
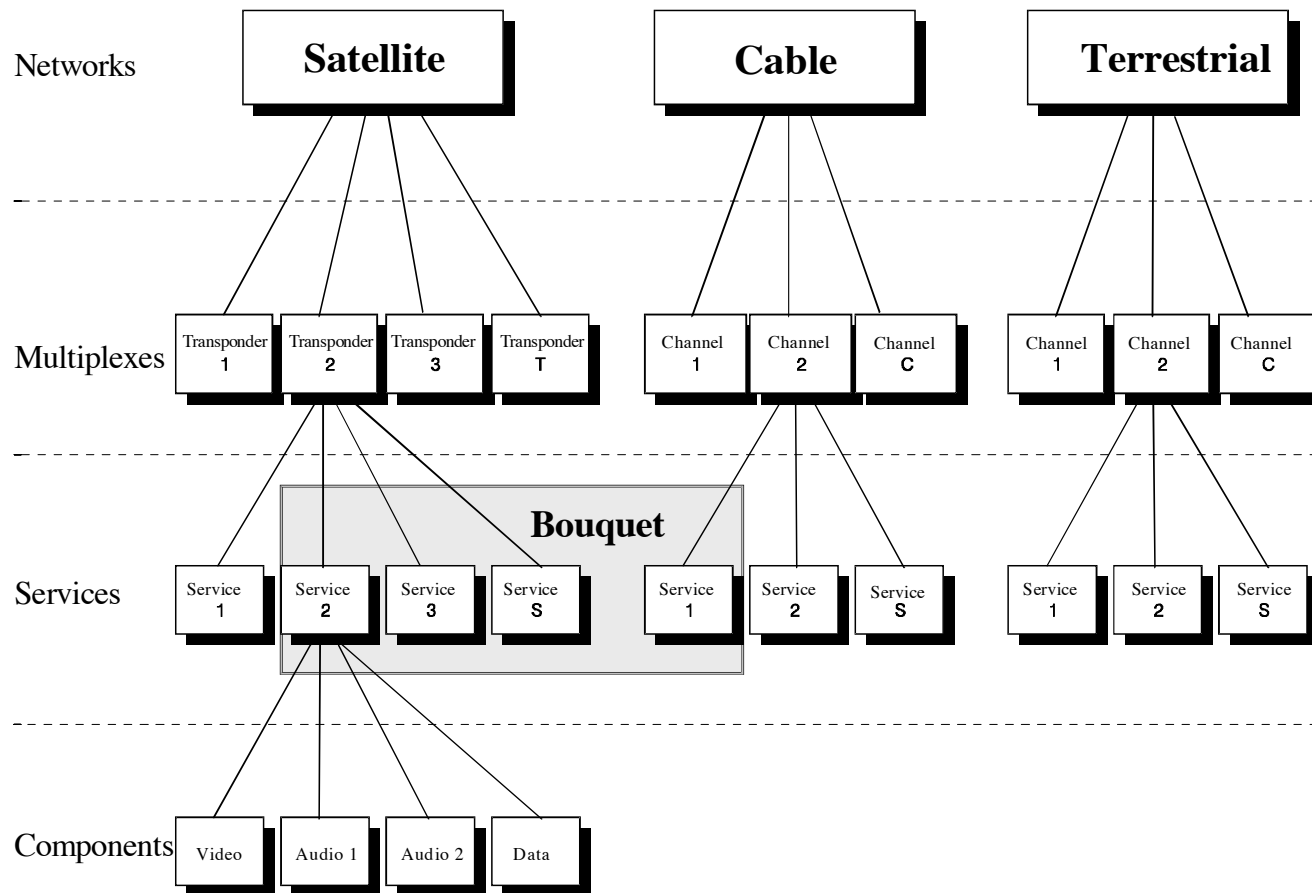 - Video: depends on Profile/Level
    - AVC: 10 sec max delay between TBn et Ebn

Institut Mines-Télécom

AVTransport - MPEG-2 TS - DVB - File Broadcasting

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DVB

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DVB

- **Created in 1992**
  - \> 300 members, >35 countries - www.dvb.org
  - Promotion of open standards for Digital TV broadcasting
- **Principal Recommandations**
  - Physical Layer
    - Satellite: DVB-S, DVB-S2
    - Cable: DVB-C
    - Terrestrial: DVB-T, DVB-T2
    - Mobiles DVB-H, DVB-SH
  - Signalisation
    - Information de services: DVB-SI
    - Services synchro: DVB-SAD
  - Protection
    - DVB-CAS, DVB-CSA
    - Interface smartcard: DVB-CI, DVB-CI+

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DVB Service Model

16/02/2017   Institut Mines-Télécom   AVTransport - MPEG-2 TS - DVB - File Broadcasting

Program Signaling Information / Service Information

- **Network Information Table (NIT)**
  - Network topology (Frequencies, FEC, …)
  - PID 16, TableID 64 | 65
- **Service Description Table (SDT)**
  - Multiplex Description (channel names, …)
  - PID 17, TableID 66 | 70
- **Bouquet Association Table (BAT)**
  - Link to other services
  - PID 17, TableID 74
- **Event Information Table (EIT)**
  - Electronic Program Guide for present and following shows
  - PID 18, TableID 78 | 79
- **Time and Date Table (TDT)**
  - UTC clock
  - PID 20, TableID 112
- **Application Information Table (AIT)**
  - Interactive App signaling (MHP, HbbTV,…)
  - PID dynamique, TableID 116
  - Type d'application
- **IP/MAC Notification Table (INT)**
  - IP Transport
  - PID Dynamique, TableID 76

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ETSI TS 300 468
- Mais pas 100% complet ☺

Short sections
- 1024 octet / section max
- Exception: EIT 4096 max

Sub-table
- Independent set of sections of a table Identified through table_extension_id

Repeat Rate >= 25 ms

16 ETSI EN 300 468 V1.11.1 (2010-04)

Defined in TS 300 468

MPEG-2 defined

MPEG-2

PID=0x0000

PAT

PID=0x0001

CAT

PID=P

PMT

PID=0x0002

TSDT
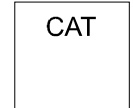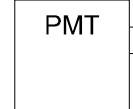
DVB
(mandatory)

PID=0x0010

NIT

Actual Network

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 Network

PID=0x0011

BAT

PID=0x0011

SDT

Other transport Stream

PID=0x0012

EIT
Actual transport stream

schedule

PID=0x0012

EIT
Other transport stream

present/following

schedule

PID=0x0013

RST

PID=0x0014

TOT

PID=0x0010 to 0x0014

ST

Network Information

Bouquet Association

Service Description

Event Information

Running Status

Time Offset

Stuffing

18 ETSI EN 300 468 V1.11.1 (2010-04

Table	PID value
PAT	0x0000
CAT	0x0001
TSDT	0x0002
reserved	0x0003 to 0x000F
NIT, ST	0x0010
SDT, BAT, ST	0x0011
EIT, ST CIT (TS 102 323 [13])	0x0012
RST, ST	0x0013
TDT, TOT, ST	0x0014
network synchronization	0x0015
RNT (TS 102 323 [13])	0x0016
reserved for future use	0x0017 to 0x001B
inband signalling	0x001C
measurement	0x001D
DIT	0x001E
SIT	0x001F

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Defined DVB SI Tables

| 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	application information section (TS 102 812 [15])
0x75	container section (TS 102 323 [13])
0x76	related content section (TS 102 323 [13])
0x77	content identifier section (TS 102 323 [13])
0x78	MPE-FEC section (EN 301 192 [4])
0x79	resolution notification section (TS 102 323 [13])
0x7A	MPE-IFEC section (TS 102 772 [50])

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DVB Descriptors

- **A Lot of them !**
  - \> 80
- **Physical Layer description**
  - frequencies, FEC, time-slicing, cellules, …
  - 1 / standard: DVB-S / S2, DVB-C, DVB-T / T2, DVB-SH
- **Non-MPEG Codecs Description**
  - VC1, AC3, DTS, DTS-HD, AAC
  - Stream configuration (~= decoder specific information)
- **Textual Descriptions**
  - Service names, Stream names (mono and multi-lingual)
    - Parental rating, icons
  - Bouquet name (mono and multi-lingual)
- **And various indications**
  - Service Redirection
  - Data broadcast (carousel)
  - Mosaic video
  - Phone (back-channel setup), …

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Data over DVB

- **Data piping**
  - raw transport on a PID
- **Data streaming**
  - send in PES packets
- **DSM-CC Data carrousel**
  - Transport on sections
- **Object Carrousel**
  - Data Carousel + file system
- **Multi Protocol Encapsulation (MPE)**
  - IP datagram over TS
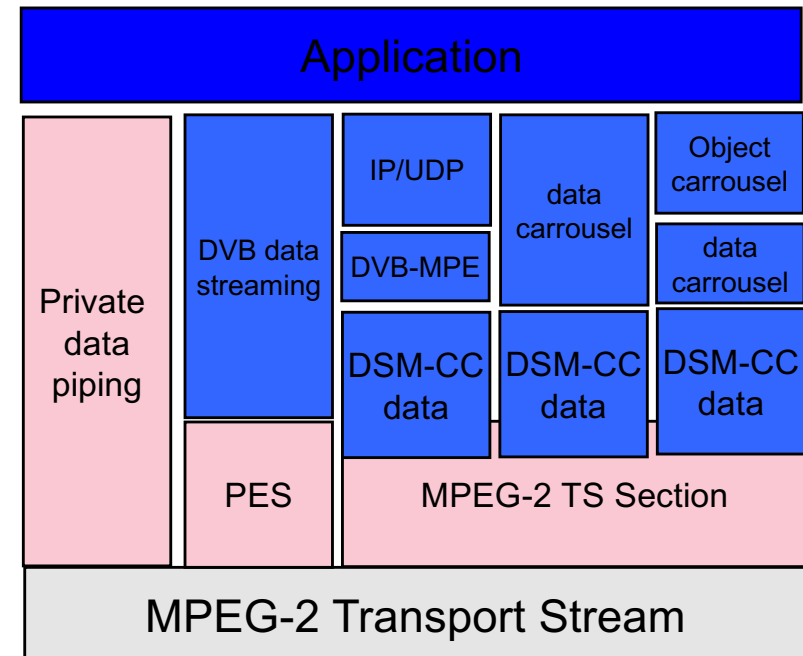
Object Caroussel

- **Mix of MPEG-2 TS sections and CORBA**
- **Concept « modules »:**
  - Files
  - File system (eg, HTML + JS + CSS)
  - Events (notifications)
  - Links to MPEG-2 TS PIDs
- **Module updating**
  - Each module has its own version
  - Update may happen on any number of modules

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Object Caroussel
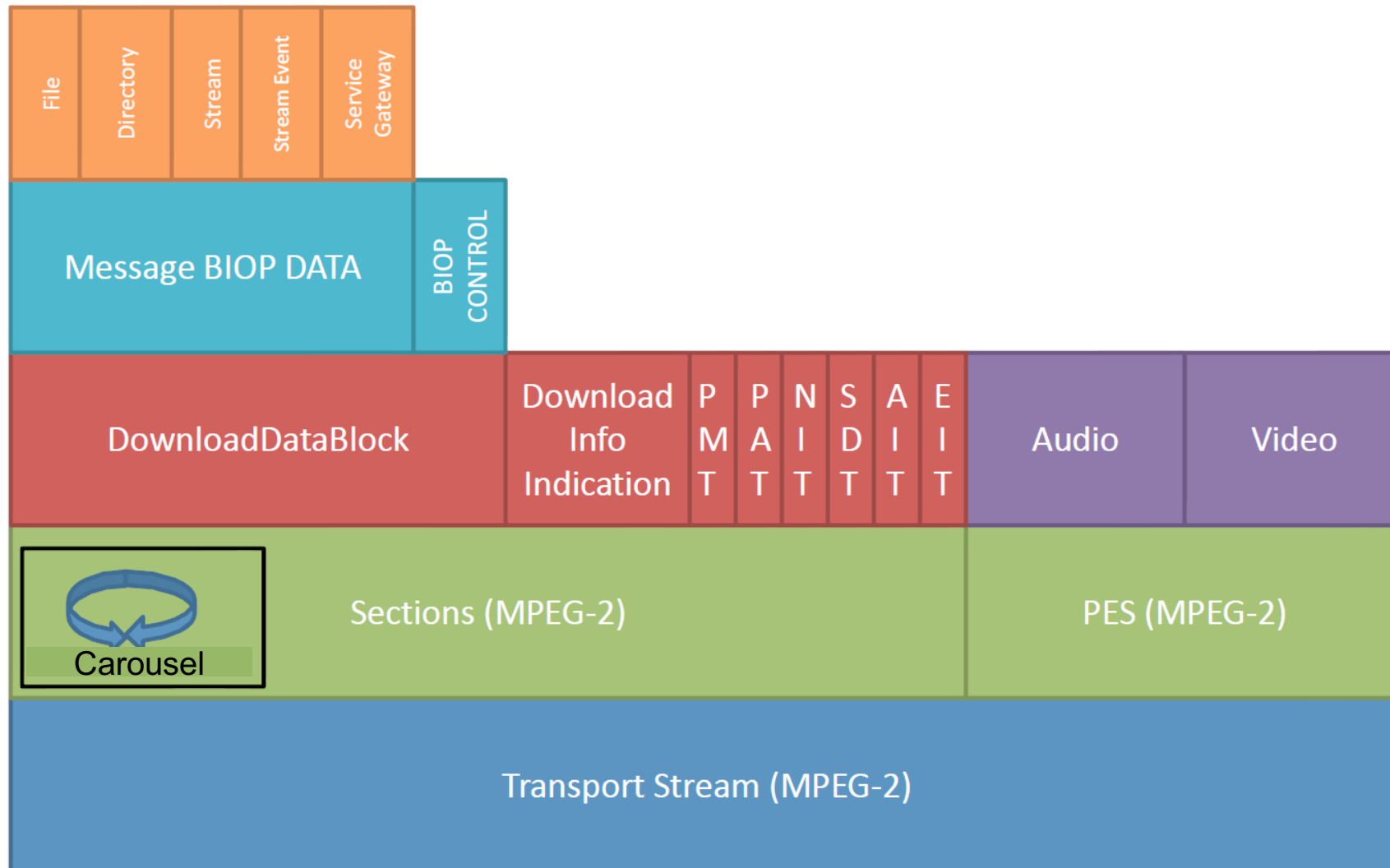
IP on MPEG-2 TS: DVB MPE

- **Pros**
  - Simple IPv4 encapsulation
  - Fast
- **Cons**
  - Only two priority modes (QoS …)
  - Complex
  - Overhead (>=16 bytes)
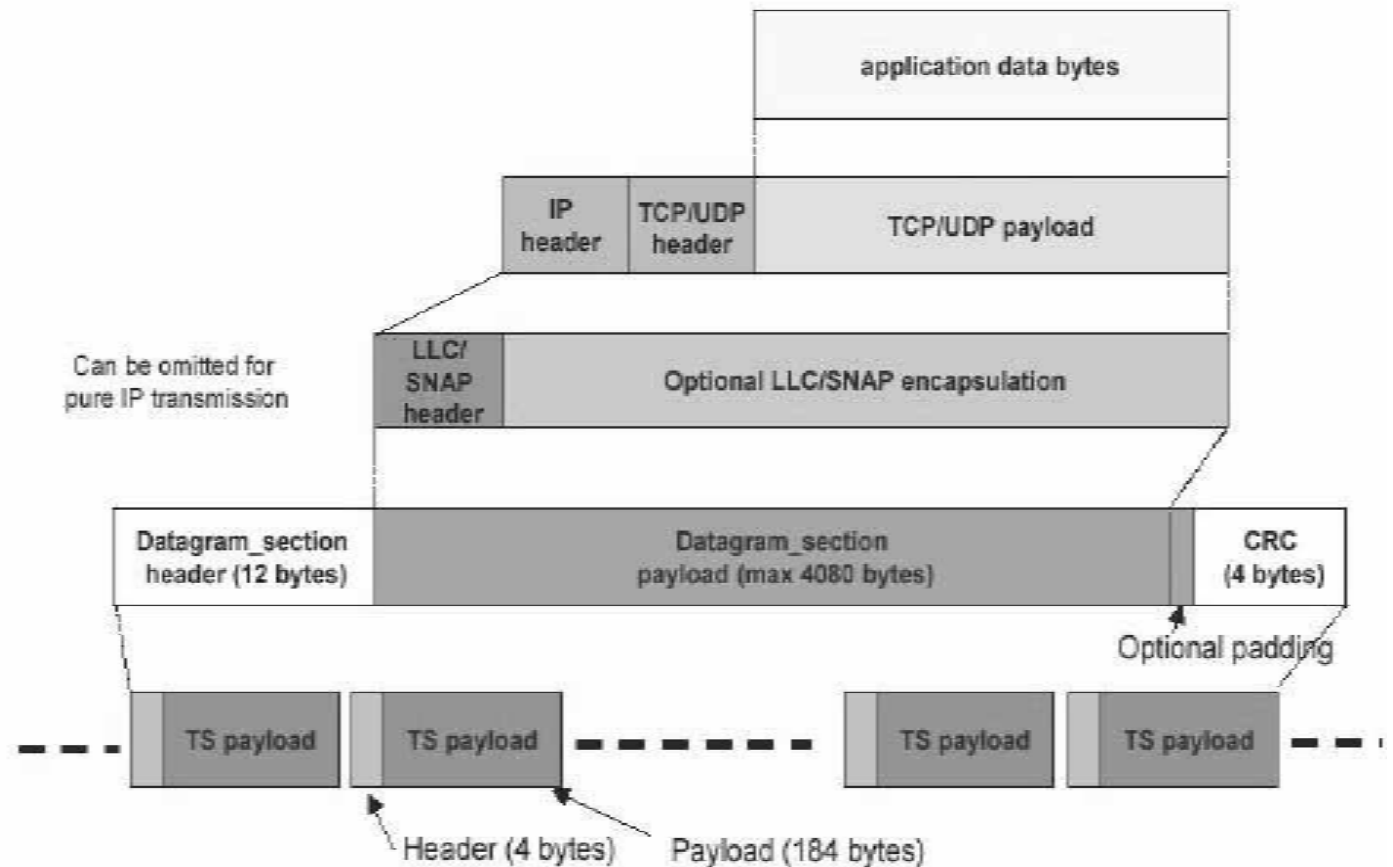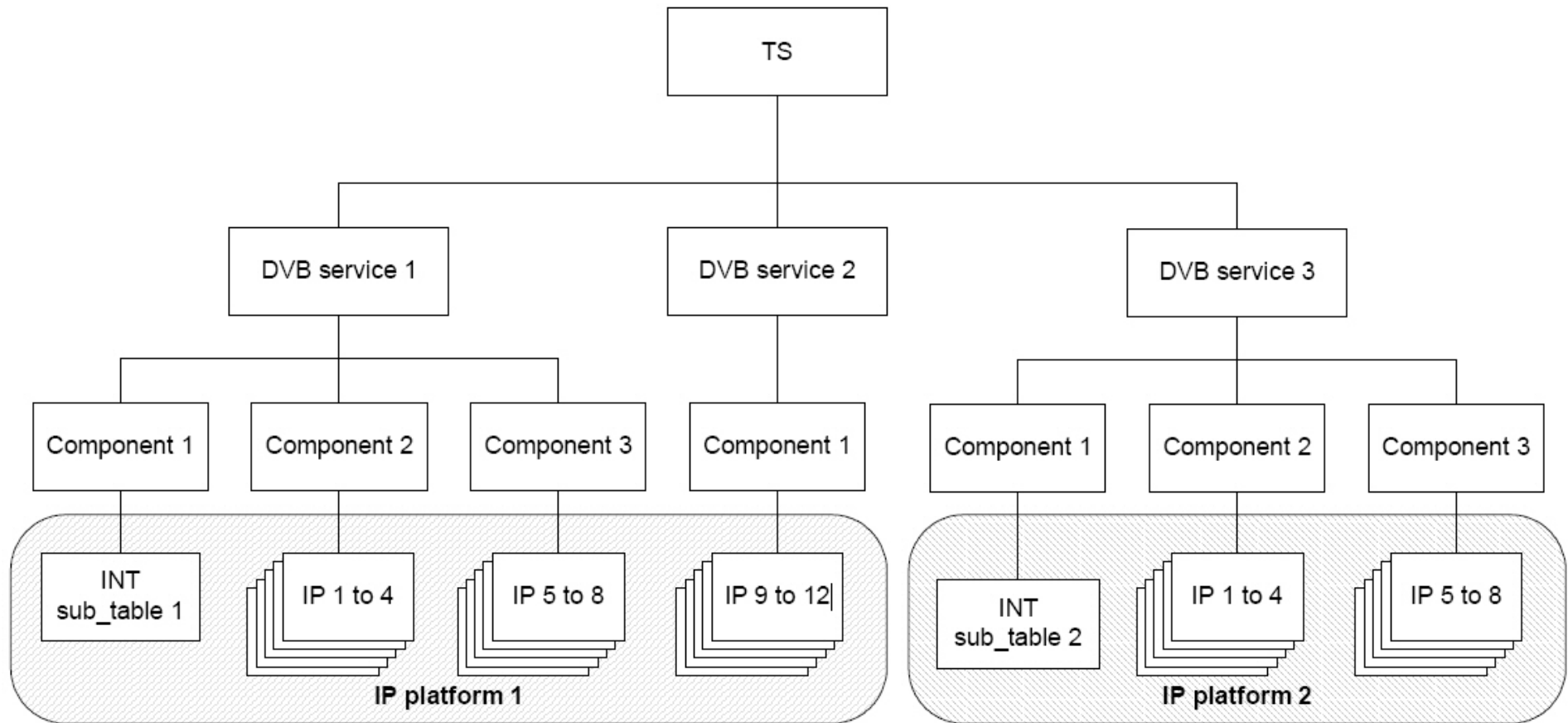
DVB MPE-FEC

- **Increase resilience to transmissions errors**
  - Redundancy
  - Reed Solomon 255/191, 25% redundant
- **Without modifying existing implementations**
  - No modification on MPE sections

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DVB MPE-FEC

192 Columns (Bytes) | 64 Columns (Bytes)

IP DGRAM | DGRAM | IP DGRAM | ... | IP DGRAM | Padding | RS Column 1 | RS Column 2 | RS Column N

IP
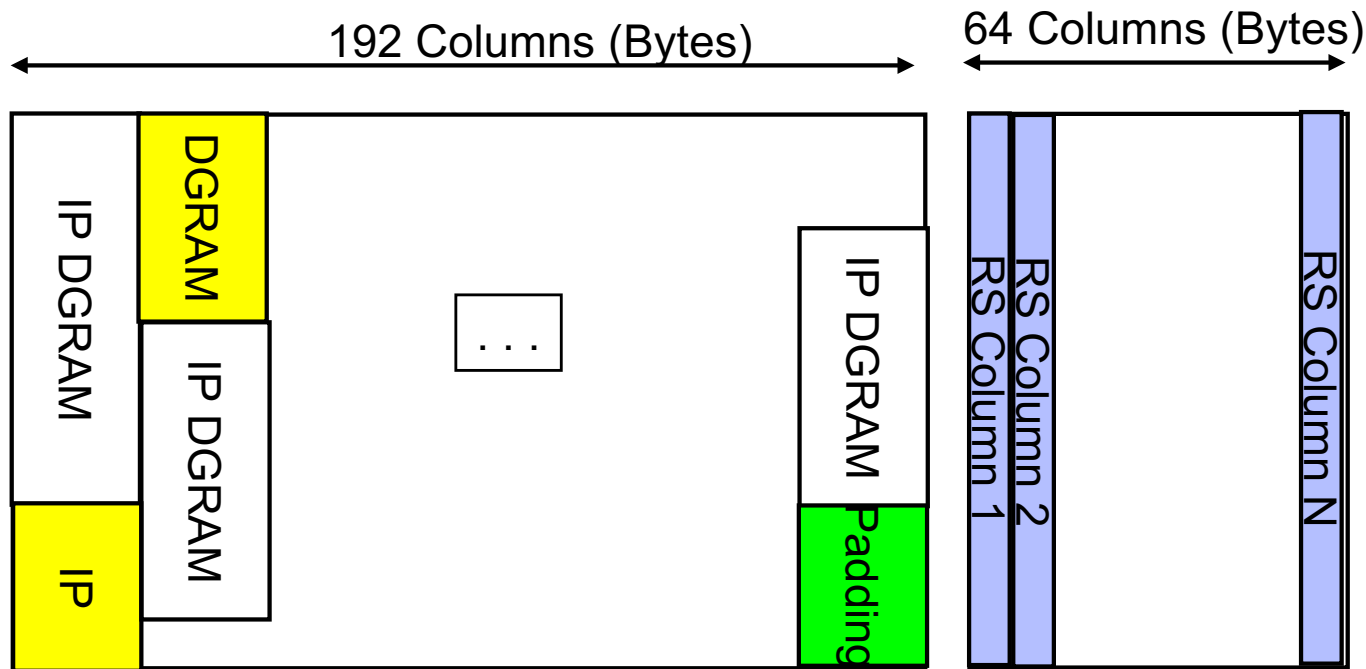
- **MPE**
  - Each MPE+IP on a section
  - Aggregation of IP datagrams in memory
- **FEC**
  - Each RS column is send in a section
  - FEC aggregation is in another table
    - Can be ignored
    - Does not interfere with MPE

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Example: DVB-H

- **Mobile Broadcasting**
  - Compatible with DVB-T
  - Time Slicing for power savings
  - IP Transport everywhere, using DVB-MPE
    - RTP for AV streaming
    - FLUTE for file carousel (SDP for description, …)
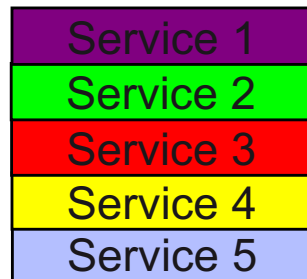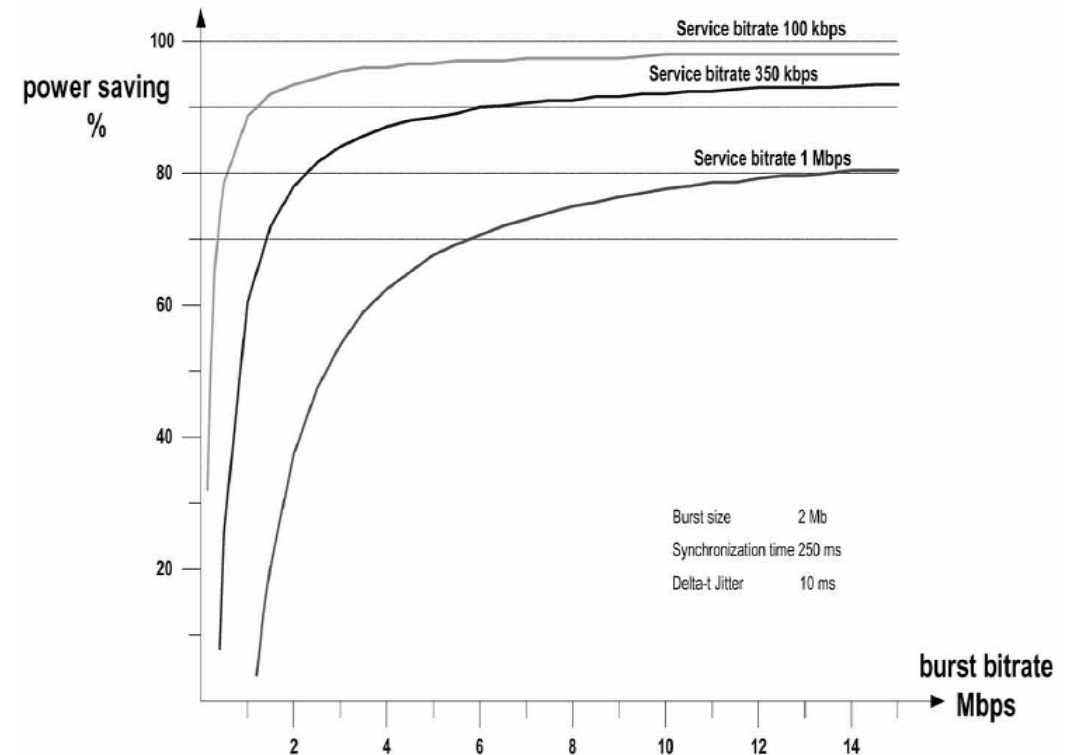 - MPE-FEC for better error resilience
- **Principles**
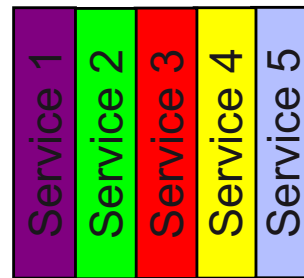 - Data sent in burst (2Mbits/burst)
  - Temporal buffer of services
- **Pros**
  - Demod/demux off during ~ (N-1)/N (N= Nb services)
  - Inactive time slot can be used for roaming handling
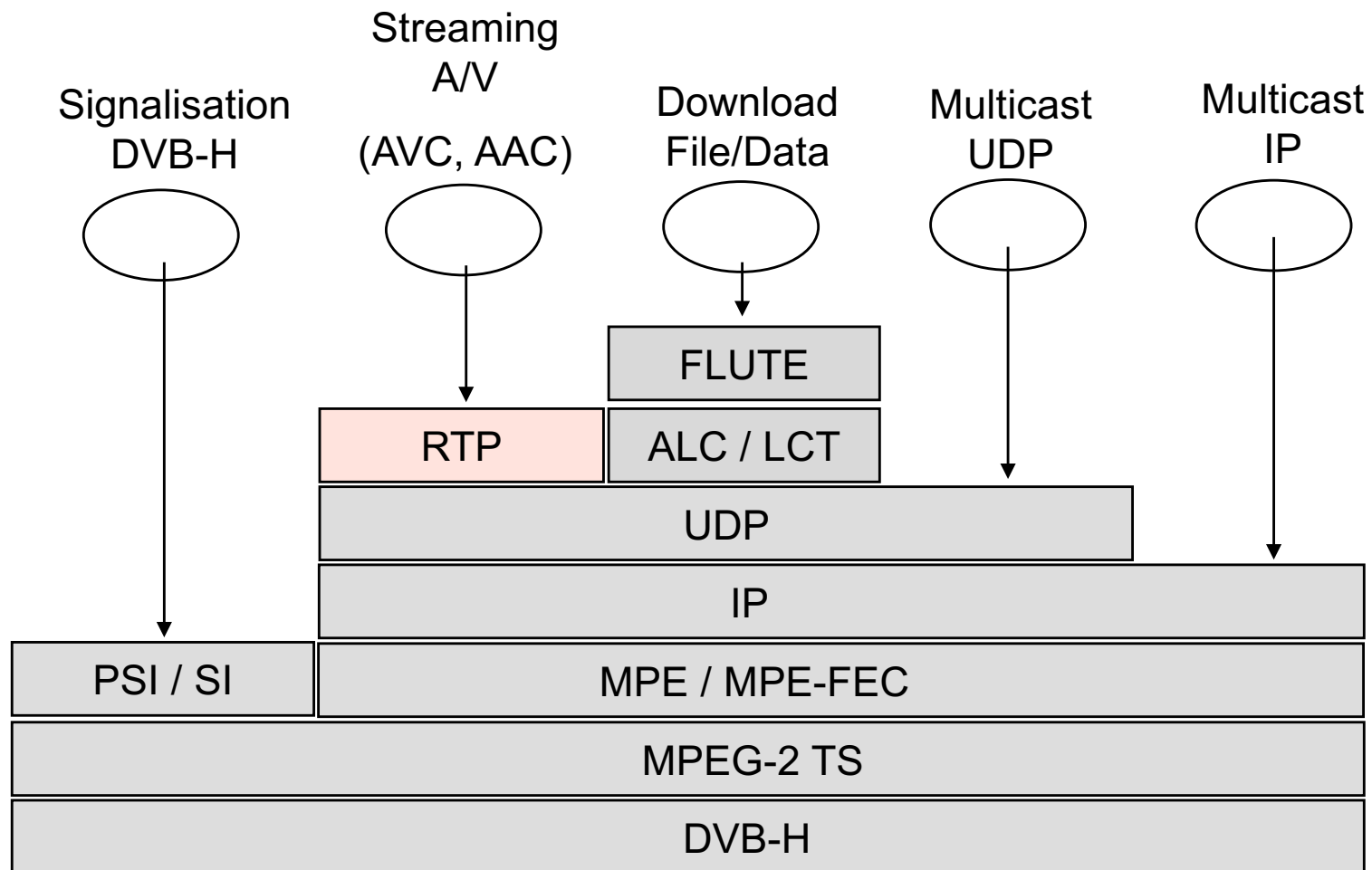- **Cons**
  - Service access time

DVB-T Multiplexe   DVB-H Multiplexe

Institut Mines-Télécom

AVTransport - MPEG-2 TS - DVB - File Broadcasting

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DVB-H Protocol Stack

DVB Future

■ **Beyond MPEG-2 TS ?**

- DVB-S/T/C: 188 byte / data packet
    – TS encapsulation « too heavy »
        • 2% for Audio Video high bitrate
        • 4 - 14% for IP over MTE
- DVB-S/T/C 2: LDPC with large bloc sizes (16k ou 64k symbols)
    – Base-band frame large, variable size !!

■ **IP in video services**

- Real-time communication:
    – RTP
    – Packet-base
- Over-The-Top services (HTTP Streaming)
    – File-based (DASH, HLD, Smooth, HDS)

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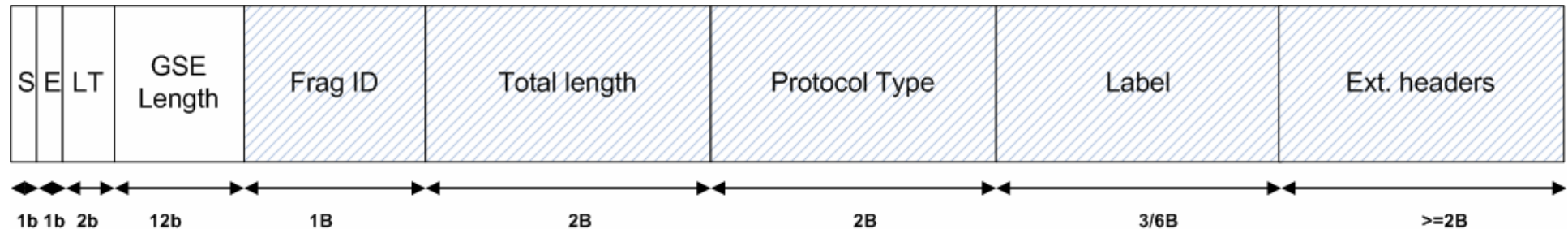# DVB GSE: Generic Stream Encapsulation

- **DVB-*x*2 Data Link**
  - ETSI TS 102 606
  - GSE vs TS in T2/S2/C2 baseband frame
  - GSE supports
    - Fixed or variable packet sizes
    - Packets from Different protocols (IPv4, IPv6)
- **Packetization**
  - Large PDUs cut in one or several GSE packets
  - Several PDUs can be aggregated in one frame
    - NO REORDERING

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GSE Header

S	E	LT	GSE Length	Frag ID	Total length	Protocol Type	Label	Ext. headers
1b	1b	2b	12b	1B	2B	2B	3/6B	>=2B

- **S(tart): packet start**
- **E: packet end**
  - if !S && E, 4 bytes CRC at end of frame
- **GSE Length: size of frame**
  - Includes PDU, header extensions & co
  - Up to 4K payload
- **Frag ID (if fragmentation)**
  - Unique identifier for each GSE fragments of a same original PDU
  - Up to 255 PDUs in parallel
- **Protocol Type: type du PDU**
  - Type-1 [0,1535]: various header extensions
    - [0,255]: mandatory extensions
  - Type-2 [1536,0xFFFF]: EtherType

- **Total Length**
  - Source PDU size
- **LT (Label Type): packet filtering**
  - 00: 6 bytes, 01: 3 bytes
  - 10: no label (broadcast)
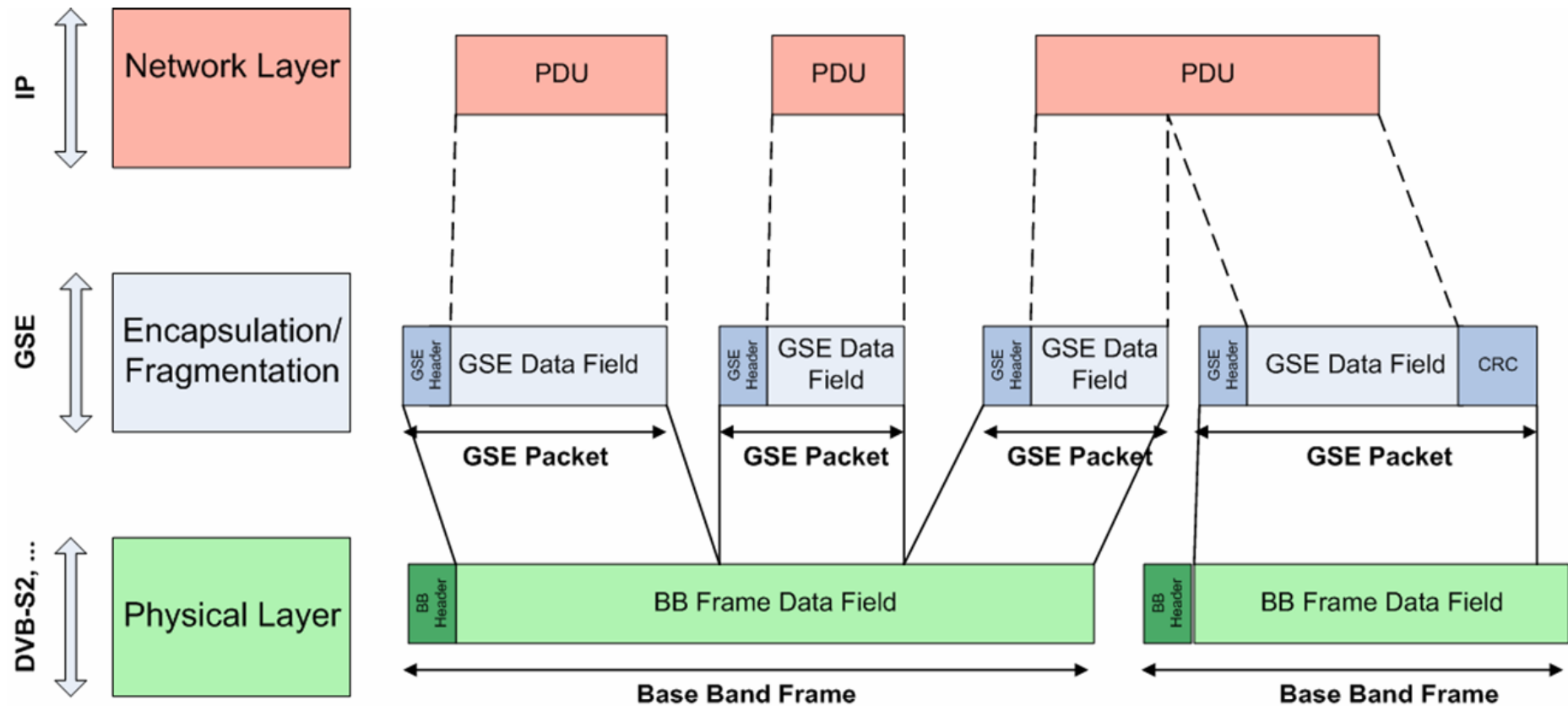- **Label**
  - Network Point of Attachment

GSE and Base Band Frame

Figure 1: GSE encapsulation within DVB protocol stack