

# MPEG-2 Program Specific Information



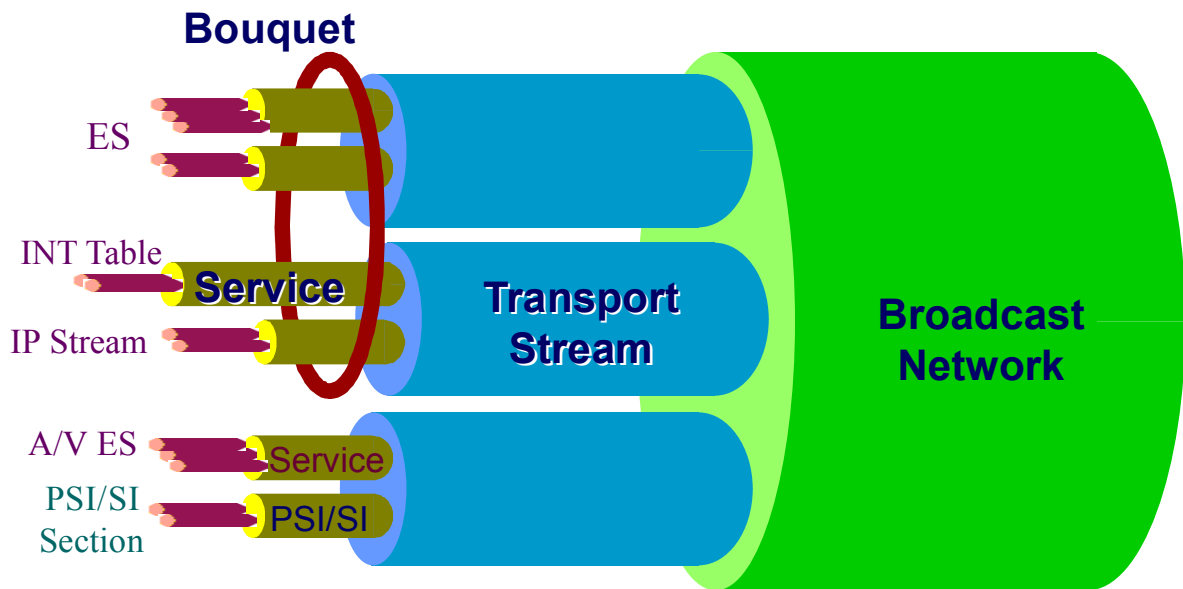
數位電視系統原理及軟體技術  
銘傳大學資工系:陳游利、徐武孝

## Agenda



- DTV Transmission Chain
-  **Program Specific Information (PSI)**
- Program Association Table (PAT)
- PMT & CAT & NIT
- Packet ID & Table ID & Descriptors
- PSI Examples

# DVB Broadcast Network



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## Program Guide Information

- ✚ PSI - Programme Service Information. This is defined by MPEG and consists of PAT, PMT, CAT, NIT, TSMT
- ✚ SI - Service Information. These are additional tables defined by DVB (eg SDT, TDT, EIT etc) (two categories - Mandatory & optional)
- ✚ PSIP - Additional tables defined by ATSC for terrestrial and cable only (MGT, VCT etc)
- ✚ ARIB SI- Additional tables defined by ARIB in Japan for satellite.

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## Program Specific Information

- ✚ includes **tables** that describe the relationship between the programs
- ✚ PSI tables shall be segmented into one or more **sections** that are carried within transports packets
- ✚ Sections may be variable in length
- ✚ The beginning of a section is indicated by a **pointer\_field** in the Transport Stream packet payload

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## Program Specific Information

Table Name	Specification Type	Allocated PID	Description
Program Association Table	MPEG	0x00	Associates program numbers with PIDs of TS packets sending A Program Map Table
Program Map Table	MPEG	Specified in PAT	Specifies PID values of stream configuring a program
Network Information Table	Private (specified in application)	Specified in PAT	Physical network parameters Examples: FDM frequency, transponder number
Conditionnal Access Table	MPEG	0x01	Associates PID values and EMM stream sending subscription details for charged broadcasting
TS Description Table	MPEG	0x02	Associates descriptors and the entire TS (application system)




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# MPEG 2 System Layer - PSI






## PSI tables

- Ⓞ **PAT** : Program Association Table
- Ⓞ **PMT** : Program Map Table
- Ⓞ **CAT** : Conditional Access Table
- Ⓞ **NIT** : Network Information Table
- Ⓞ Private Table





### PMT Program 1 (PID 65)

Components of Program 1		
 Video		PID 131
 Audio English		PID 132
 Audio German		PID 133

### PAT (PID 00)

 Prog. 1	PMT PID 65
 Prog. 2	PMT PID 32
 Prog. 3	PMT PID 56
 Prog. 4	PMT PID 120
 NIT	PID 16

### CAT (PID 01)

 EMM A	PID 61
 EMM B	PID 76
 EMM C	PID 38
 EMM D	PID 109

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# MPEG 2 System Layer - PSI

Program Map Table For Programme 1

Stream 1	PCR	31
Stream 2	Video 1	54
Stream 3	Audio 1	48
Stream 4	Audio 2	49
.....	.....	.....
Stream k	Data k	66

Table section id always set to 0x02

Program Map Table For Programme 2

Stream 1	PCR	41
Stream 2	Video 1	19
Stream 3	Audio 1	81
Stream 4	Audio 2	82
.....	.....	.....
Stream k	Data k	88

Program Association Table (always PID 0)

Program 0	PID = 16
Program 1	PID = 22
Program 2	PID = 33
.....	.....
Program K	PID = 55

Table section id always set to 0x00



Multi-Program MPEG-2 Transport Stream

ETC.

CA Section 1 (programme 1)	EMM PID (99)
CA Section 2 (programme 2)	EMM PID (109)
CA Section 3 (programme 3)	EMM PID (119)
.....	.....
CA Section k (programme k)	EMM PID k

Table section id always set to 0x01

Conditional Access Table (always PID 1)

Private Section 1	NIT info
Private Section 2	NIT info
Private Section 3	NIT info
.....	.....
Private Section k	NIT info

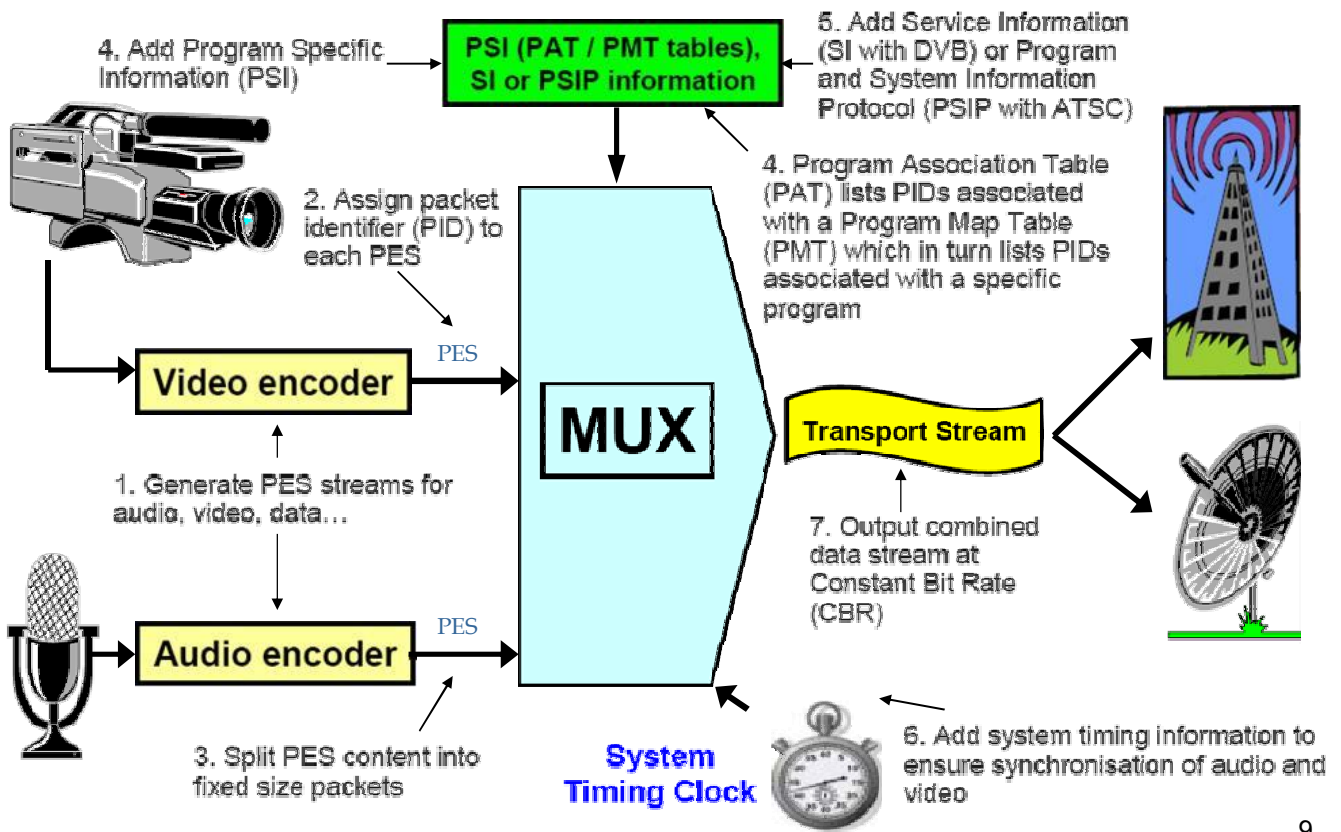
Table section id assigned by system

Network Information Table (always programme 0)  
NIT is considered private data by ISO

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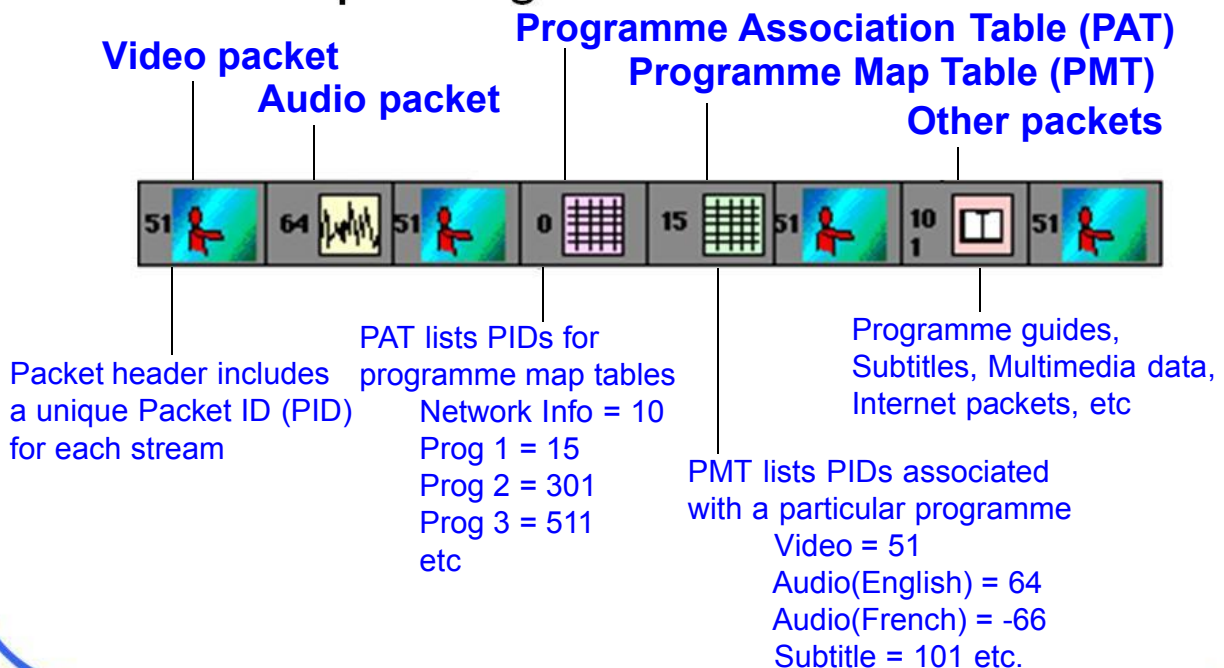


# MPEG-2 Transport Stream



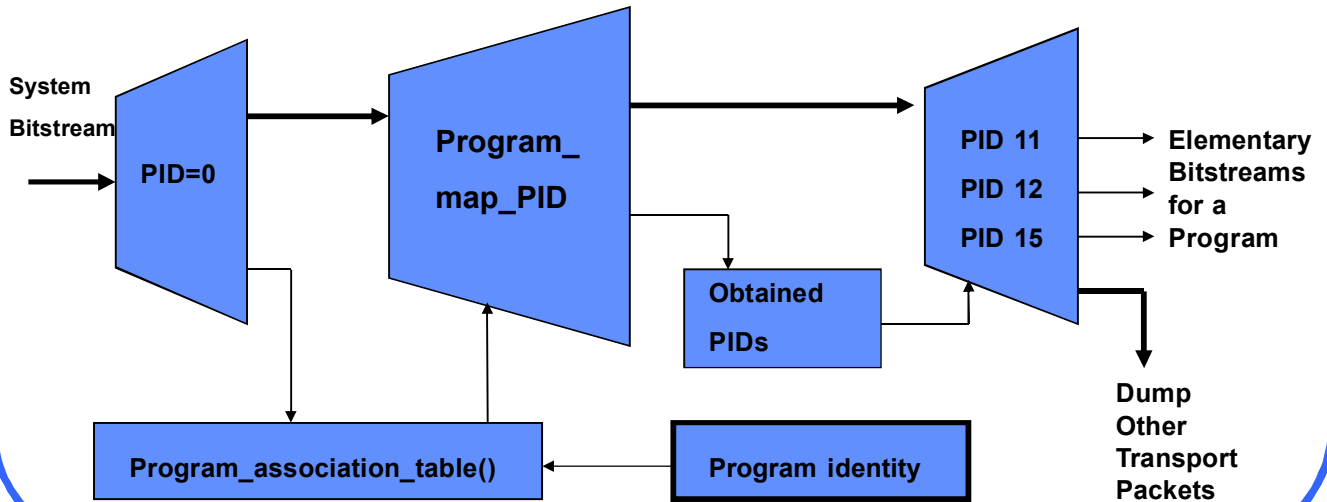
## Multiplexed TS Stream

– Multiple Program TS:



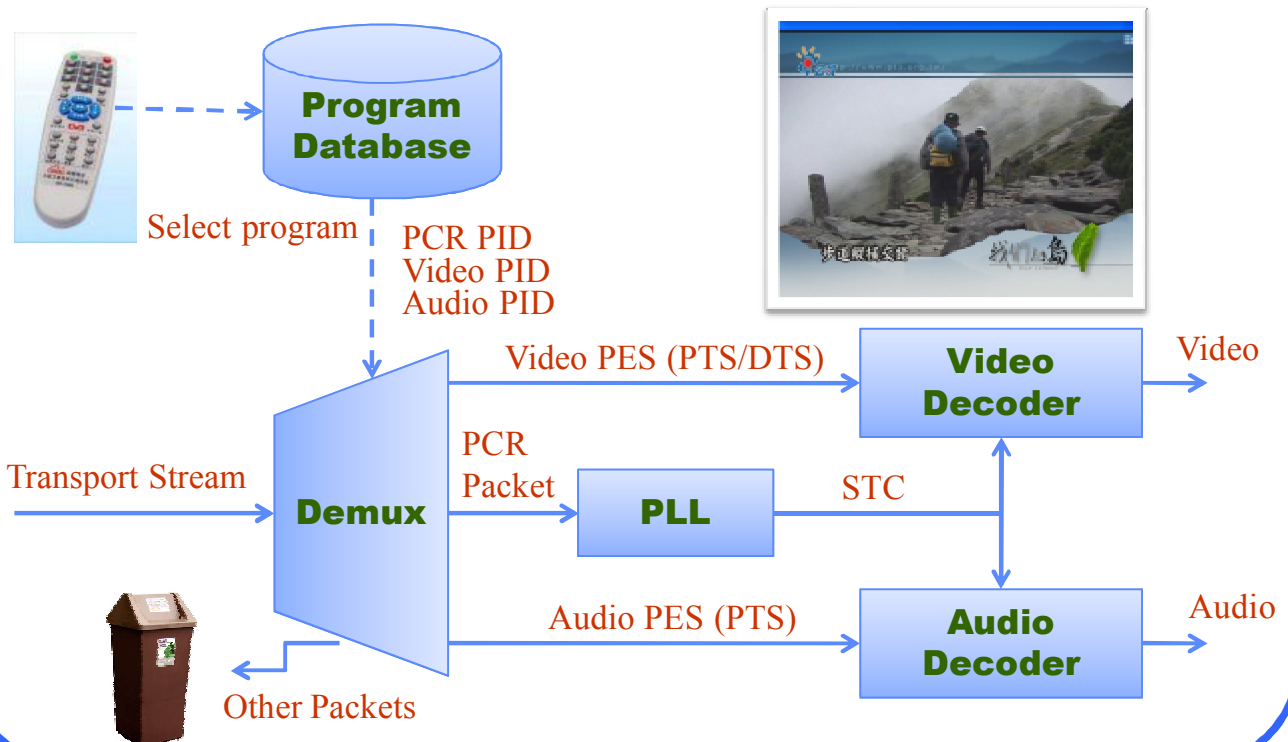
# High Level De-multiplexing

- Using program\_association\_table to identify the PID of the bit stream carrying the program\_map\_table.
- Using program\_map\_table to obtain elementary bit streams.



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# High Level De-multiplexing



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# Agenda

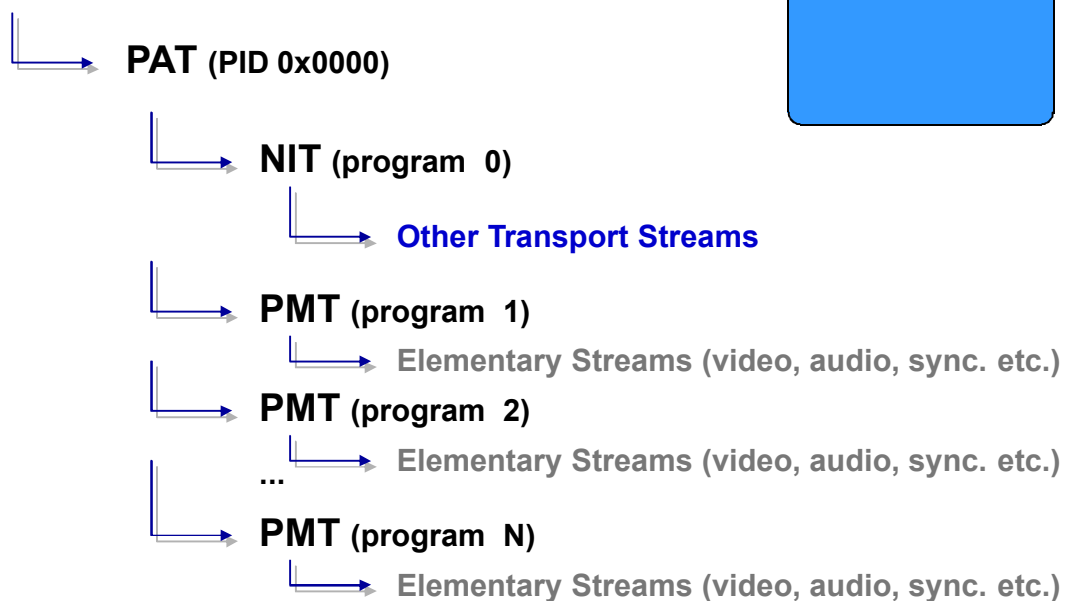


- DTV Transmission Chain
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-  **Program Association Table (PAT)**
- PMT & CAT & NIT
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## MPEG-2 System: PSI table linkages

Actual Transport Stream



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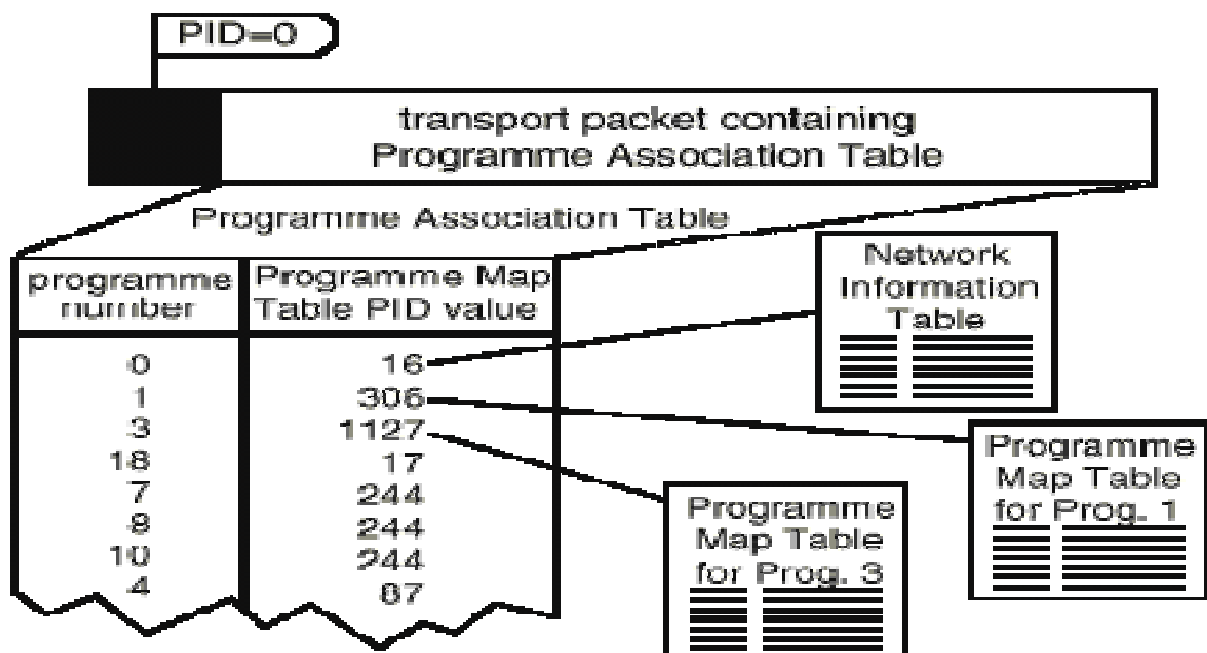
# MPEG-2 System: PAT

- PAT (PID=0x00)
  - identifies the Transport Stream
  - associates a Program Number and a PMT (Program Number: a user defined value)
  - Program Number = 0 gives the PID of NIT (Network Information Table)



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# MPEG-2 System: PAT

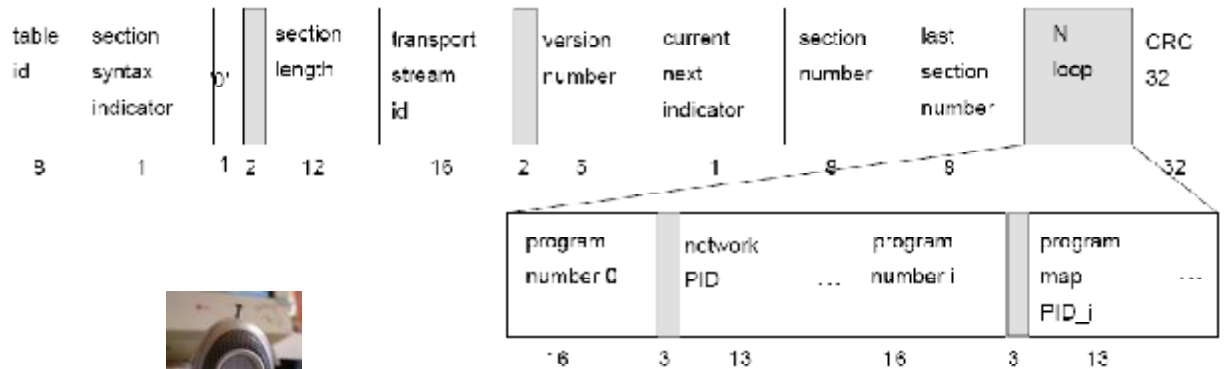


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# MPEG-2 System: PAT

## Program Association Section Diagram



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## 函式GetPAT

(提取資料流中各節目之起始位址)

Syntax	No. of bits	Mnemonic
program_association_section() {		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
'0'	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
transport_stream_id	16	uimsbf
reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
for (i=0; i<N;i++) {		
program_number	16	uimsbf
reserved	3	bslbf
if(program_number == '0') {		
network_PID	13	uimsbf
} else {		
program_map_PID	13	uimsbf
}		
}		
CRC_32	32	rpchof
}		

Annotations: A red arrow points from PatSection[0] to the table\_id field. A blue arrow indicates a total of 8 bits for the section header fields. A red box highlights the for loop, with a red arrow pointing to DynPtr[0]. A green arrow indicates 5 bits for the version\_number field. A green arrow indicates 4xN bits for the program map table. A green arrow indicates 4 bits for the CRC\_32 field.

Syntax	No. of bits	Mnemonic
program_association_section() {		
<b>table_id</b>	8	uimsbf
<b>section_syntax_indicator</b>	1	bslbf
'0'	1	bslbf
<b>reserved</b>	2	bslbf
<b>section_length</b>	12	uimsbf
<b>transport_stream_id</b>	16	uimsbf
<b>reserved</b>	2	bslbf
<b>version_number</b>	5	uimsbf
<b>current_next_indicator</b>	1	bslbf
<b>section_number</b>	8	uimsbf
<b>last_section_number</b>	8	uimsbf
for (i=0; i<N;i++) {		
<b>program_number</b>	16	uimsbf
<b>reserved</b>	3	bslbf
if(program_number=='0') {		
<b>network_PID</b>	13	uimsbf
}		
else {		
<b>program_map_PID</b>	13	uimsbf
}		
}		
<b>CRC_32</b>	32	rpchof
}		

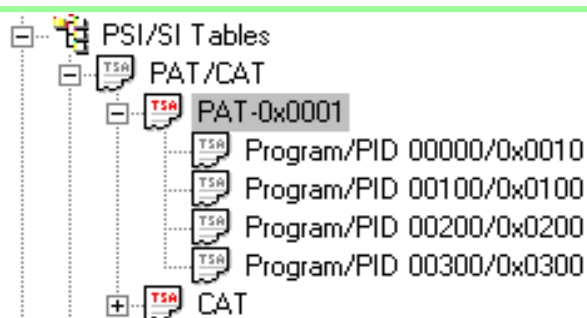
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## PAT區段的文法

Syntax	No. of bits
program_association_section() {	
<b>table_id</b>	8
...	
<b>transport_stream_id</b>	16
...	
for (i = 0; i < N; i++) {	
<b>program_number</b>	16
<b>reserved</b>	3
if (program_number == '0') {	
<b>network_PID</b>	13
} else {	
<b>program_map_PID</b>	13
}	
}	
...	
}	

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# MPEG-2 System: PAT




Program Association Table (PAT) : Table Valid

PID: <input type="text" value="0x0000"/>	Sect. Count: <input type="text" value="1"/>	Prog. No	PID
TSID: <input type="text" value="0x0001"/>	Pkt Count: <input type="text" value="49"/>	0	0x0010
Version: <input type="text" value="0"/>	Tables/Sec: <input type="text" value="9.805"/>	100	0x0100
	Table Count: <input type="text" value="49"/>	200	0x0200
	Syntax Error: <input type="text" value="0"/>	300	0x0300

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## Agenda

- DTV Transmission Chain
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- Program Association Table (PAT)
-  **Program Map Table (PMT)**
- Packet ID & Table ID & Descriptors
- PSI Examples

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# PMT表格

- ✚ PMT(Program Map Table)表格的目的就是提供一個節目與其基礎串流的對應關係。
- ✚ PMT區段的PID不是固定的，而是由PAT表格指定的。
- ✚ 一個節目通常只有一個視訊訊號，但可能會同時有好幾個音訊訊號。



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# PMT區段的文法

Syntax	No. of bits
<code>TS_program_map_section() {</code>	
<code>table_id</code>	8
<code>...</code>	
<code>PCR_PID</code>	13
<code>...</code>	
<code>program_info_length</code>	12
<code>for (i = 0; i &lt; N; i++) {</code>	
<code>descriptor()</code>	
<code>}</code>	
<code>for (i = 0; i &lt; N1; i++) {</code>	
<code>stream_type</code>	8
<code>reserved</code>	3
<code>elementary_PID</code>	13
<code>reserved</code>	4
<code>ES_info_length</code>	12
<code>for (i = 0; i &lt; N2; i++) {</code>	
<code>descriptor()</code>	
<code>}</code>	
<code>}</code>	
<code>...</code>	
<code>}</code>	

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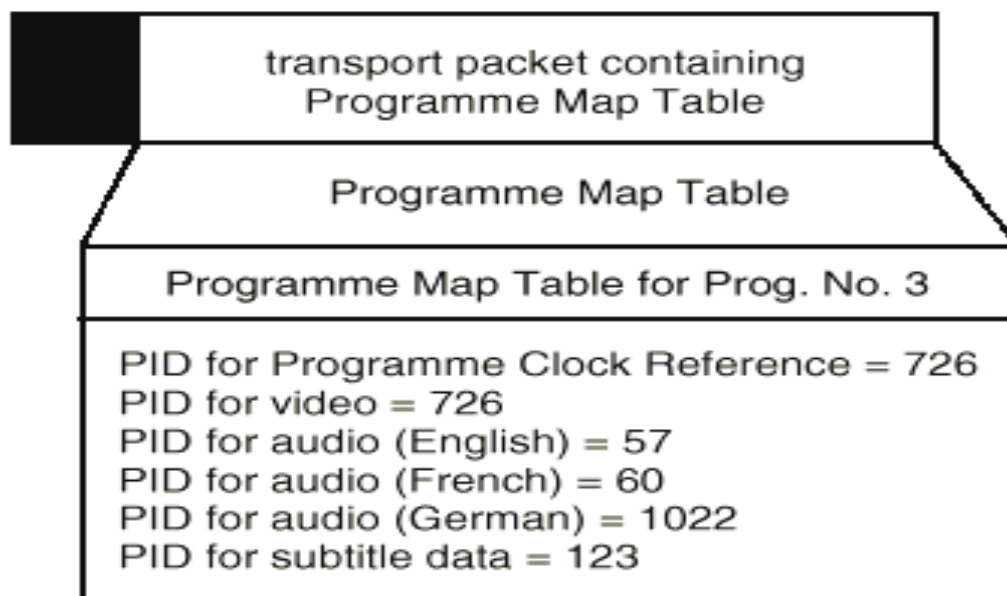
# MPEG-2 System: PMT

## + PMT

- ④ specifies PID values for components of one program
- ④ indicates the Program Number
- ④ indicates the elementary streams and their PID
- ④ indicates the PID containing the clock (PCR)
- ④ provides descriptors (Program and Elementary Stream)

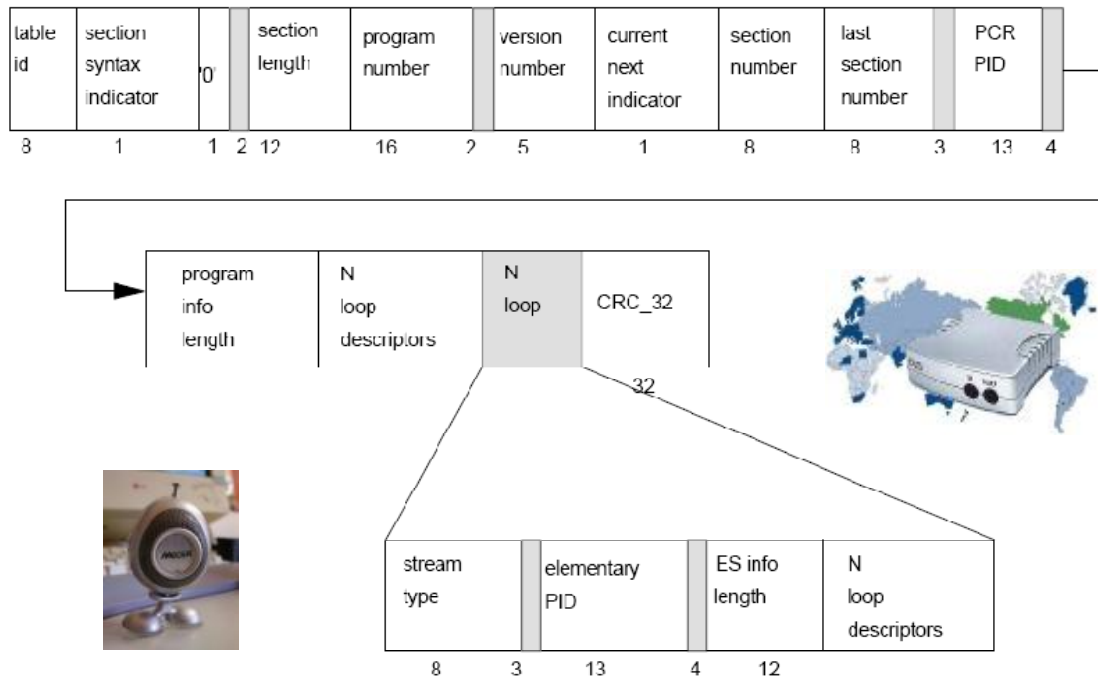
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# MPEG-2 System: PMT



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# Program Map Section Diagram



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## 函式GetPMT (提取各節目視訊、聲音、文字等)

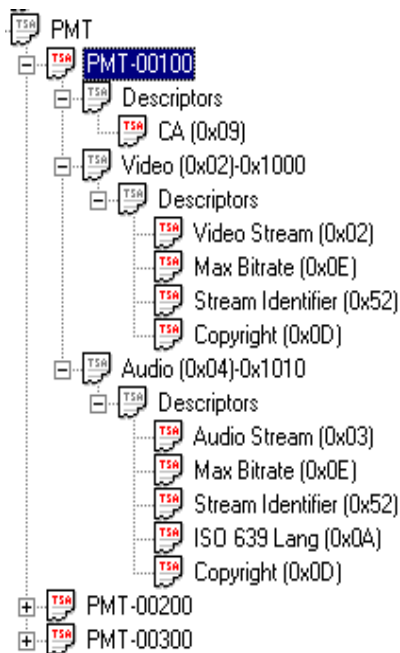
Syntax	No. of bits	Mnemonic
TS_program_map_section() {		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
'0'	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
program_number	16	uimsbf
reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
reserved	3	bslbf
PCR_PID	13	uimsbf
reserved	4	bslbf
program_info_length	12	uimsbf
for (i=0; i<N; i++) {		
descriptor()		
}		
for (i=0; i<N1; i++) {		
stream_type	8	uimsbf
reserved	3	bslbf
elementary_PID	13	uimsbf
reserved	4	bslbf
ES_info_length	12	uimsbf
for (i=0; i<N2; i++) {		
descriptor()		
}		
}		
CRC_32	32	rpchof
}		

資料來源  
ISO/IEC 13818-1

Syntax	No. of bits	Mnemonic
TS_program_map_section() {		
<b>table_id</b>	8	<b>uimsbf</b>
<b>section_syntax_indicator</b>	1	<b>bslbf</b>
'0'	1	<b>bslbf</b>
<b>reserved</b>	2	<b>bslbf</b>
<b>section_length</b>	12	<b>uimsbf</b>
<b>program_number</b>	16	<b>uimsbf</b>
<b>reserved</b>	2	<b>bslbf</b>
<b>version_number</b>	5	<b>uimsbf</b>
<b>current_next_indicator</b>	1	<b>bslbf</b>
<b>section_number</b>	8	<b>uimsbf</b>
<b>last_section_number</b>	8	<b>uimsbf</b>
<b>reserved</b>	3	<b>bslbf</b>
<b>PCR_PID</b>	13	<b>uimsbf</b>
<b>reserved</b>	4	<b>bslbf</b>
<b>program_info_length</b>	12	<b>uimsbf</b>
for (i=0; i<N; i++) {		
descriptor()		
}		
for (i=0; i<N1; i++) {		
<b>stream_type</b>	8	<b>uimsbf</b>
<b>reserved</b>	3	<b>bslbf</b>
<b>elementary_PID</b>	13	<b>uimsbf</b>
<b>reserved</b>	4	<b>bslbf</b>
<b>ES_info_length</b>	12	<b>uimsbf</b>
for (i=0; i<N2; i++) {		
descriptor()		
}		
}		
<b>CRC_32</b>	32	<b>rpchof</b>
}		

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## MPEG-2 System: PMT



Program Management Table (PMT): Table Valid

PID:  Sect. Count:  Tables/Sec:

PCR PID:  Pkt Count:  Table Count:

Program:  Version:  Syntax Error:

Program Information Descriptors:		Elementary Stream Information:	
Tag	Length	Stream type	Elementary PID
CA (0x09)	0x17	Video (0x02)	0x1000
		Audio (0x04)	0x1010

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# Agenda



- DTV Transmission Chain
- Program Specific Information (PSI)
- Program Association Table (PAT)



## **Conditional Access Table (CAT)**

- Packet ID & Table ID & Descriptors
- PSI Examples

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## CAT表格

- ✚ 當一個傳輸串流中有部分基礎串流經過**加密**(scrambling)時，傳輸串流就必須包含CAT(Conditional Access Table)表格，以便處理加密的資訊。
- ✚ CAT表格提供解密所需的**描述器**(descriptor)，在描述資料中會指出CA\_PID，表示PID為CAD\_PID的傳輸封包提供解密所需的更詳細訊息，如下列兩種。
  - Ⓞ 授權控制訊息(ECM; Entitlement Control Message)。
  - Ⓞ 授權管理訊息(EMM; Entitlement Management Message)。
- ✚ 台灣地區目前(2006年)所播放的數位電視節目，並無加密。



# MPEG-2 System: CAT

## ✚ CAT (PID=0x01)

- Ⓜ includes descriptors indicating:
  - the CA system used
  - the PIDs containing system wide messages (i.e. EMM)
- Ⓜ they are as many descriptors as CA systems or Access Conditions

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# MPEG-2 System: CAT

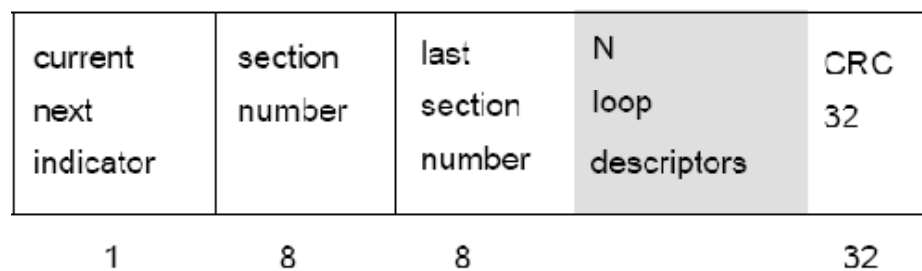


Conditional Access Descriptor (0x9)	
<input checked="" type="checkbox"/> Valid	
System ID:	0xBEEF
PID:	0x00CA

00000000 44 54 53 5F 45 4D 4D 5F 43 41 5F 44 61 74 61

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# MPEG-2 System: CAT



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# Conditional Access Table

Syntax	No. of bits	Mnemonic
CA_section() {		
<b>table_id</b>	<b>8</b>	<b>uimsbf</b>
<b>section_syntax_indicator</b>	<b>1</b>	<b>bslbf</b>
'b0'	<b>1</b>	<b>bslbf</b>
<b>reserved</b>	<b>2</b>	<b>bslbf</b>
<b>section_length</b>	<b>12</b>	<b>uimsbf</b>
<b>reserved</b>	<b>18</b>	<b>bslbf</b>
<b>version_number</b>	<b>5</b>	<b>uimsbf</b>
<b>current_next_indicator</b>	<b>1</b>	<b>bslbf</b>
<b>section_number</b>	<b>8</b>	<b>uimsbf</b>
<b>last_section_number</b>	<b>8</b>	<b>uimsbf</b>
for (i=0; i<N;i++) {		
descriptor()		
}		
<b>CRC_32</b>	<b>32</b>	<b>rpchof</b>
}		

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# Agenda



- DTV Transmission Chain
- Program Specific Information (PSI)
- Program Association Table (PAT)
- PMT & CAT & NIT

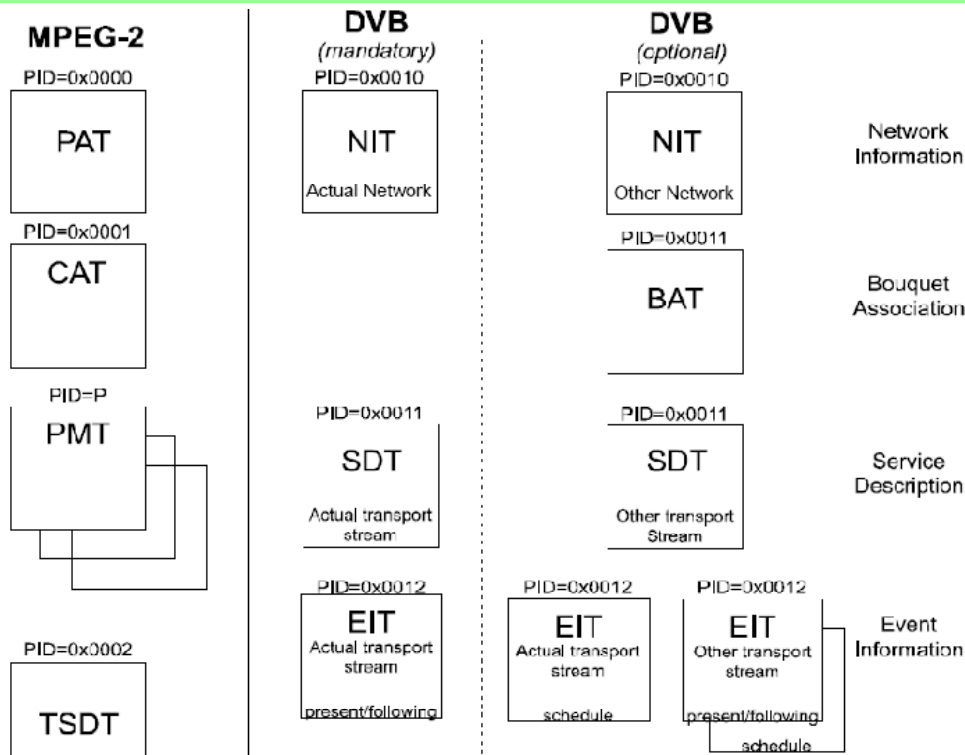


## **Packet ID & Table ID & Descriptors**

- PSI Examples

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## PSI / SI table information



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# Packet identifiers (PID)

## ✚ PSI: Program Specific Information

Structure Name	PID number	Description
Program Association Table (PAT)	0x00	associates Program Number and PMT
Program Map Table (PMT)	indicated in PAT	specifies PID values for components of programs
Conditional Access Table (CAT)	0x01	associates EMM streams each with a unique PID value
Network Information Table (NIT)	see DVB SI	physical network parameters

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# PSI / SI PID

**Table 1: PID allocation for SI**

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 [36])	0x0012
RST, ST	0x0013
TDT, TOT, ST	0x0014
network synchronization	0x0015
RNT (TS 102 323 [36])	0x0016
reserved for future use	0x0017 to 0x001B
inband signalling	0x001C
measurement	0x001D
DIT	0x001E
SIT	0x001F

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# MPEG-2 System: PID Example

PID	Pkt. Count	Rate (Mb/s)	% Bandwidth	TblErr	CCErrors	Service Type
0x0000	50	0.015	0.100	0	0	Table
0x0001	5	0.002	0.010	0	0	Table
0x0010	20	0.006	0.040	0	0	Table
0x0011	150	0.045	0.300	0	0	Table
0x0012	100	0.030	0.200	0	0	Table
0x0014	10	0.003	0.020	0	0	Table
0x00CA	100	0.030	0.200	0	0	EMM
0x0100	200	0.060	0.400	0	0	Table
0x0200	200	0.060	0.400	0	0	Table
0x0300	200	0.060	0.400	0	0	Table
0x0CA0	100	0.030	0.200	0	0	ECM
0x0CA1	100	0.030	0.200	0	0	ECM
0x0CA2	100	0.030	0.200	0	0	ECM
0x1000	8996	2.707	18.000	0	0	Video
0x1010	875	0.263	1.751	0	0	Audio
0x1200	8996	2.707	18.000	0	0	Video
0x1210	875	0.263	1.751	0	0	Audio
0x1300	8996	2.707	18.000	0	0	Video
0x1310	875	0.263	1.751	0	0	Audio
0x1FFF	19030	5.727	38.077	0	0	NULL PID

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# PSI / SI Table ID

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	resolution_notification_section (TS 102 323 [36])
0x75	container_section (TS 102 323 [36])
0x76	related_content_section (TS 102 323 [36])
0x77	content_identifier_section (TS 102 323 [36])
0x78	MFE-FEC_section (EN 301 192 [37])
0x79 to 0x7D	reserved for future use

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# MPEG-2 System: Descriptors

## + Descriptors

- video\_stream\_descriptor *frame rate, profile and level...*
- audio\_stream\_descriptor *coding layer*
- conditional\_access\_descriptor *CA system, ECM or EMM PIDs*
- copyright\_descriptor
- ISO\_639\_language\_descriptor
- .....



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## Agenda



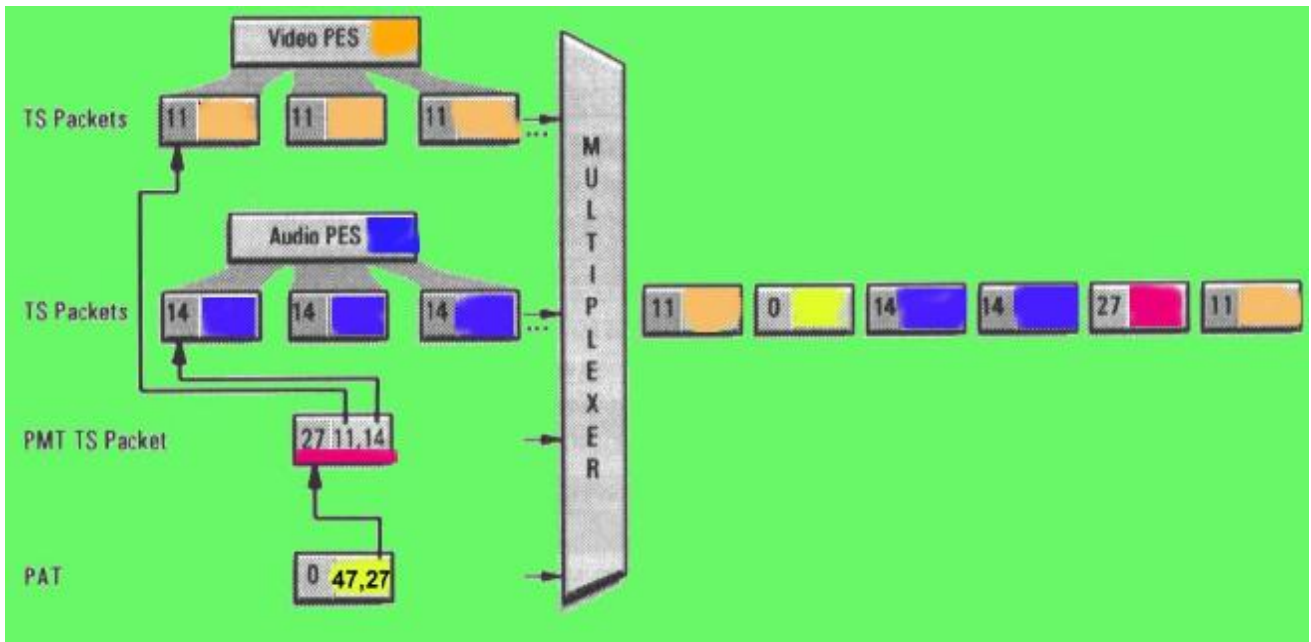
- DTV Transmission Chain
- Program Specific Information (PSI)
- Program Association Table (PAT)
- PMT & CAT & NIT
- Packet ID & Table ID & Descriptors



## *PSI Examples*

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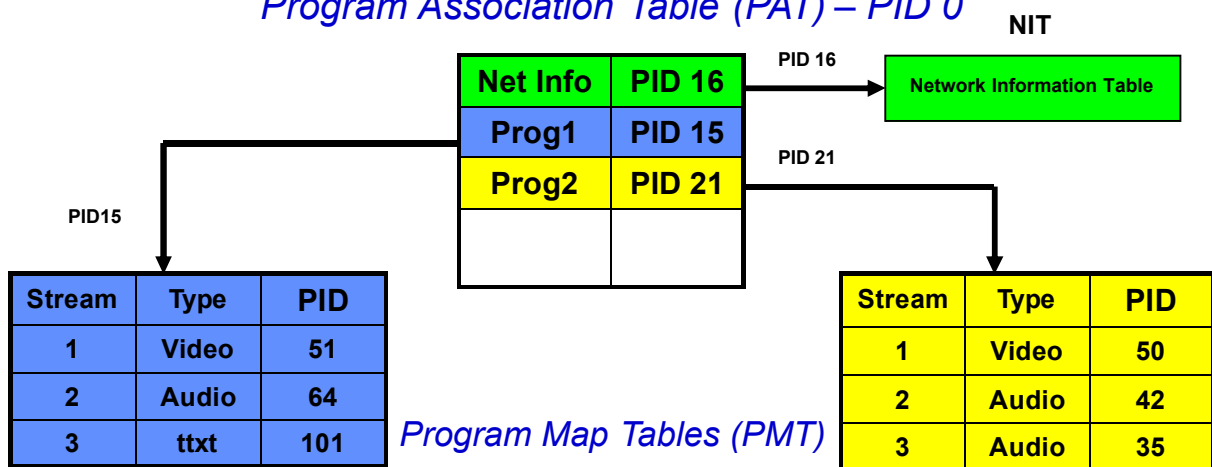
# PSI Example 1



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# PSI Example 2

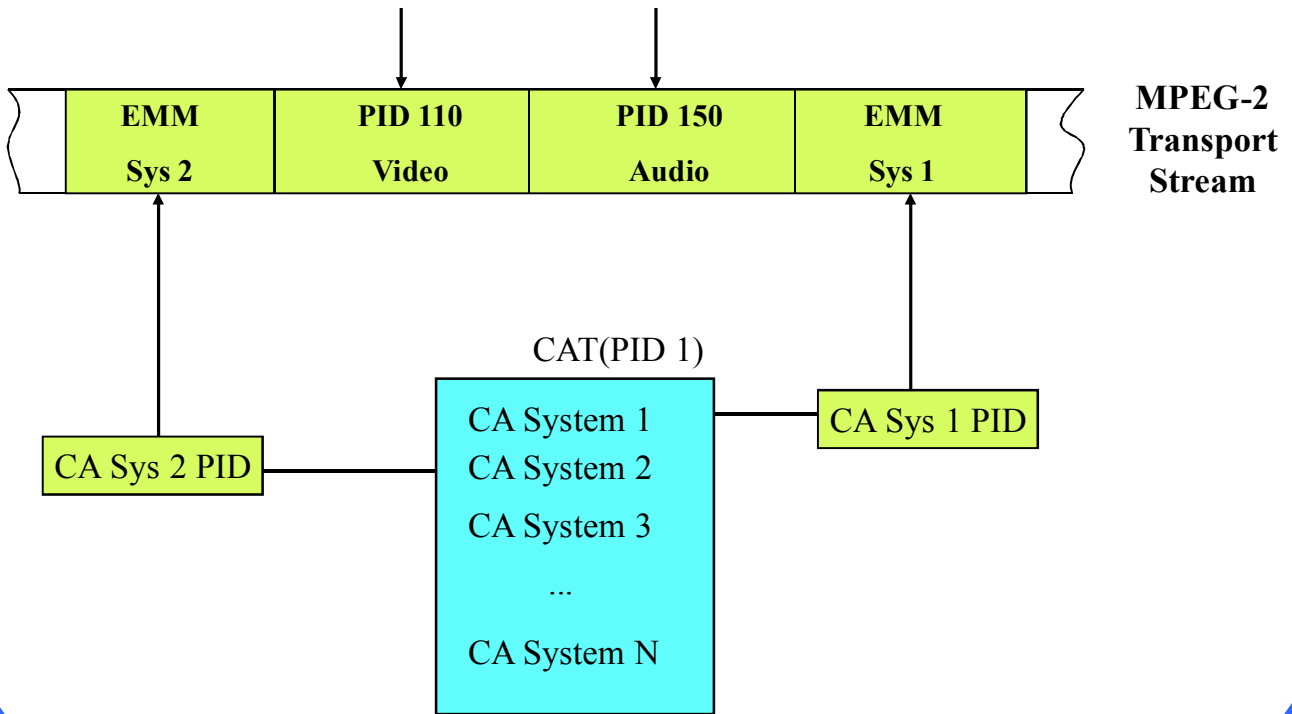
Program Association Table (PAT) – PID 0



PID NO.	0	16	15	21	51	35	64	50	42	101
Packets	PAT	NIT	Prog1 PMT	Prog2 PMT	Prog1 Vid1	Prog2 Aud2	Prog1 Aud1	Prog2 Vid1	Prog2 Aud1	Prog1 txt

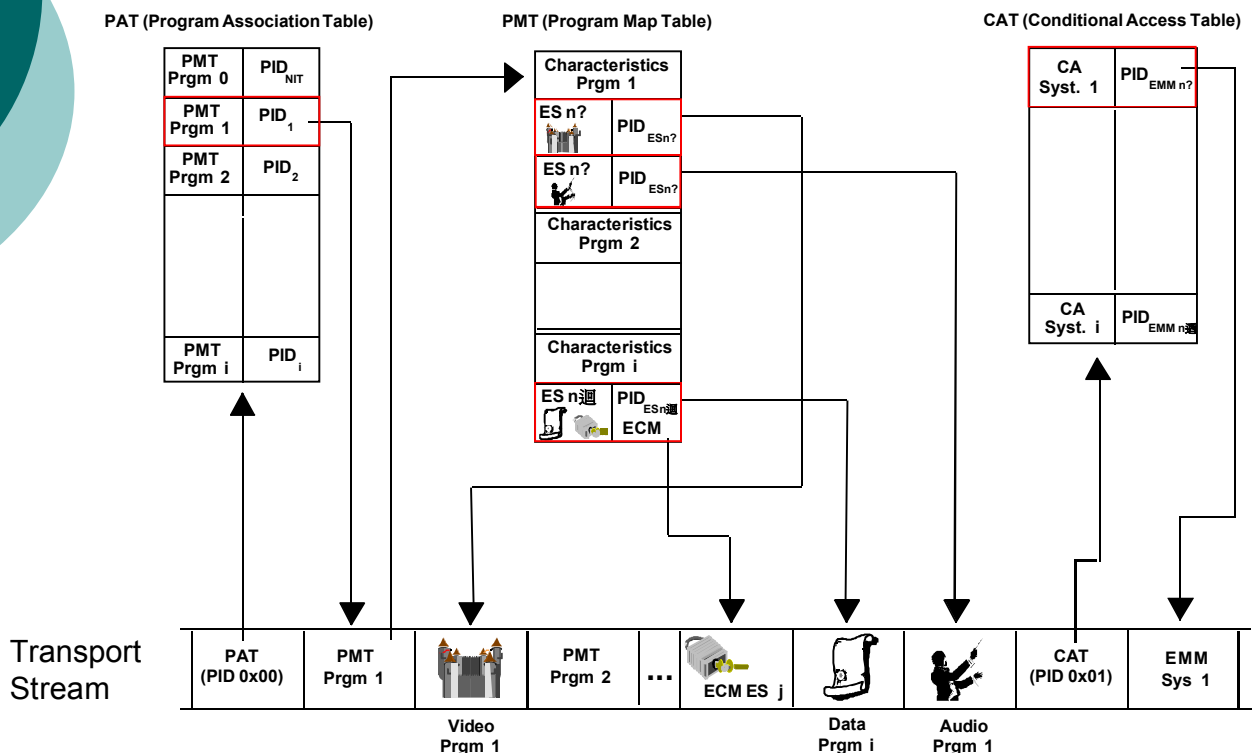
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# PSI Example 3



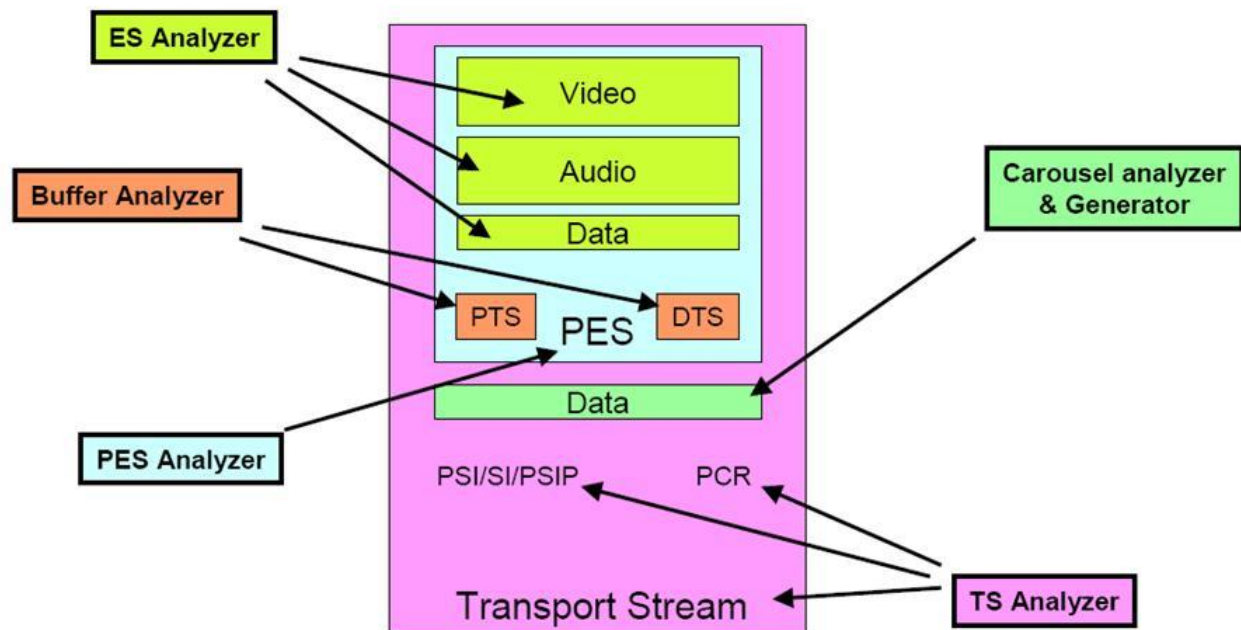
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# PSI Example 4





# Transport Stream Test Layers



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# Decoded Example (NIT)

## NIT

network name descriptor	
char	CTV
service_id	0x64
service_type	DTS
service_id	0x65
service_type	DTS
service_id	0x66
service_type	DTS
service_id	0x96
service_type	DBS

terrestrial delivery descriptor	
centre_frequency	6.8228MHz
bandwidth	6 MHz
Priority	high priority
Time_Slicing_indicator	Time Slicing not used
MPE_FEC_indicator	MPE_FEC not used
constellation	16-QAM
hierarchy_information	no hierarchy
code_rate_HP_stream	2/3 modulation level
code_rate_LP_stream	2/3 modulation level
guard_interval	guard interval value 1/4
transmission_mode	8k mode
other_frequency_flag	no other frequency

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# Decoded Example (SDT)

## SDT

service descriptor	
service_id	0x64
service_type	DTS
char	CTV
char	中視數位台

service descriptor	
service_id	0x65
service_type	DTS
char	CTV
char	中視新聞台

service descriptor	
service_id	0x66
service_type	DTS
char	CTV
Char	生活頻道

service descriptor	
service_id	0x96
service_type	DBS
char	CTV
char	GEMSTAR

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# Decoded Example (EIT P/F)

## EIT present/following

service_id	0x0064
present/following	present
event_id	0x0B
start_time	2006-6-28-10:00:00
Duration	1小時
component_type	MPEG1 layer 2 audio dual mono channel
component_type	MPEG2 video aspect ratio 30Hz
event_name_char	大家來說笑

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## Decoded Example (EIT P/F)

<b>text_char</b>	康康 郁方 康丁 素珠 石松
<b>text_char</b>	大家來說笑 集數：669 1、康丁說笑話、吐槽素珠、石松 2、康丁演唱“可憐的戀花再會吧” 3、素珠說笑話、吐槽康丁、石松 4、素珠演唱“四季紅” 5、石松說笑話、吐槽康丁、素珠 6、石松演唱“阿公店”

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## Decoded Example (EIT P/F)

<b>service_id</b>	0x0064
<b>present/following</b>	following
<b>event_id</b>	0x0B
<b>start_time</b>	2006-6-28-11:00:00
<b>Duration</b>	1小時
<b>component_type</b>	MPEG1 layer 2 audio dual mono channel
<b>component_type</b>	MPEG2 video aspect ratio 30Hz
<b>event_name_char</b>	中視新聞全球報導

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## Decoded Example (EIT Scheduled)

### EIT schedule (以0x64部份schedule為例)

<b>service_id</b>	0x0064
<b>event_id</b>	0x15
<b>start_time</b>	2006-6-28-10:00:00
<b>Duration</b>	1小時
<b>component_type</b>	MPEG1 layer 2 audio dual mono channel
<b>component_type</b>	MPEG2 video aspect ratio 30Hz
<b>event_name_char</b>	大家來說笑

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## Decoded Example (EIT Scheduled)

<b>service_id</b>	0x0064
<b>present/following</b>	following
<b>event_id</b>	0x16
<b>start_time</b>	2006-6-28-11:00:00
<b>Duration</b>	1小時
<b>component_type</b>	MPEG1 layer 2 audio dual mono channel
<b>component_type</b>	MPEG2 video aspect ratio 30Hz
<b>event_name_char</b>	中視新聞全球報導

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## Decoded Example (EIT Scheduled)

service_id	0x0064
event_id	0x17
start_time	2006-6-28-12:00:00
duration	1小時 30 分鐘
component_type	MPEG1 layer 2 audio dual mono channel
component_type	MPEG2 video aspect ratio 30Hz
event_name_char	風塵三俠之紅拂女
text_char	舒淇 霍建華 於榮光 鄭則仕
text_length	data占207byte
text_char	紅拂女第8集 李密卻趁機設計翟讓被殺是虬髯客所為，將花夫人囚禁在石牢中，準備等虬髯客來救妻子時，將他一舉成擒。逃跑的程咬金無意間發現李密勾結宇文化及，陰謀讓瓦崗軍和李淵的軍隊相鬥，漁翁得利。虬髯客大急，但苦於重傷，只得忍耐等待時機。 ...

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## Decoded Example (EIT Scheduled)

service_id	0x0064
present/following	following
event_id	0x18
start_time	2006-6-28-13:30:00
duration	1小時
component_type	MPEG1 layer 2 audio dual mono channel
component_type	MPEG2 video aspect ratio 30Hz
event_name_char	愛上九點半

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# Any Questions?

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敬請多



多指教