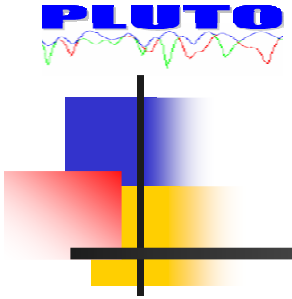

DVB-H

The DVB-H Standard for Mobile Broadcast

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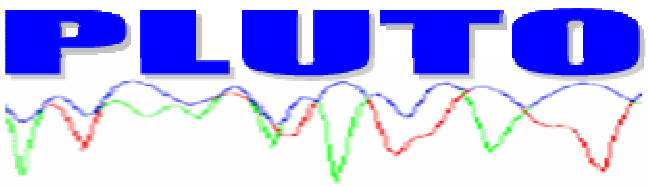
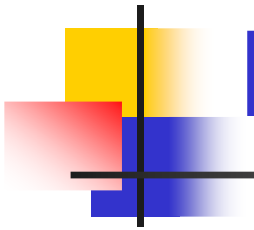
IST

- Project PLUTO Physical Layer DVB Transmission Optimisation
- Started in January
- Coordinator: Prof. John Cosmas, Brunel University

10 partners: UK, D, F, FIN





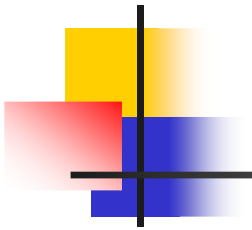
Presentation outline

- DVB-H background
- DVB-H transmission system
- DVB-H data organisation
- DVB-ESG
- DVB-H media protocols

DVB-H

- DVB-H => DVB H-(ANDHELD) targets broadcasting to mobile terminals

DVB-H is aiming to provide mass media distribution in mobile systems



DVB-H

- DVB-H is an outgrowth of digital television terrestrial DVB-T standard
- DVB-H and DVB-T are ’cousins’, with both important similarities and differences

  DVB-H is optimised for specific mobile reception requirements and integration with modern networking

Mobile reception

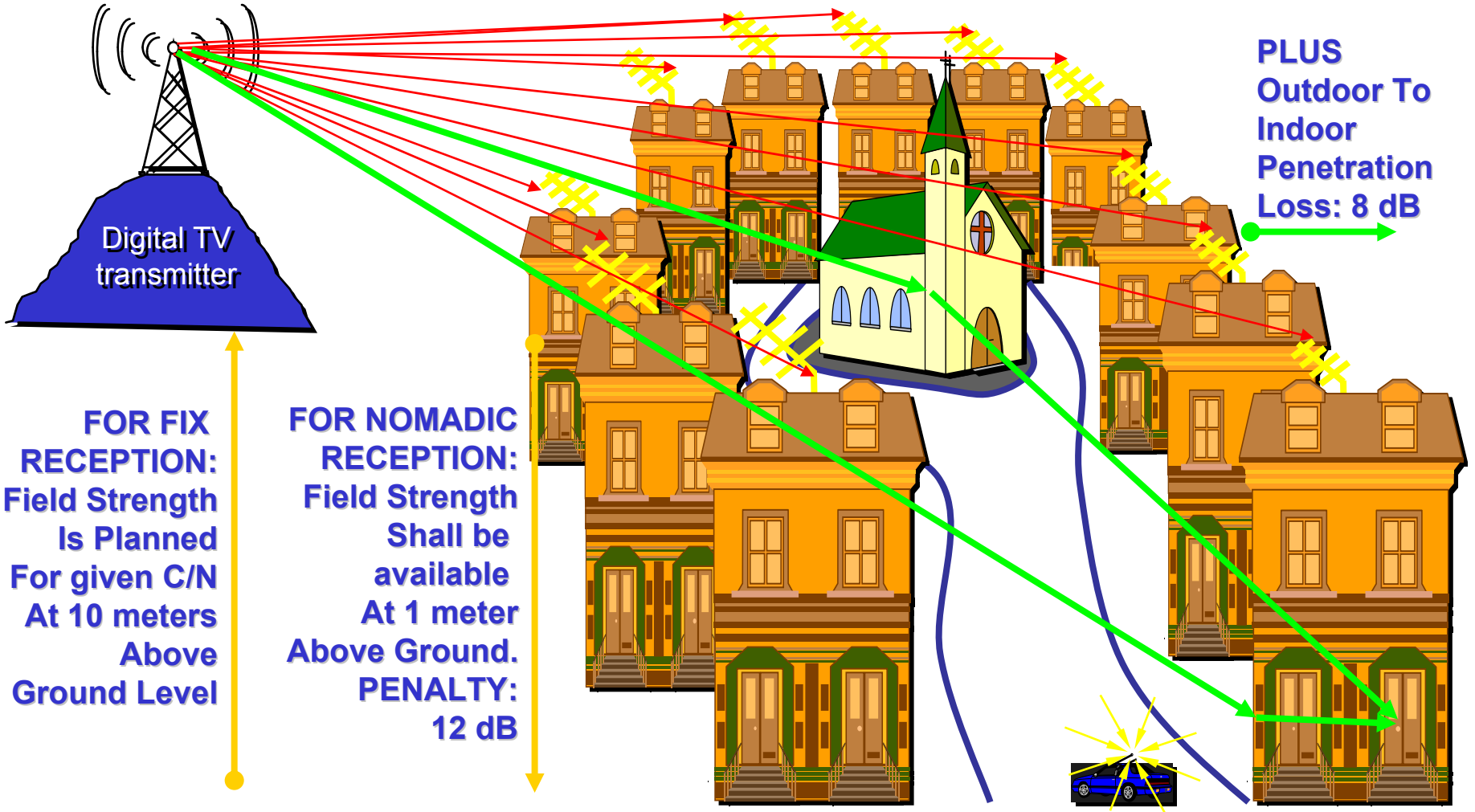
- Conditions and requirements:
  - reception ’everywhere’

    (ground level, indoors, urban canyons)
  - no receiving antenna

    (very small internal antenna)
  - power consumption very critical
  - user expectations based on mobile experience

    (coverage like in mobile networks, no concern about signal availability, long battery life)

Mobile reception penalty



Broadcast to NOMADIC handhelds Terminals:

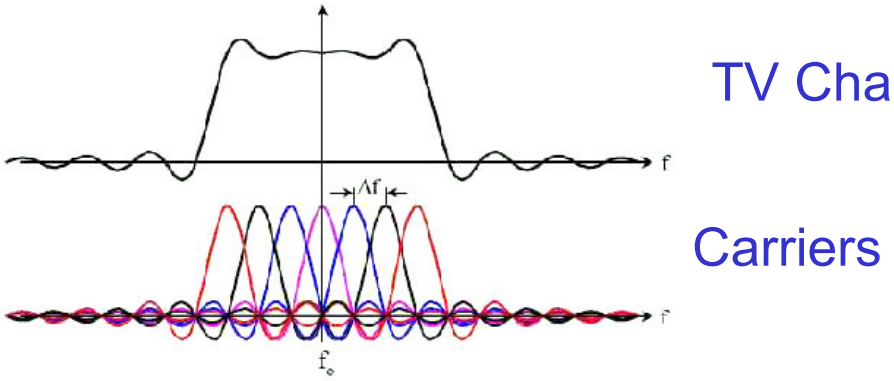
- Ground level penalty = 12 dB
- Indoor OR (AND) Mobile penalty = 8 dB (16 dB)

DVB-H transmission system

- DVB-H is coping with mobile penalty by enhancements to the DVB-T transmission system
- However, from the transmission point DVB-H is downward compatible to the DVB-T, DVB-T transmission system can carry DVB-H data

DVB-H/T modulation

- DVB-H/T modulation is based on multicarrier COFDM filling up TV channel



- DVB-T specifies 2k and 8k carriers
  DVB-H adds modulation with 4k carrier
- Carriers are modulated with QPSK, 16 QAM or 64 QAM

Orthogonal Sub-carriers

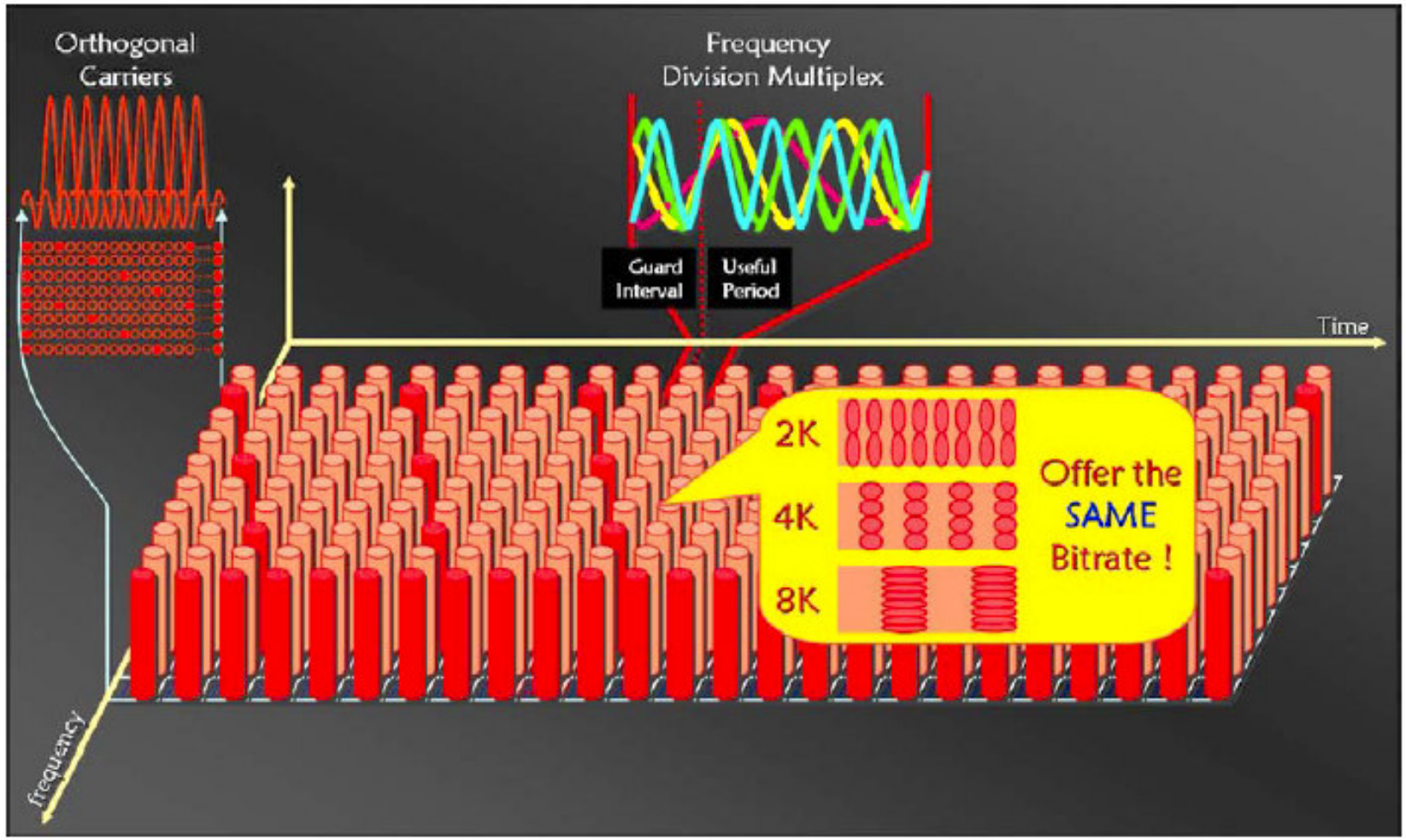
- DVB-H/T multi-carrier physical layer
  - High spectrum efficiency comes from orthogonal arrangement of the sub-carriers within the channel. This avoids inter-carrier interference while decreasing the inter-carrier distance to its ultimate lowest value. It implies also a strict relationship between symbol duration and inter-carrier spacing (i.e. $\Delta t=1/\Delta f$),

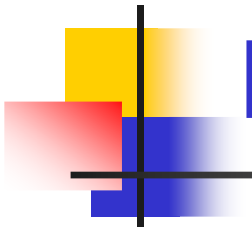
Physical Layer – Pilot Carriers

- DVB-H/T multi-carrier physical layer
  - pattern of pilot carriers spread in the channel, which are used in the receiver to recover the channel state information, enabling an accurate estimation of the transmission error for each data sub-carrier.

Pilot Carriers

- DVB-T multi-carrier physical layer





Physical Layer – Guard Interval

- DVB-T multi-carrier physical layer
  - High resilience against “echoes” resulting from the multi-path propagation of the transmitted signal thanks to the “guard interval”, which provides an robust method of avoiding inter-symbol interference

Error Correction

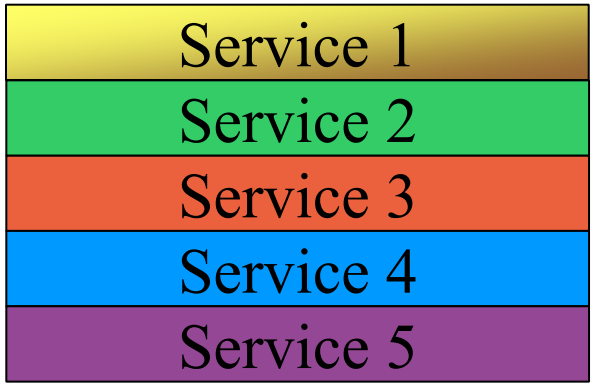
- DVB-T multi-carrier physical layer
  - error correction capability provided by the concatenation of one “block” of FEC (i.e. Reed Solomon coding) and one “bit” of FEC (i.e. convolutional “Viterbi” coding) each completed with an interleaver to bring time and frequency diversity into the signal

DVB-H enhacements vs. DVB-T

- TPS bits allow the receiver to rapidly identify the presence of DVB-H services and further improve service discovery during the RF scanning process
- 4K mode brings additional flexibility in network planning (providing a better compromise between transmission cell size and maximum speed)
- In-depth interleaver aims to improve impulse noise resilience

DVB-H addresses battery life

- DVB-H standard addresses battery life in the terminal by TIME SLICING



DVB-T

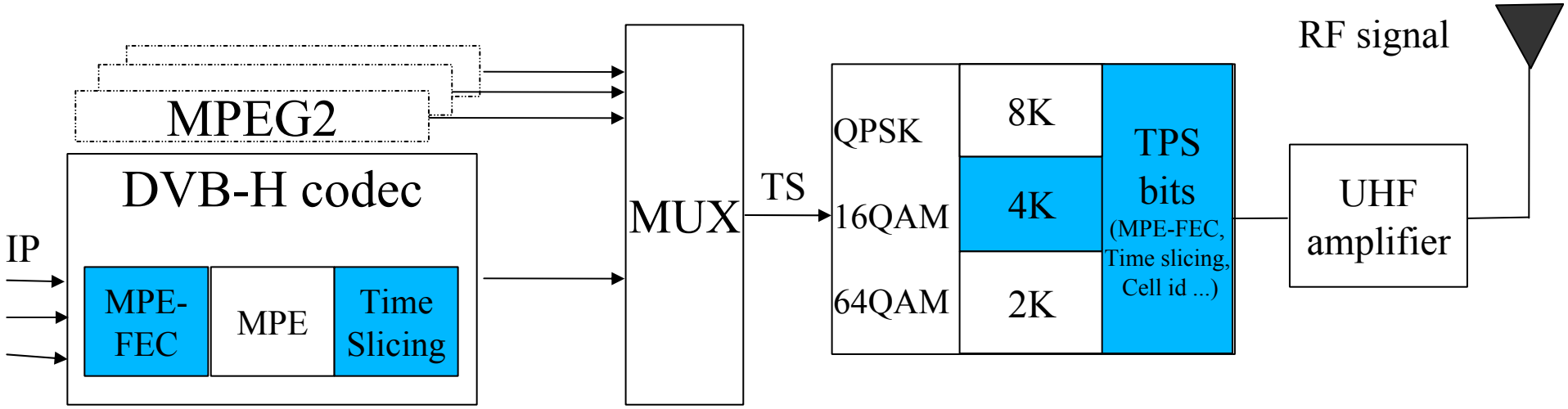
Services multiplexed in time

DVB-H

Services send in BURSTS and buffered. Between the bursts terminal receiver switched off

Advantages of time slicing: power saving, easy handover
Disadvantage: long channel tuning time

DVB-H Transmission System



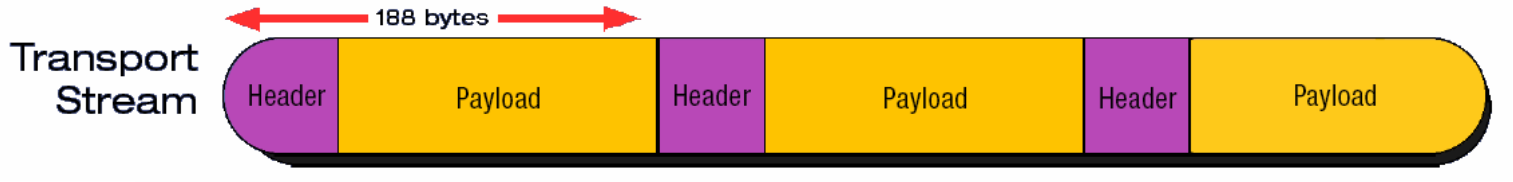
Multiplex (can be done with DVB-T MPEG-2)

DVB-H modulator

In blue, DVB-H specific components

DVB-H Data Organisation

- DVB-H uses MPEG-2 Transport Stream (TS) packets, same as in DVB-T,C,S:

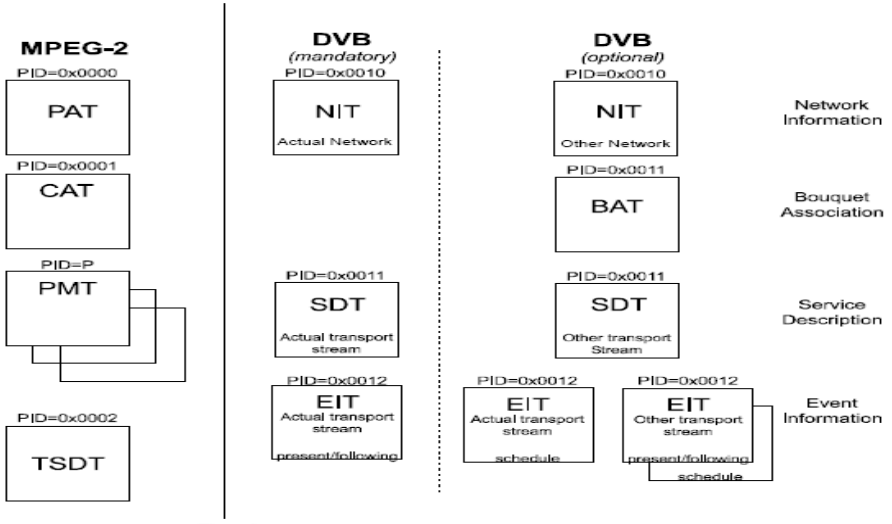


Syntax	No. of bits	Mnemonic
transport_packet(){		
sync_byte	**8**	**bslbf**
transport_error_indicator	**1**	**bslbf**
payload_unit_start_indicator	**1**	**bslbf**
transport_priority	**1**	**bslbf**
PID	**13**	**uimsbf**
transport_scrambling_control	**2**	**bslbf**
adaptation_field_control	**2**	**bslbf**
continuity_counter	**4**	**uimsbf**
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**	**bslbf**
}		
}		
}		

PID – Packet Identifier, packets carrying single media have the same PID which is unique for a given multiplex

MPEG-2 Stream Information

The MPEG-2 TS carries packets with Stream Information (**SI**) presented In the form of tables. There are two types of tables, one from the MPEG-2 standard and another from the DVB standard (**SI/PSI** system)



SI/PSI Tables

The most important are

PAT- Program Association Table reference to PID's of PMT's multiplex

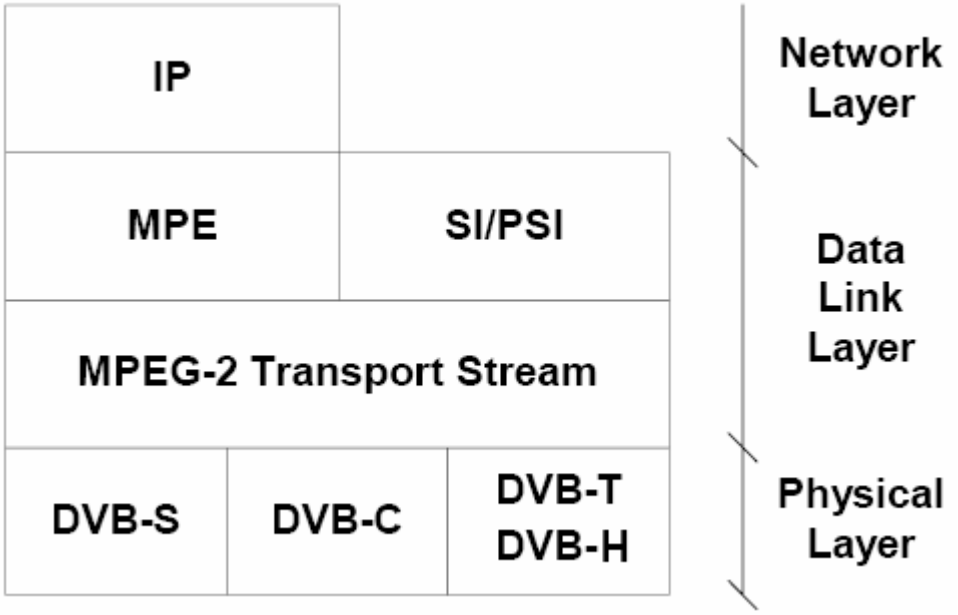
PMT- Program Management Table listing PID's of media in a program

NIT – Network Information Table, reference to all multipelxes of a network

DVB-H uses basic tables

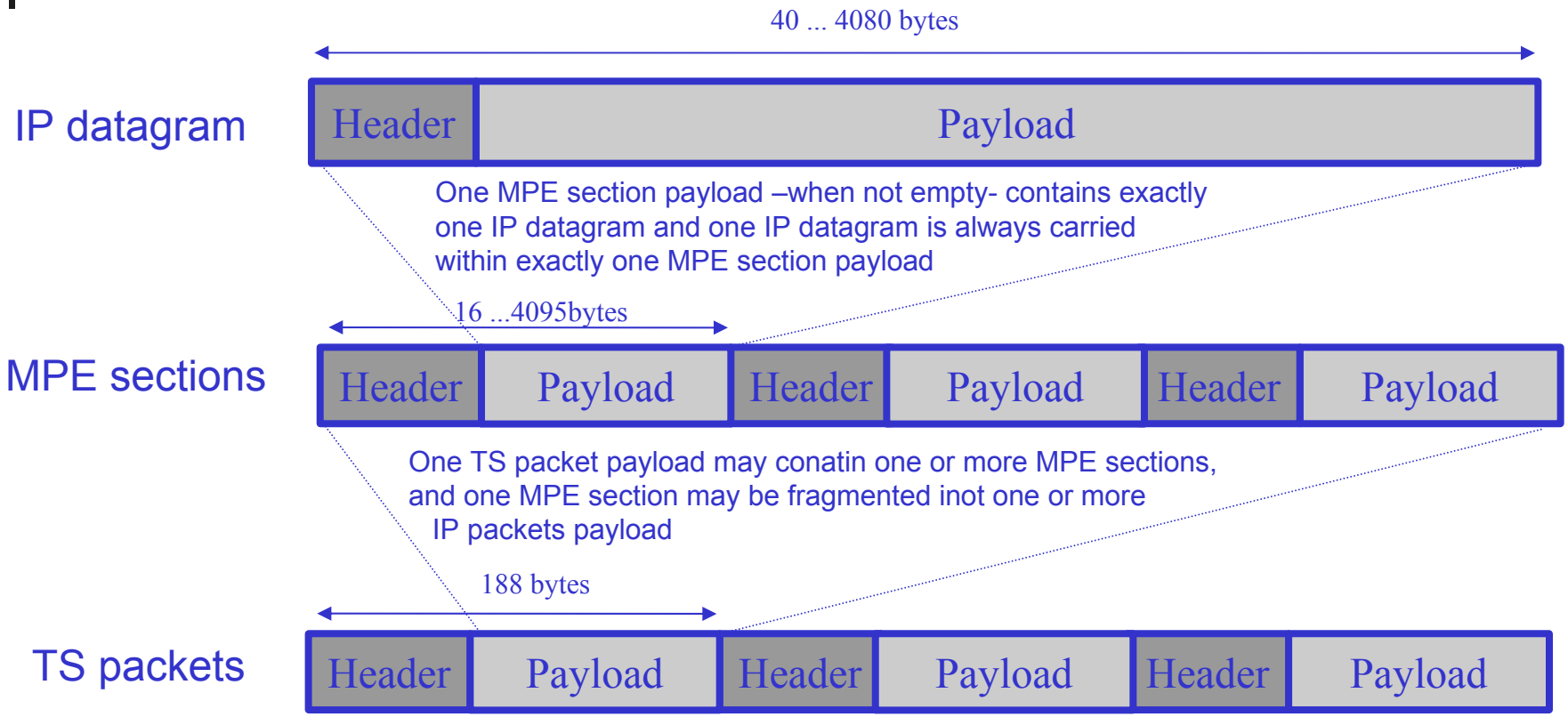
IP packets in DVB

- DVB system can be used for transmission of IP packets. This is done by Multiprotocol Encapsulation MPE

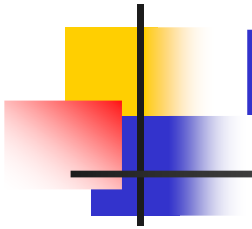


- **DVB-H USES EXCLUSIVELY IP PACKETS FOR MEDIA TRANSFER**

Multiprotocol Encapsulation



IP packets are embedded into MPE sections which are put into TS packets



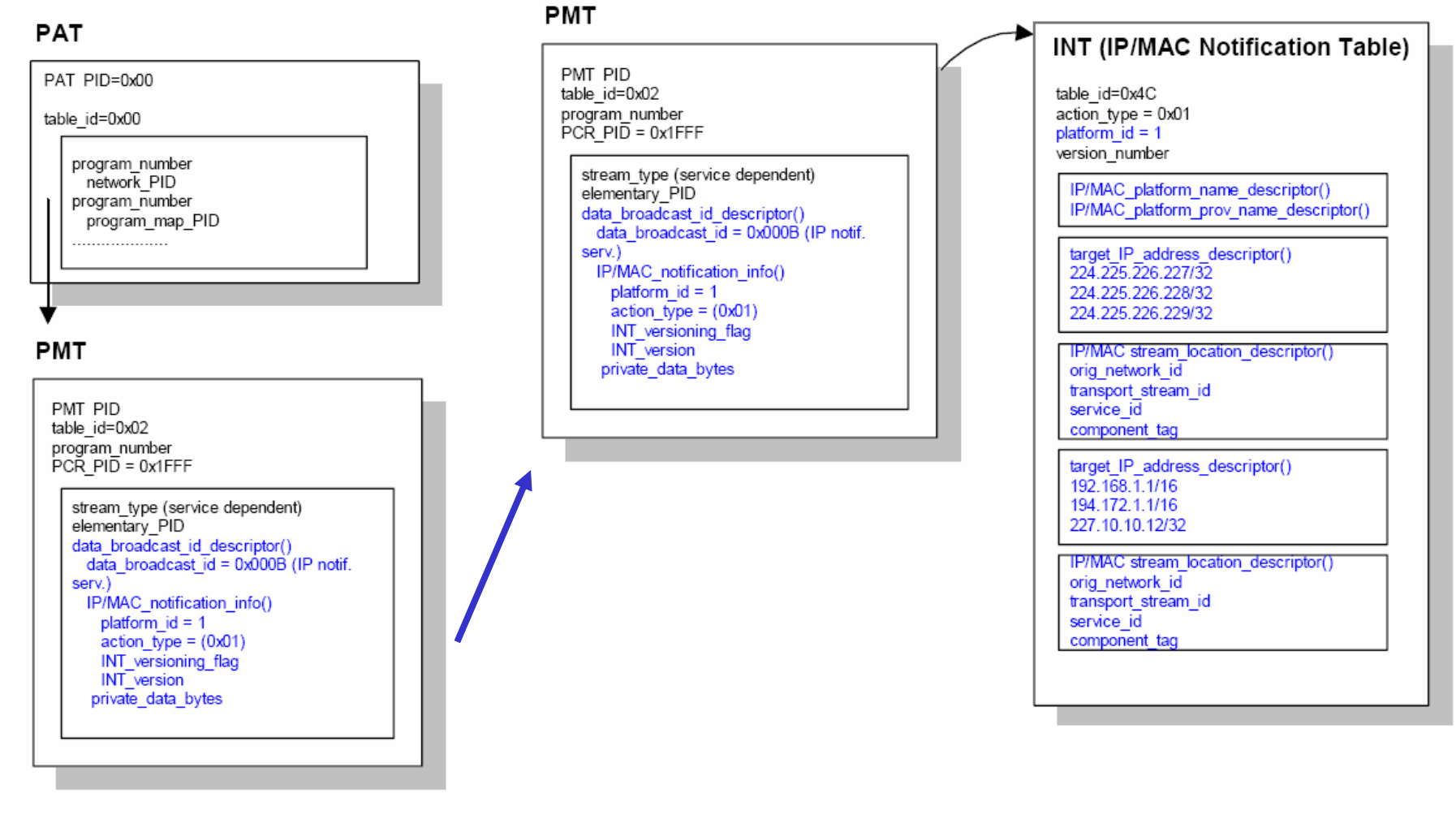
DVB IPDC – IP Datacast

IP/MAC Platform: A set of IP/MAC streams managed by an organization. May span several transport streams within one or multiple DVB networks and several IP/MAC platforms may co-exist in the same transport stream. Identified by its platform_id

Platform_id – uniquely identifies an IP/MAC platform. It is associated with platform_name.

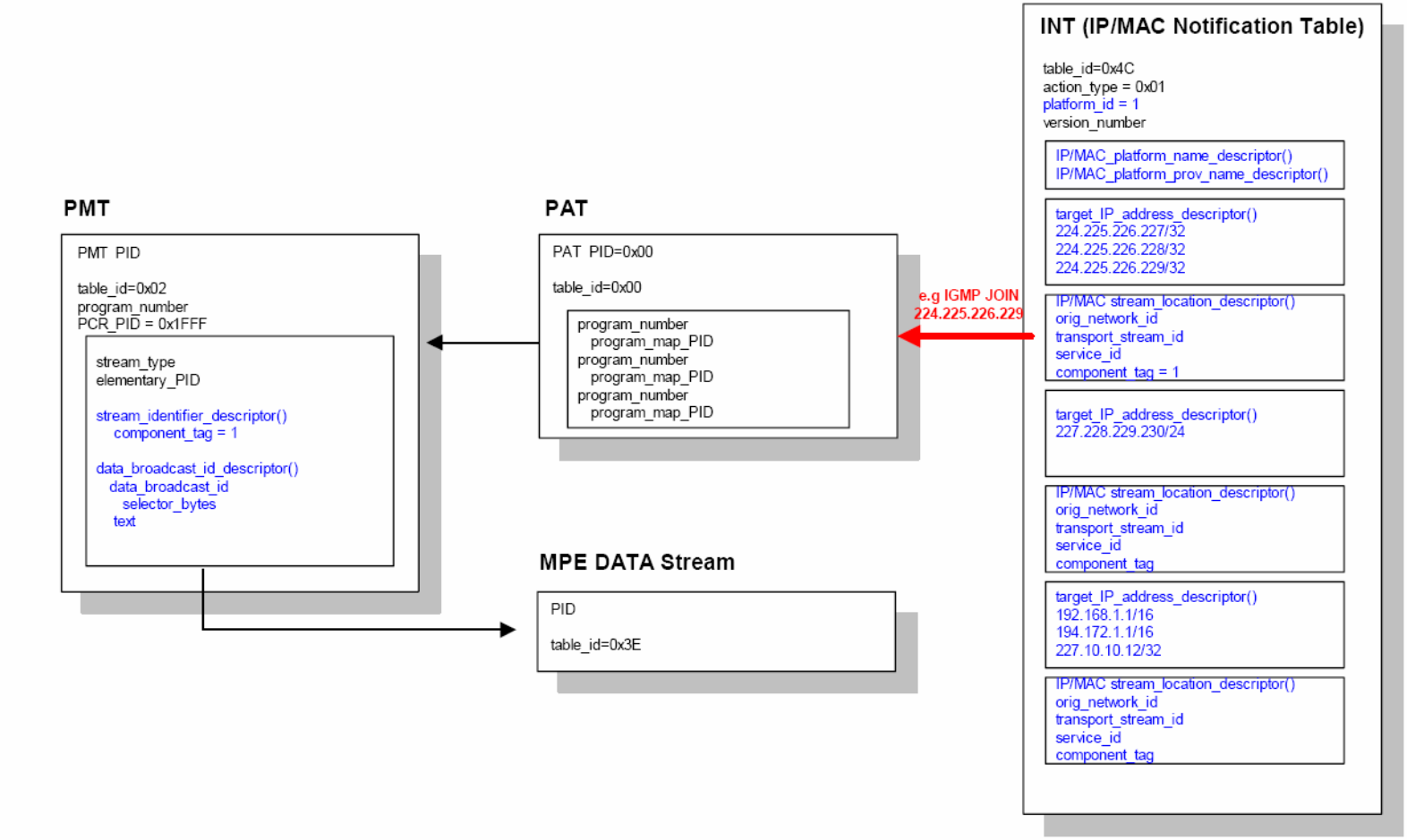
IP/MAC stream: A data stream including an address header containing an IP and/or MAC address. It is encapsulated in an MPEG-2 TS multiplex. An example: IP multicast stream conveyed in MPE sections.

IP Datacast in SI Tables



From PAT -> PMT and from PMT to INT

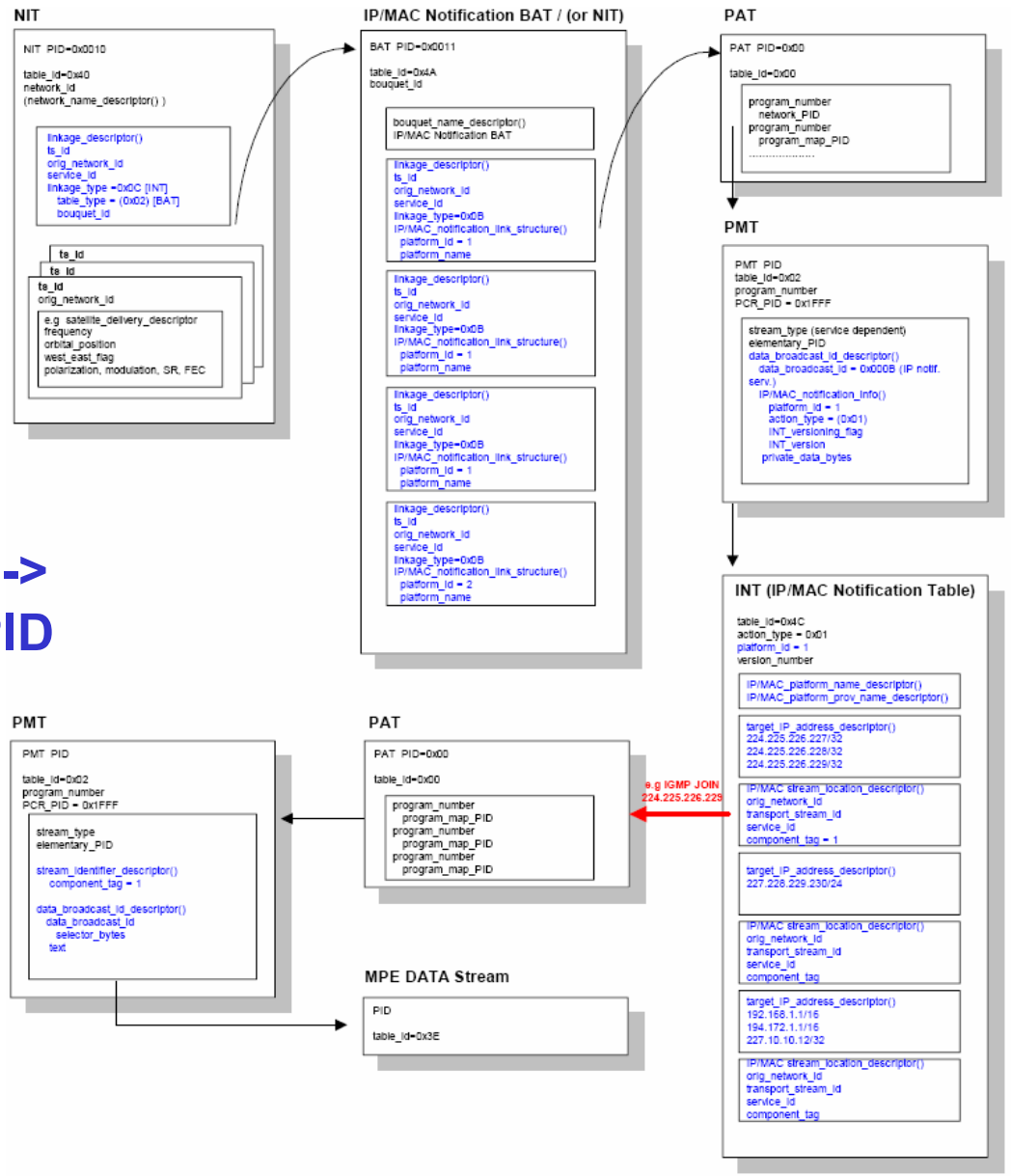
IPDC DATA PIN-POINTING



From INT stream_location_descriptor to PAT -> PAT -> PMT-> MPE PID

General Pin-Pointing Scheme

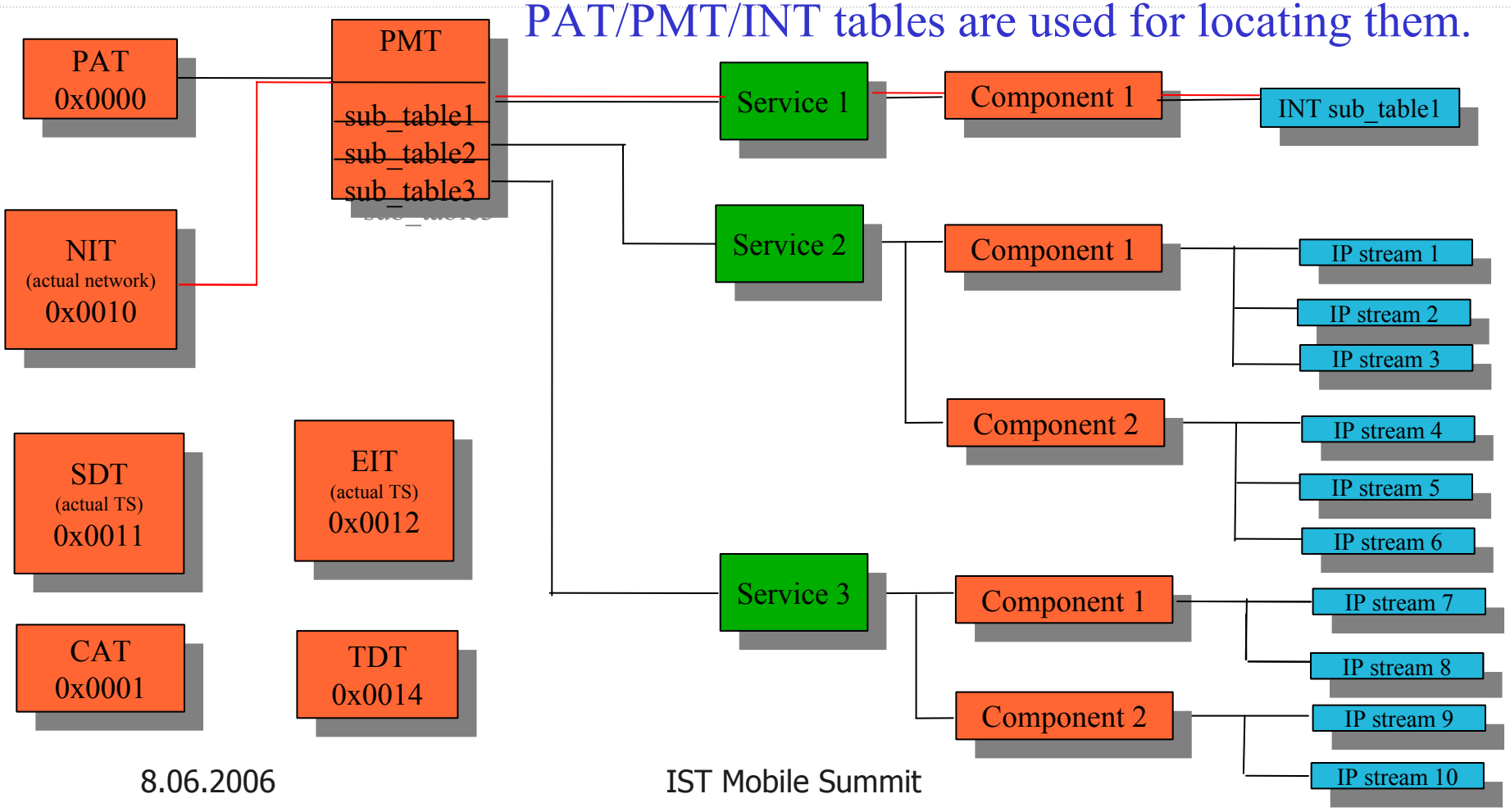
From NIT -> INT -> PAT -> INT ->
-> PAT -> PMT –> MPE PID



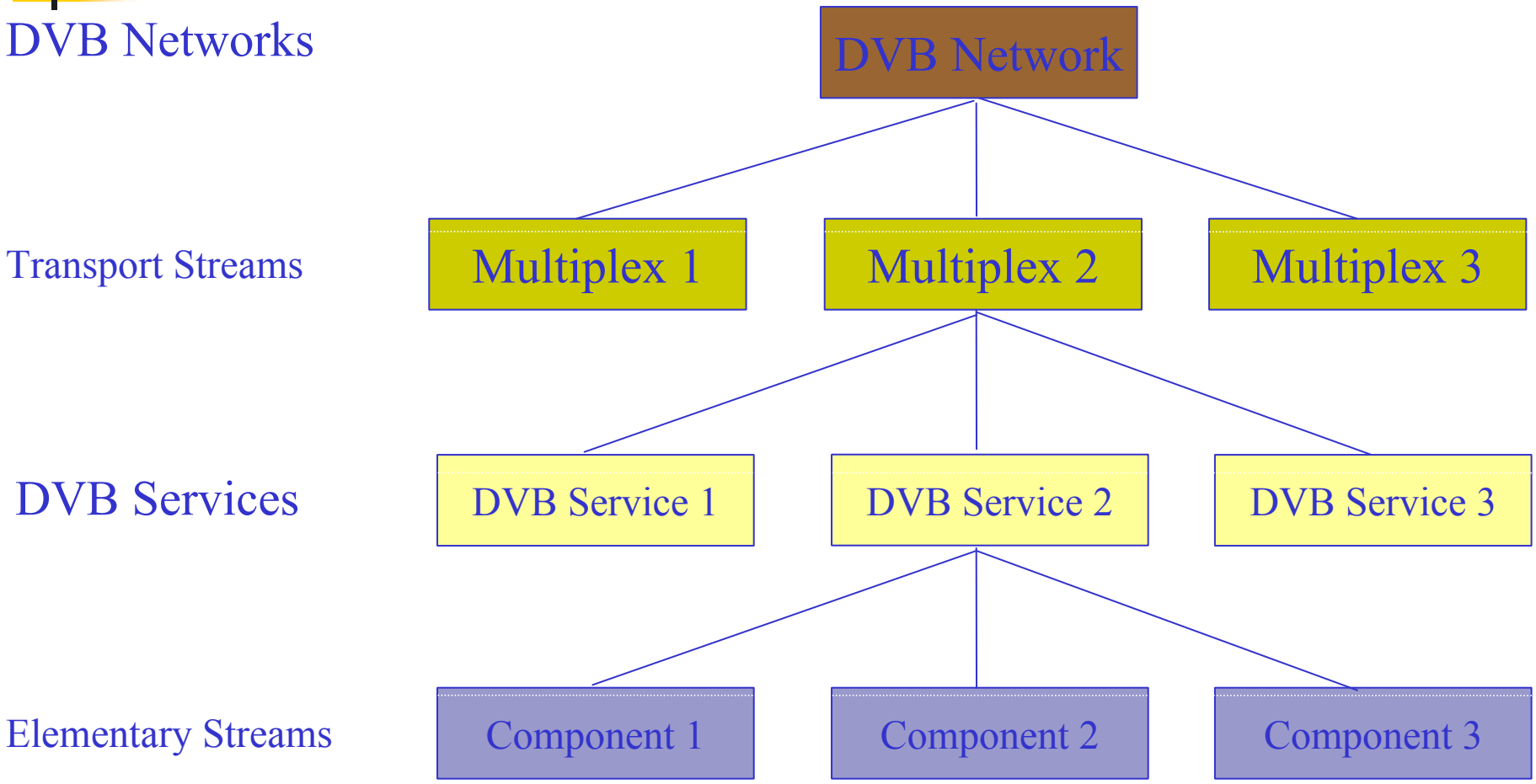
SI/PSI and DVB-H Services

DVB-H network is made of services which are made of components. Component runs in single PID and is made of IP streams.

PAT/PMT/INT tables are used for locating them.

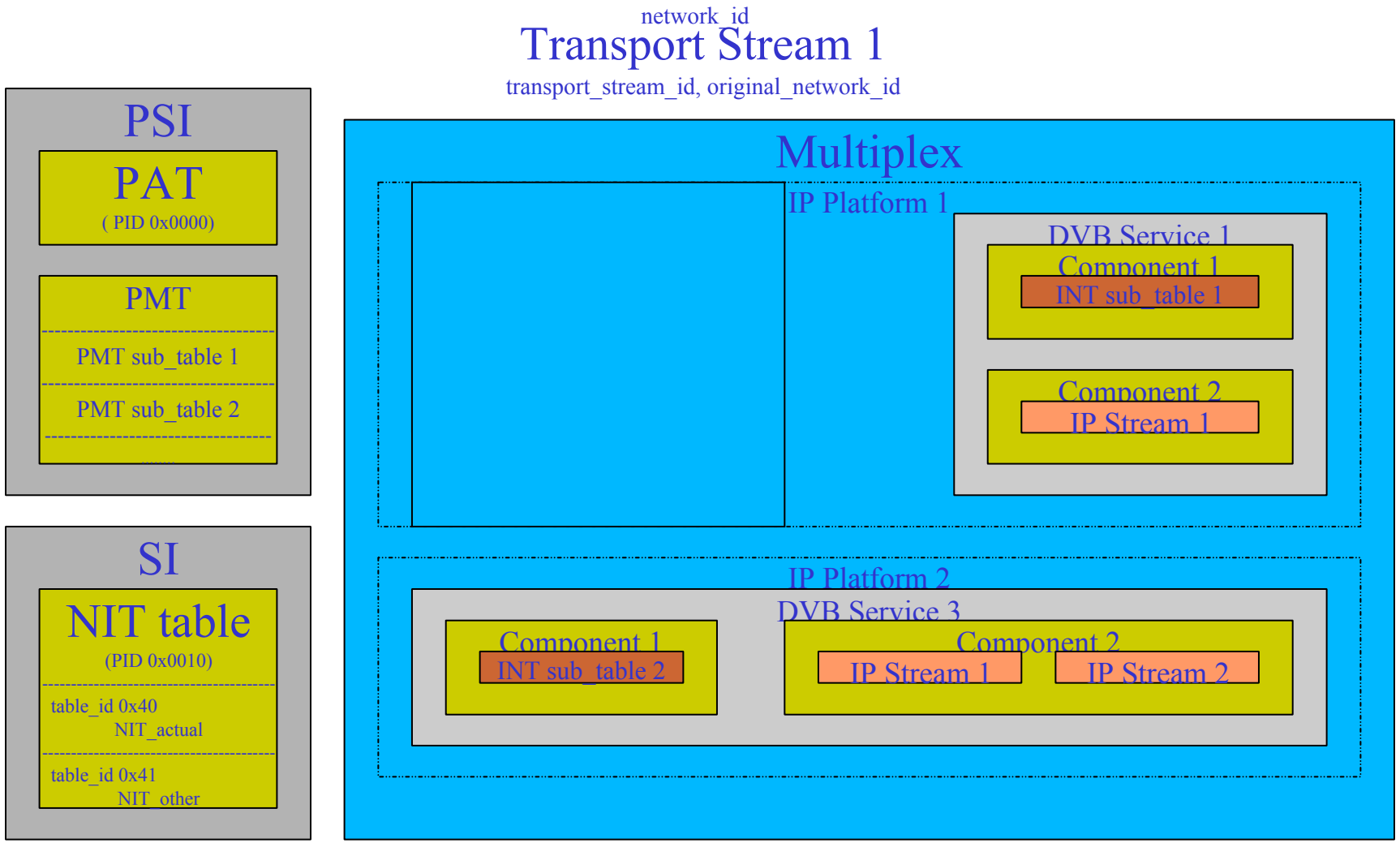


DVB-H Networks

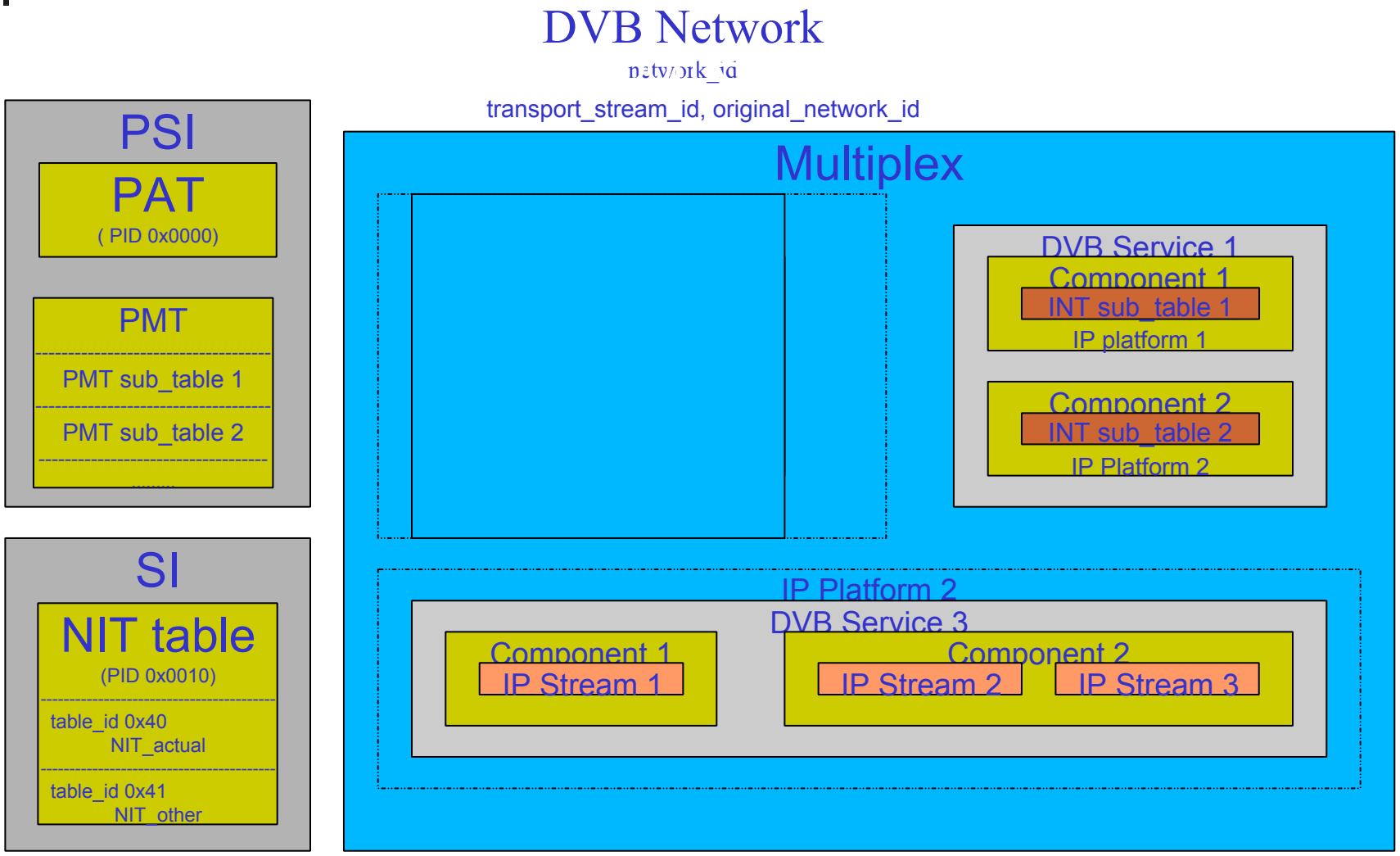


Networks->Multiplexes->Services->Components

Case: Two IP platforms/services

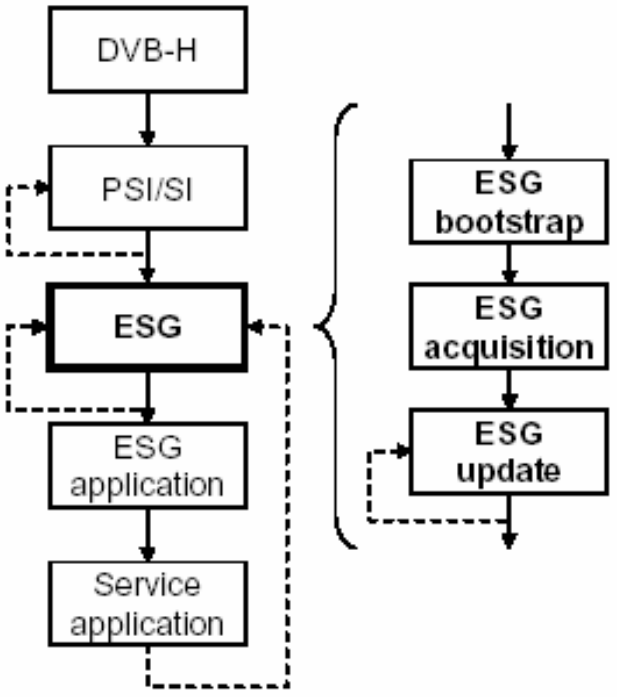


Case: Service 1: 2 IP platforms



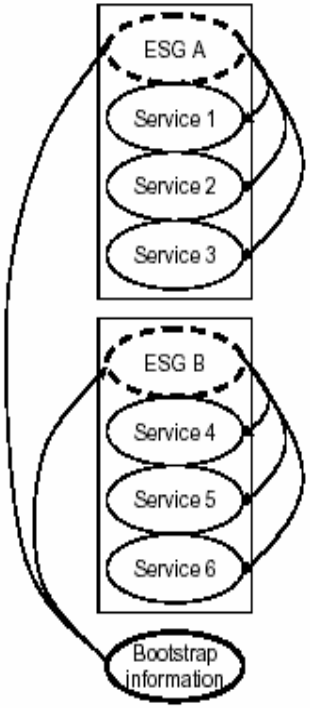
ELECTRONIC SERVICE GUIDE

ESG is DVB-H specific system for carrying information about particular contents of services. One can say that SI tables carry static information where services are and ESG dynamic information about what is in the services.



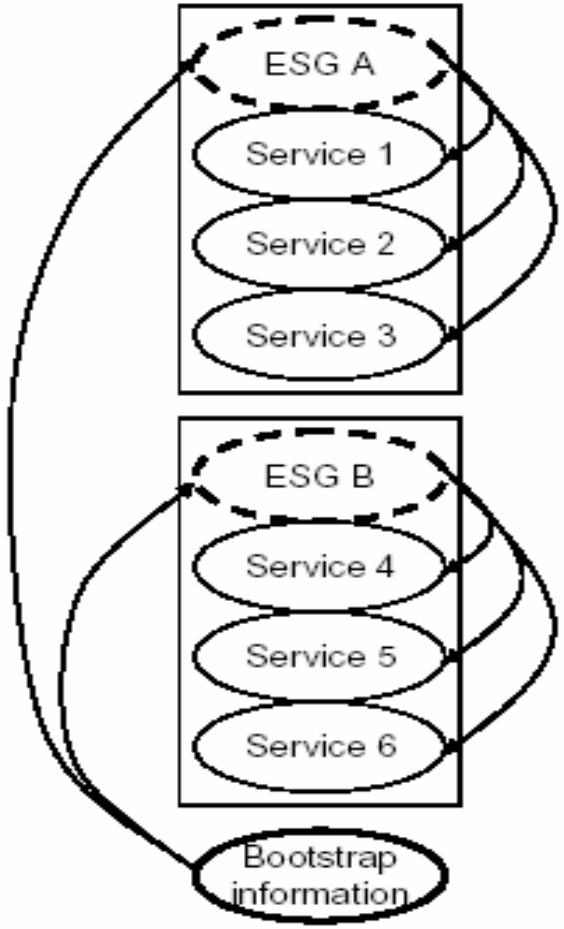
To tune to particular programming the receiver has to recover ESG. Information is given in SI tables-

Each service may have its own ESG There is thus an ESG bootstrap Information telling about location of ESG's for particular services



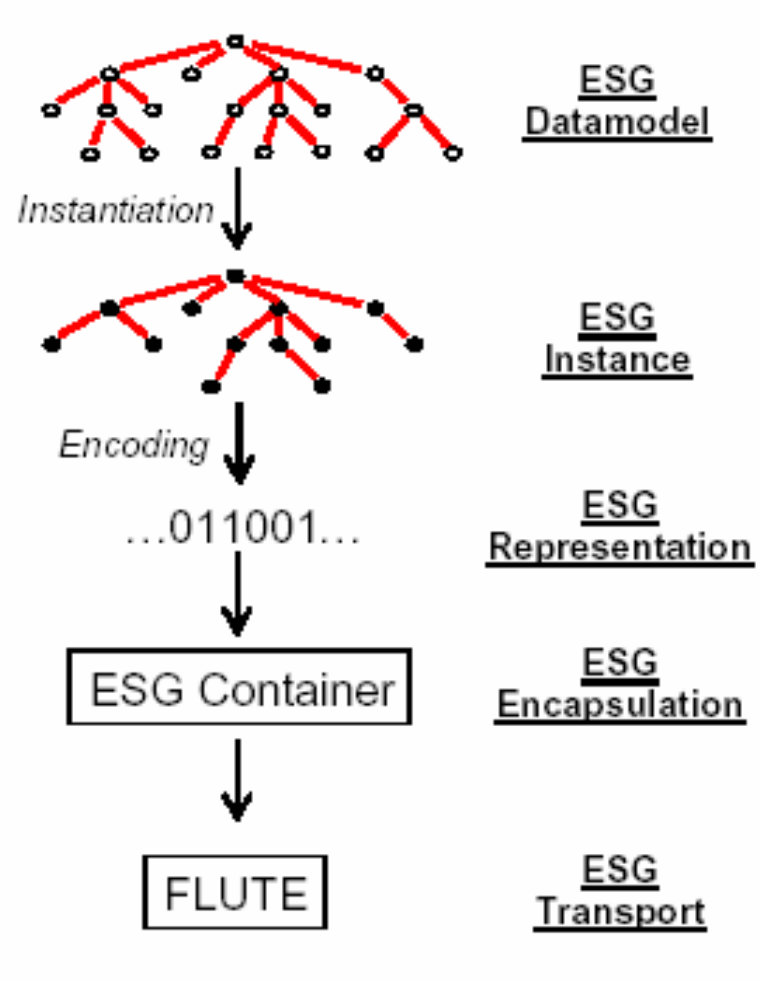
ESG Bootstrapping

- Operation through which the terminal knows which ESGs are available and how to acquire them
- ESG Bootstrap Descriptors
  - ESG Provider Discovery Descriptor
  - ESG Access Descriptor



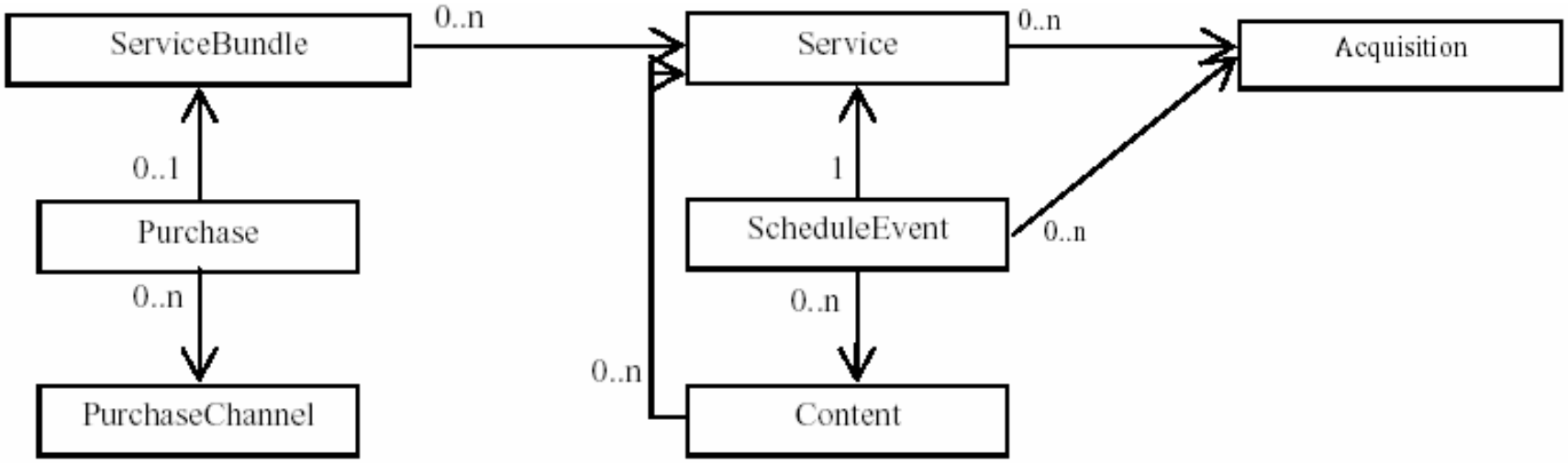
ESG Layers

- Datamodel
  - XML Schema
- Instance
  - ESG Data
- Representation
  - Fragments
- Encapsulation
  - Containers
- Transport
  - FLUTE

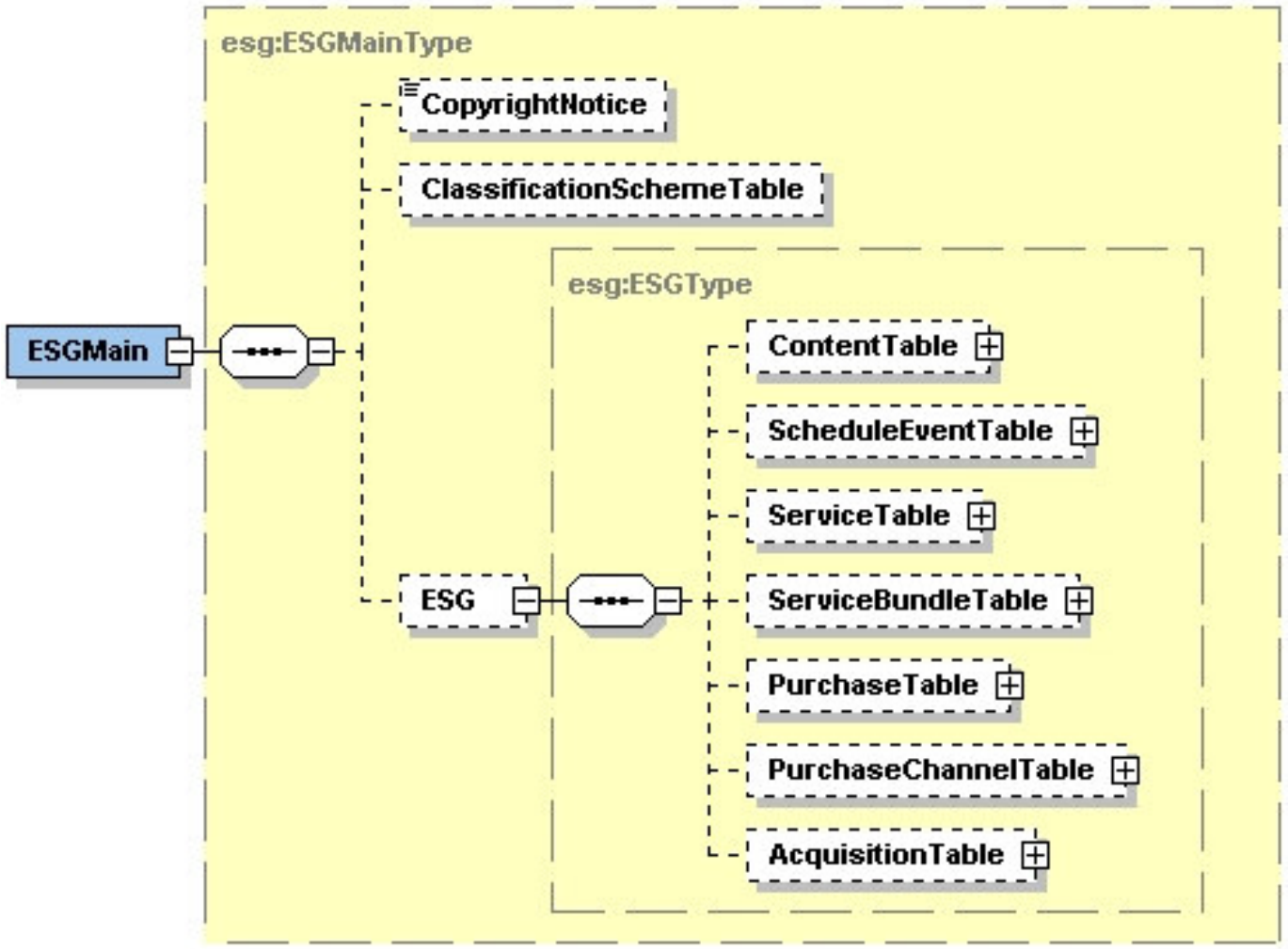


ESG Data Model

- Described by XML Schema
- Subdivided into ESG Fragments
- ESG Wrapper
  - Specifies how the ESG is compiled based on the ESG Fragments



ESG Main Element



ESG Schema

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v3.5 NT (http://www.xmlspy.com) by  () -->
<schema targetNamespace="urn:dvb:ipdc:esg:2005" xmlns:mpeg7="urn:mpeg:mpeg7:schema:2001"
xmlns="http://www.w3.org/2001/XMLSchema" xmlns:tva="urn:tva:metadata:2005" xmlns:esg="urn:dvb:ipdc:esg:2005"
elementFormDefault="qualified" attributeFormDefault="unqualified">
        <import namespace="http://www.w3.org/XML/1998/namespace"/>
        <import namespace="urn:mpeg:mpeg7:schema:2001"/>
        <import namespace="urn:tva:metadata:2005"/>
        <element name="ESGMain" type="esg:ESGMainType"/>
        <complexType name="ESGMainType">
                <sequence>
                        <element name="CopyrightNotice" type="string" minOccurs="0"/>
                        <element name="ClassificationSchemeTable"
type="tva:ClassificationSchemeTableType" minOccurs="0"/>
                        <element name="ESG" type="esg:ESGType" minOccurs="0"/>
                </sequence>
                <attribute ref="xml:lang" use="optional" default="en"/>
                <attribute name="publisher" type="string" use="optional"/>
                <attribute name="publicationTime" type="dateTime" use="optional"/>
                <attribute name="rightsOwner" type="string" use="optional"/>
        </complexType>
        <complexType name="ESGType">
                <sequence>
                        <element name="ContentTable" type="esg:ContentTableType" minOccurs="0"/>
                        <element name="ScheduleEventTable" type="esg:ScheduleEventTableType"
minOccurs="0"/>
                        <element name="ServiceTable" type="esg:ServiceTableType" minOccurs="0"/>
                        <element name="ServiceBundleTable" type="esg:ServiceBundleTableType"
minOccurs="0"/>
                        <element name="PurchaseTable" type="esg:PurchaseTableType" minOccurs="0"/>
                        <element name="PurchaseChannelTable" type="esg:PurchaseChannelTableType"
minOccurs="0"/>
                        <element name="AcquisitionTable" type="esg:AcquisitionTableType" minOccurs="0"/>
                </sequence>
        </complexType>
```

ESG Schema

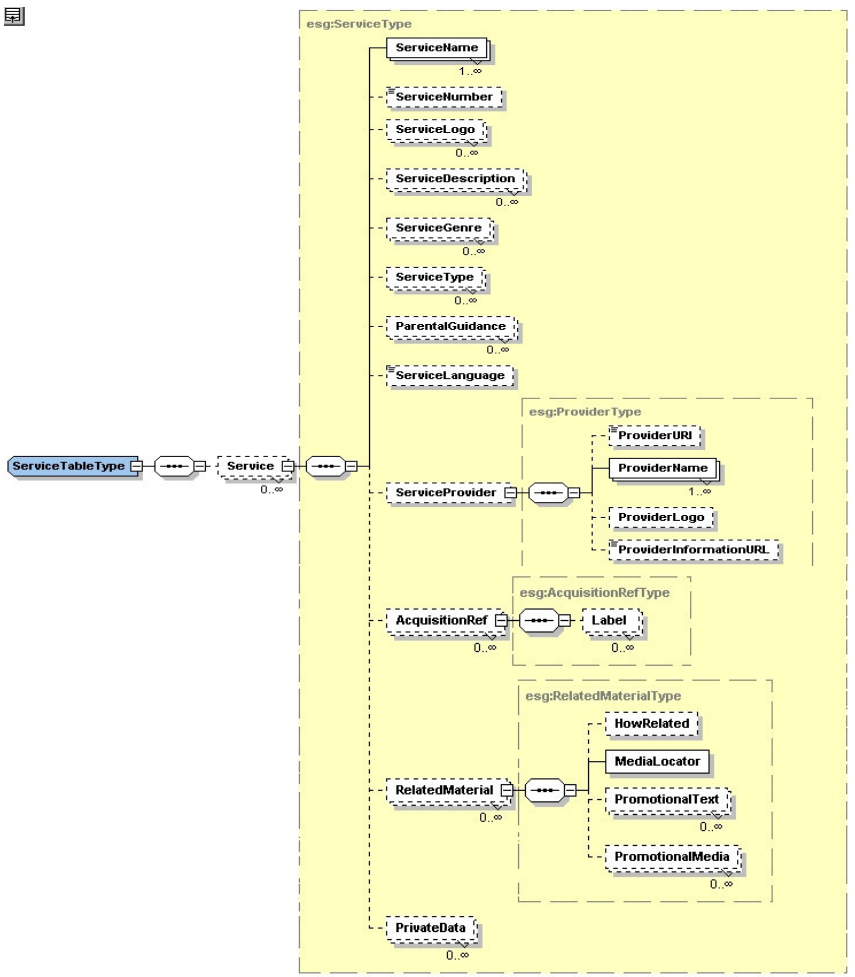
```
<complexType name="ContentTableType">
                    <sequence>
                              <element name="Content" type="esg:ContentType" minOccurs="0" maxOccurs="unbounded"/>
                    </sequence>
          </complexType>
          <complexType name="ScheduleEventTableType">
                    <sequence>
                              <element name="ScheduleEvent" type="esg:ScheduleEventType" minOccurs="0"
maxOccurs="unbounded"/>
                    </sequence>
          </complexType>
          <complexType name="ServiceTableType">
                    <sequence>
                              <element name="Service" type="esg:ServiceType" minOccurs="0" maxOccurs="unbounded"/>
                    </sequence>
          </complexType>
          <complexType name="ServiceBundleTableType">
                    <sequence>
                              <element name="ServiceBundle" type="esg:ServiceBundleType" minOccurs="0"
maxOccurs="unbounded"/>
                    </sequence>
          </complexType>
          <complexType name="PurchaseTableType">
                    <sequence>
                              <element name="Purchase" type="esg:PurchaseType" minOccurs="0" maxOccurs="unbounded"/>
                    </sequence>
          </complexType>
          <complexType name="PurchaseChannelTableType">
                    <sequence>
                              <element name="PurchaseChannel" type="esg:PurchaseChannelType" minOccurs="0"
maxOccurs="unbounded"/>
                    </sequence>
          </complexType>
          <complexType name="AcquisitionTableType">
                    <sequence>
                              <element name="Acquisition" type="esg:AcquisitionType" minOccurs="0" maxOccurs="unbounded"/>
                    </sequence>
          </complexType>
```

ESG Schema

- <ESGMain xmlns="urn:dvb:ipdc:esg:2005">
  - <ESG>
    - <ContentTable/>
    - <ScheduleEventTable/>
    - <ServiceTable/>
    - <ServiceBundleTable/>
    - <PurchaseTable/>
    - <PurchaseChannelTable/>
    - <AcquisitionTable/>
  - </ESG>
- </ESGMain>

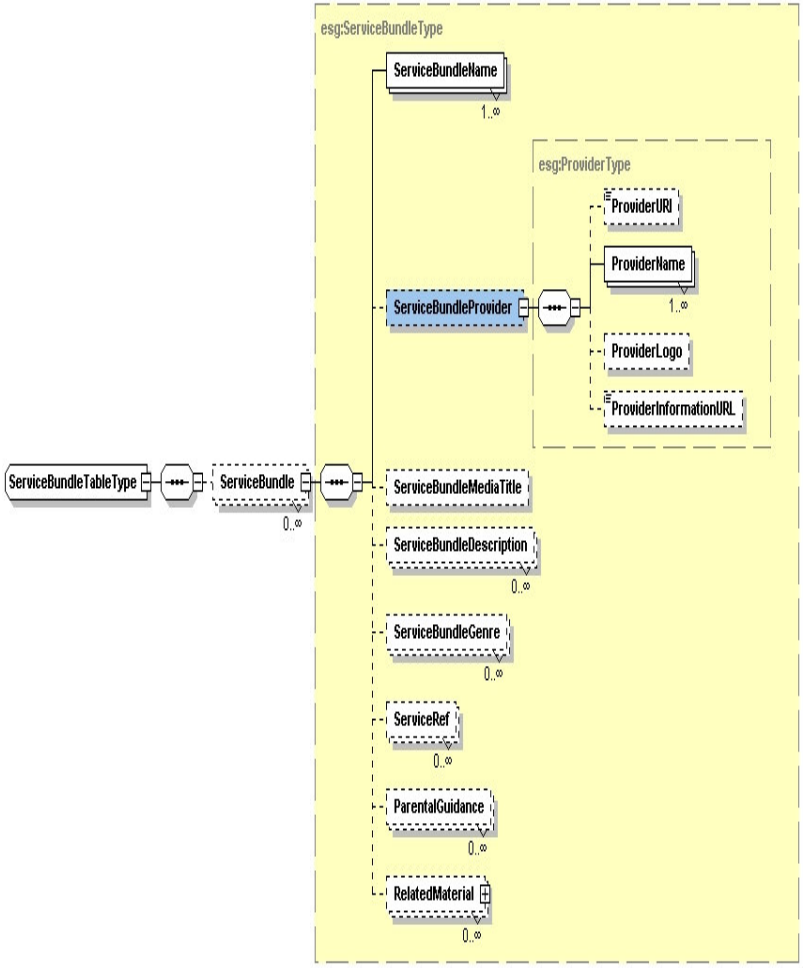
Service Fragment

- Elements
  - Name
  - Number
  - Logo
  - Description
  - Genre
  - Type
  - Parental Guidance
  - Language
  - Provider
  - Acquisition Reference
  - Related Material
  - Private Data
- Attributes
  - serviceID
  - freeToAir
  - clearToAir



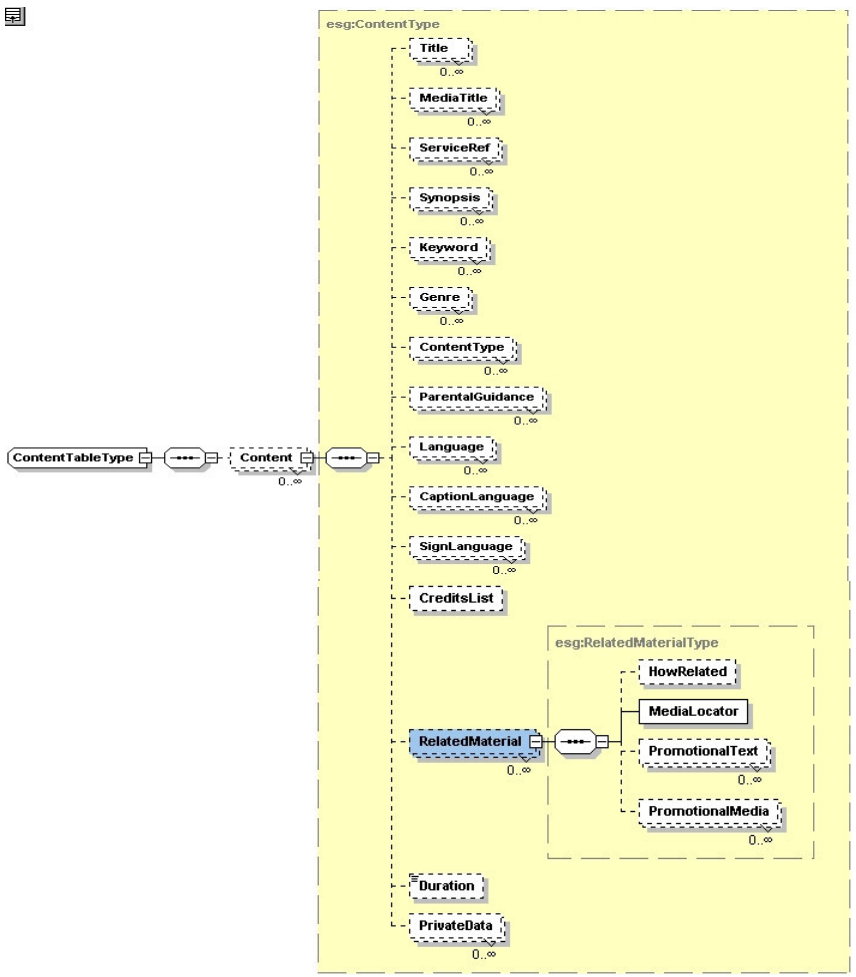
Service Bundle Fragment

- Elements
  - Name
  - Provider
  - Media Title
  - Description
  - Genre
  - Service Reference
  - Parental Guidance
  - Related Material
- Attributes
  - serviceBundleID



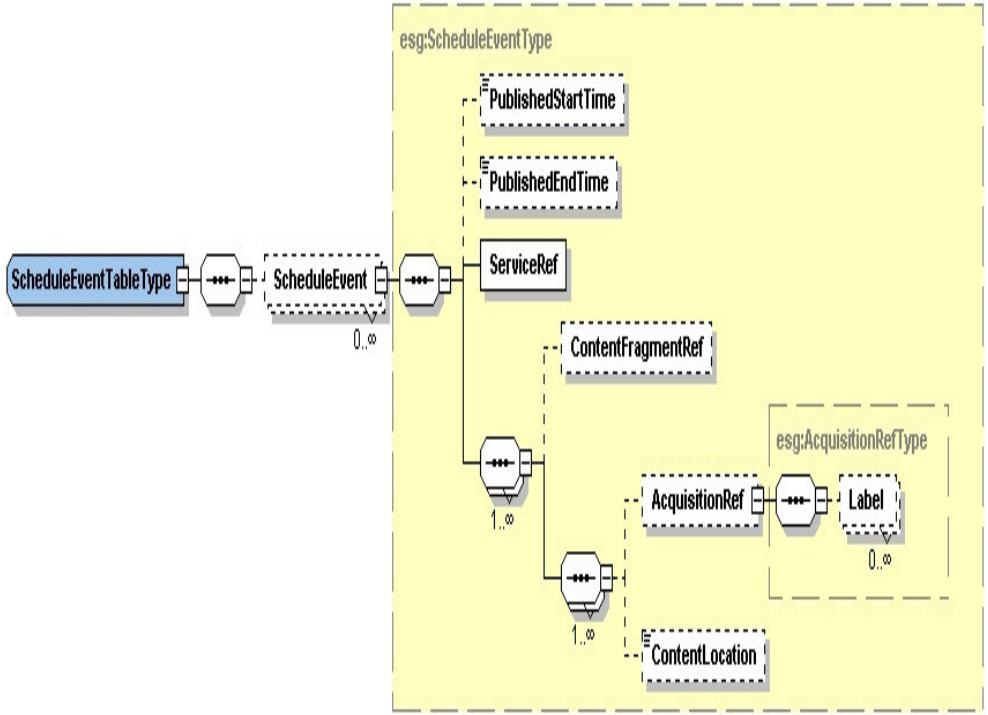
Content Fragment

- Elements
  - Title
  - Media Title
  - Service Reference
  - Synopsis
  - Keyword
  - Genre
  - Content Type
  - Parental Guidance
  - Language
  - Caption Language
  - Sign Language
  - Credits List
  - Related material
  - Duration
  - Private Data



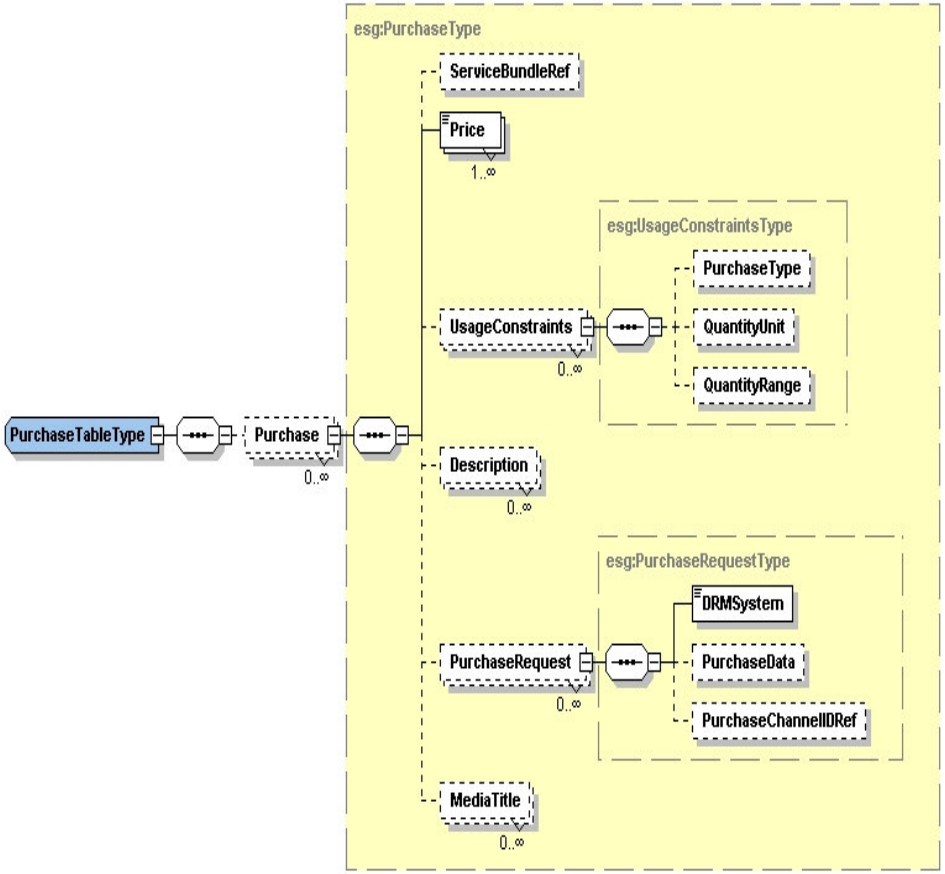
Schedule Event Fragment

- Elements
  - Published Start Time
  - Published End Time
  - Service Reference
  - Content Fragment Reference
  - Acquisition Reference
  - Content Location
- Attributes
  - live
  - repeat
  - freeToAir
  - clearToAir
  - scheduleID



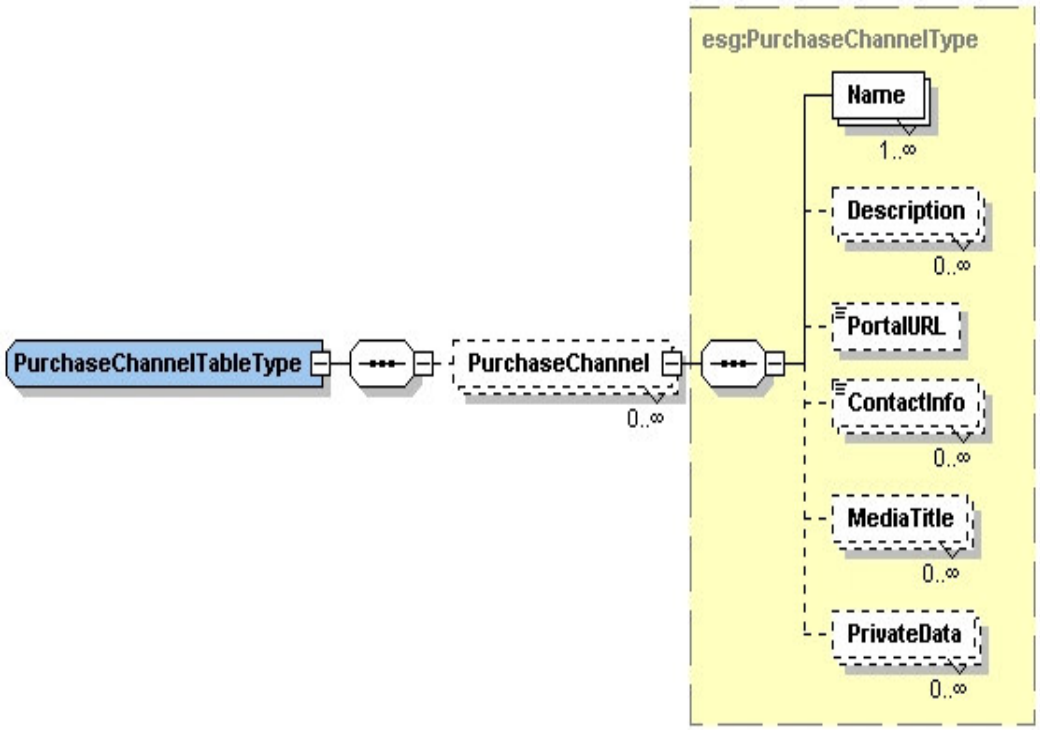
Purchase Fragment

- Elements
  - Service Bundle Reference
  - Price
  - Usage Constraints
  - Purchase Type
  - Quantity Unit
  - Quantity Range
  - Description
  - Purchase Request
  - DRM System
  - Purchase Data
  - Purchase Channel ID Reference
  - Media Title
- Attributes
  - start
  - end
  - purchaseID



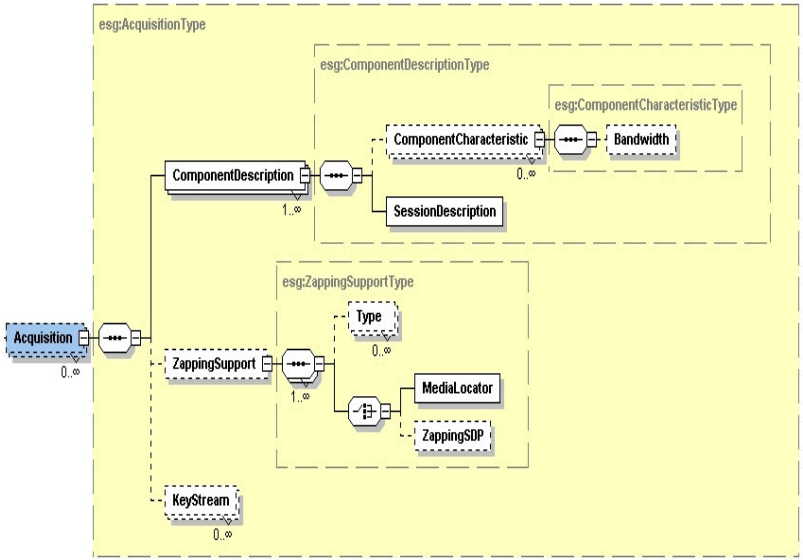
Purchase Channel Fragment

- Elements
  - Name
  - Description
  - Portal URL
  - Contact Info
  - Media Title
  - Private Data

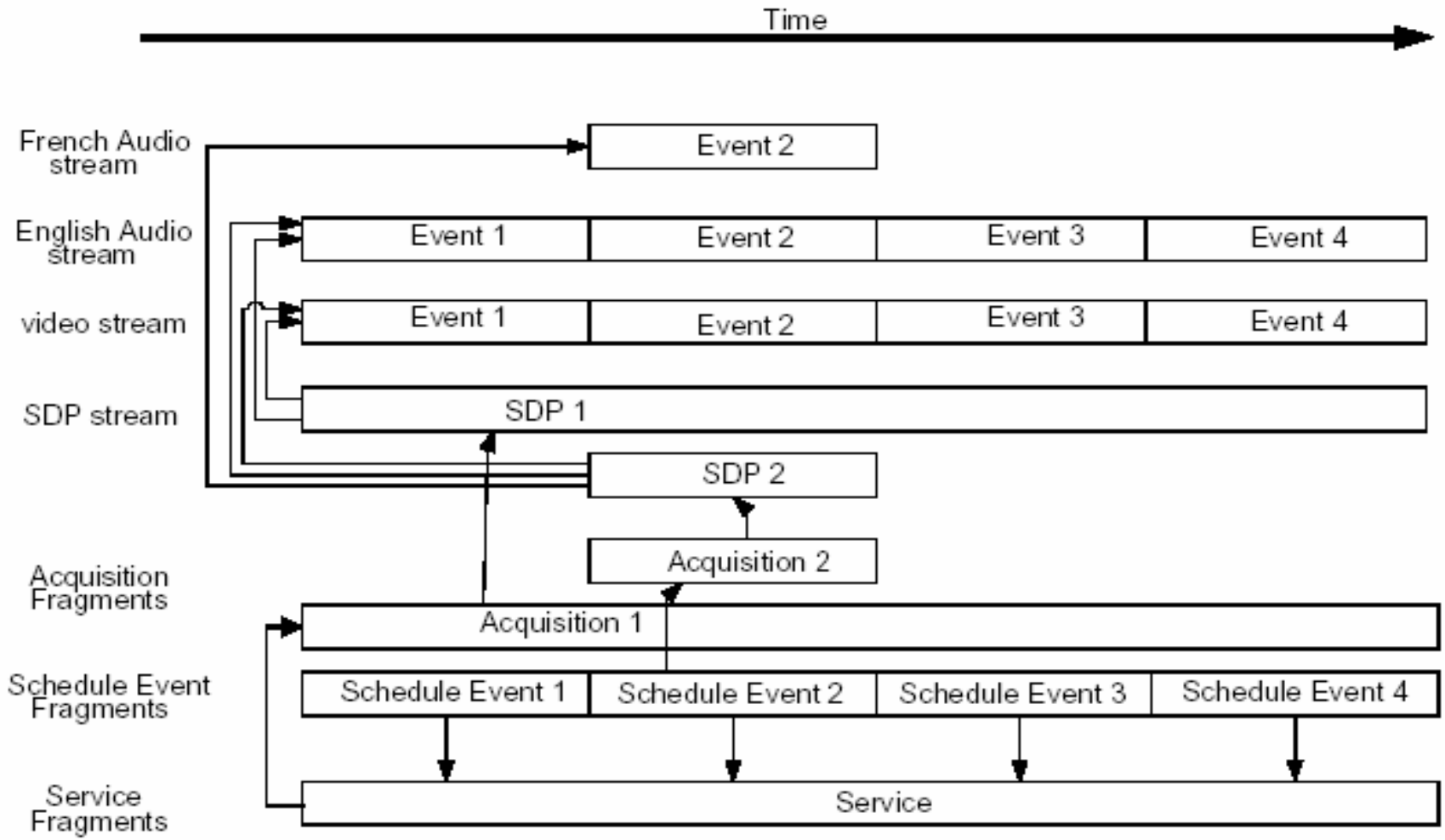


Acquisition Fragment

- Elements
  - Component Description
  - Component Characteristic
  - Session Description
  - Zapping Support
  - Key Stream
- Attributes
  - acquisitionID
  - contentMimeType

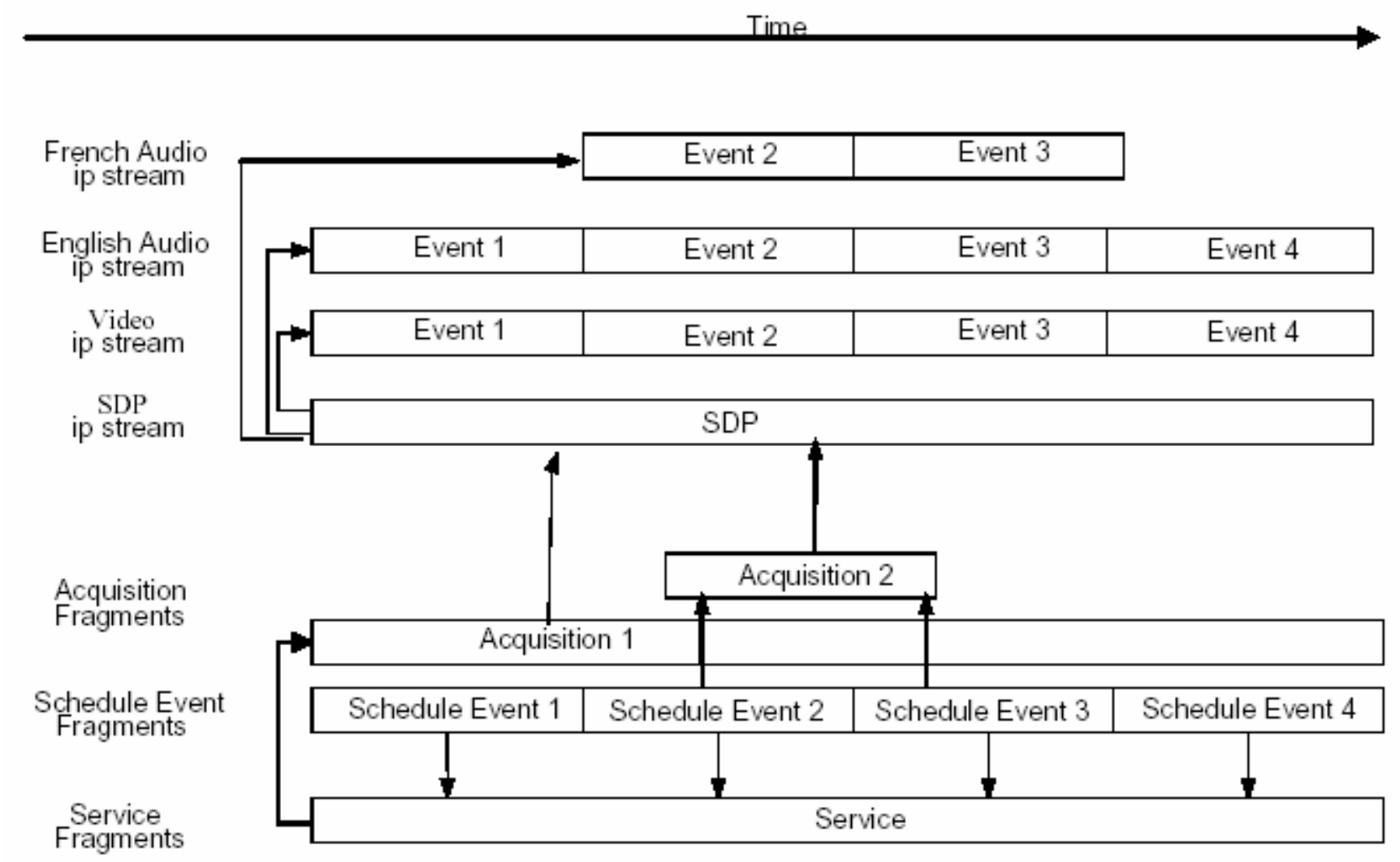


Use Case 1

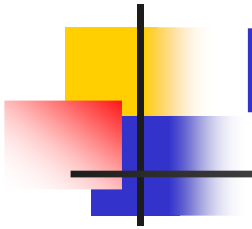


ESG acquisitions are coordinated with different SDP messages

Use Case 2



There is single SDP message for the service



ESG File Representation

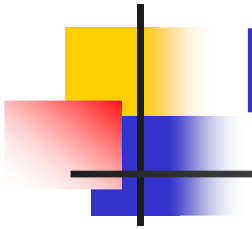
- ESG Fragments may be represented in three ways
  - Uncompressed
  - Compressed with GZIP (GnuZIP)
  - Compressed with BiM (Binary format for Metadata)
- Representation signalling
  - ESG Init Message

Encoding Version

Value	Encoding version
0x00 to 0xEF	TVA reserved
0xF0	DVB reserved
0xF1	DVB profile of TVA MPEG_7 profile (BiM) ISO/IEC 15938-1 [3] as defined in this specification.
0xF2	GZip encoded
0xF3	No Encoding i.e. raw XML
0xF4 to 0xF7	DVB reserved
0xF8 to 0xFF	User defined

ESG Init Message

Syntax	No. of bits	Mnemonic
ESG Init Message{		
EncodingVersion	8	uimsbf
IndexingFlag	1	bslbf
reserved	7	
DecoderInitptr	8	bslbf
if(IndexingFlag) {		
IndexingVersion	8	uimsbf
}		
if(EncodingVersion == '0xF1') {		
BufferSizeFlag	1	bslbf
PositionCodeFlag	1	bslbf
reserved	6	
CharacterEncoding	8	uimsbf
if (BufferSizeFlag == '1') {		
BufferSize	24	uimsbf
}		
}		
if(EncodingVersion == '0xF2' || EncodingVersion == '0xF3') {		
CharacterEncoding	8	uimsbf
}		
Reserved	0 or 8+	
DecoderInit( )		bslbf
}		



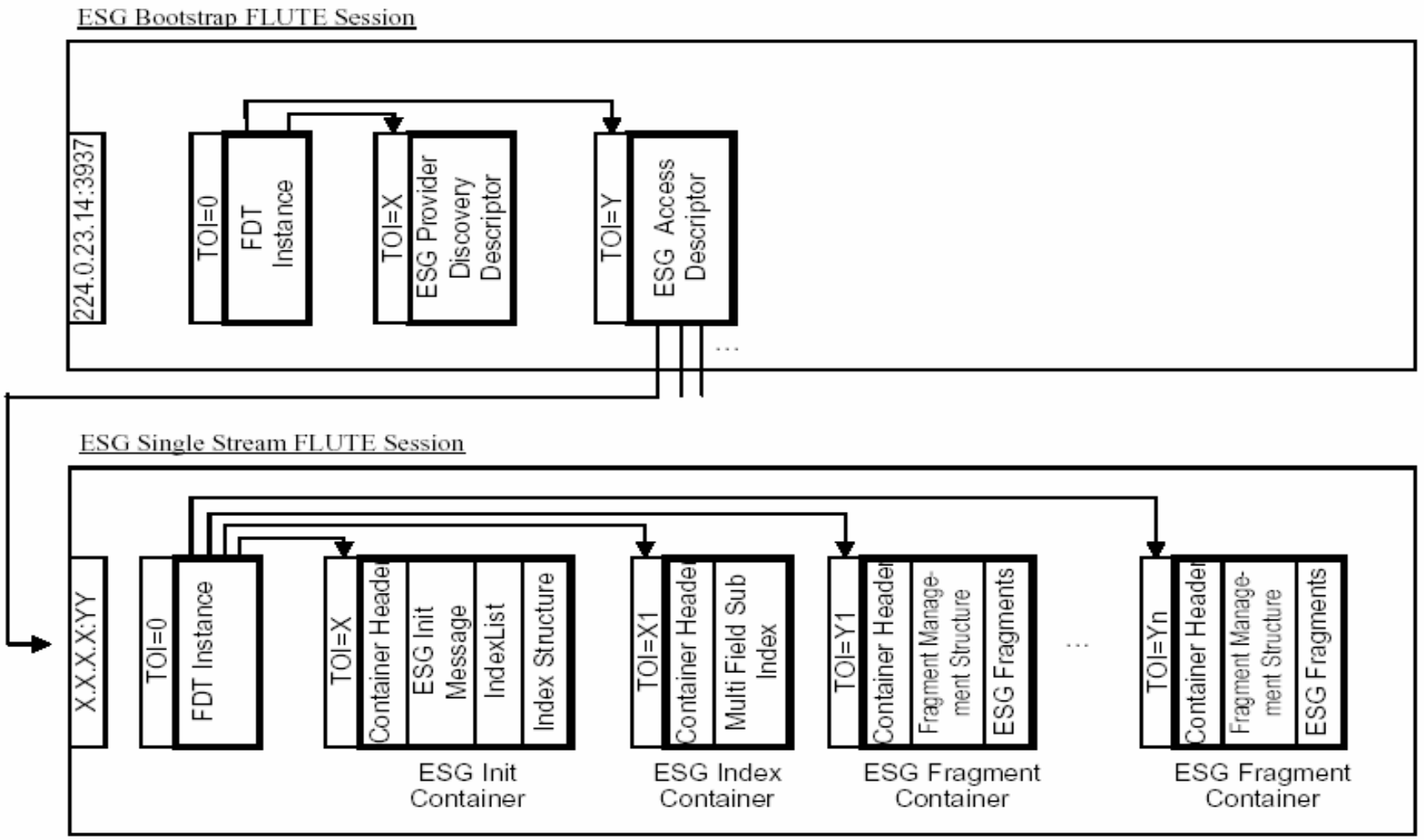
ESG Fragment Encapsulation

- Fragmentation
  - Decompose ESG into self-consistent units of data
  - ESG Fragments can be obtained in random order
  - Each fragment can be transmitted and updated independently
- Encapsulation
  - Aggregation
  - Fragment management
  - Processing support

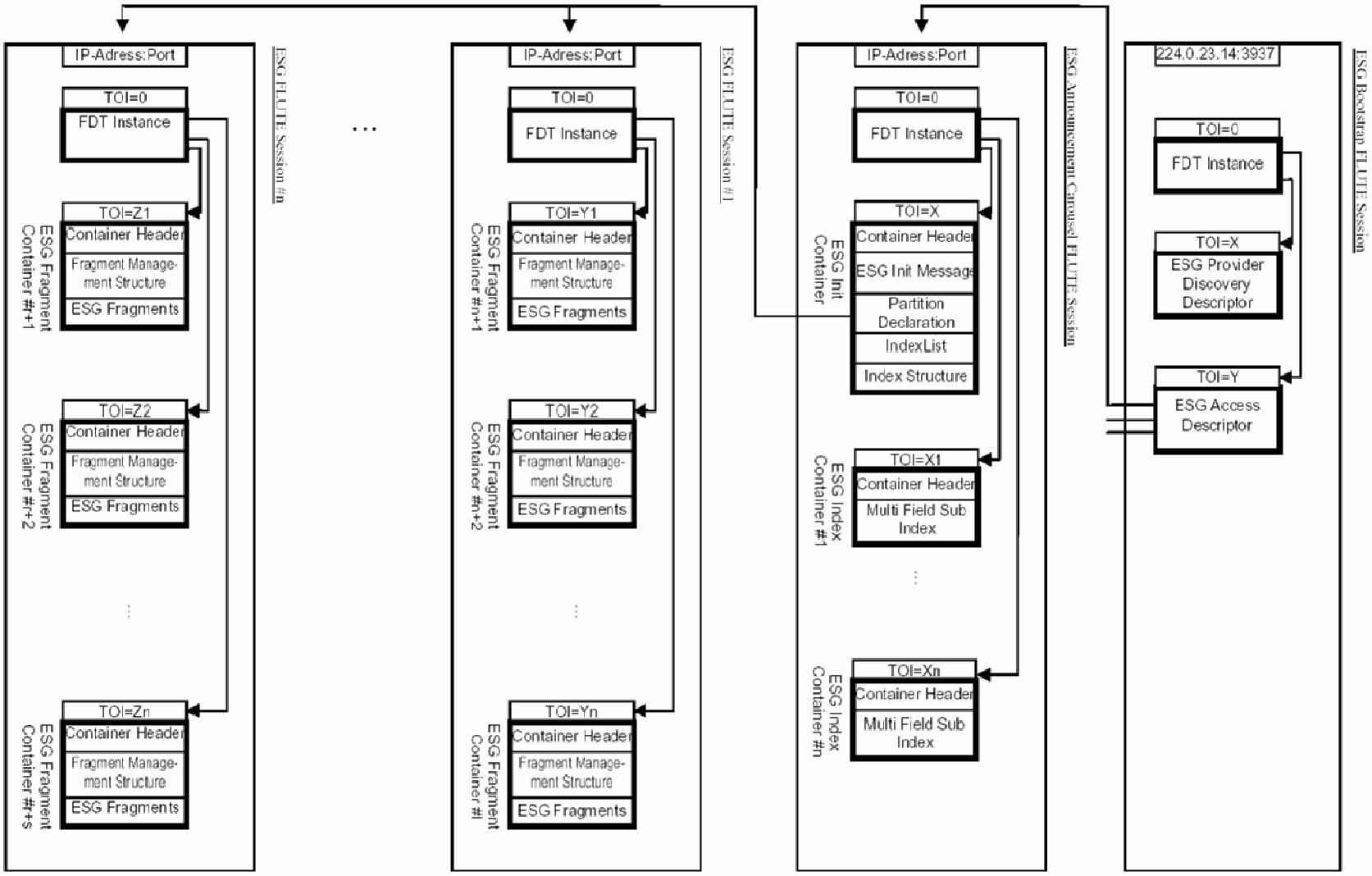
ESG Transport

- Single stream mode
  - ESG Containers are transported in single session
- Multiple stream mode
  - ESG Containers are transported in multiple sessions over several IP streams
- **The DVB-H file transport protocol - FLUTE**
  - File Delivery over Unidirectional Transport
  - Transport Object
  - TOI (Transport Object Identifier)
  - FDT (File Delivery Table)

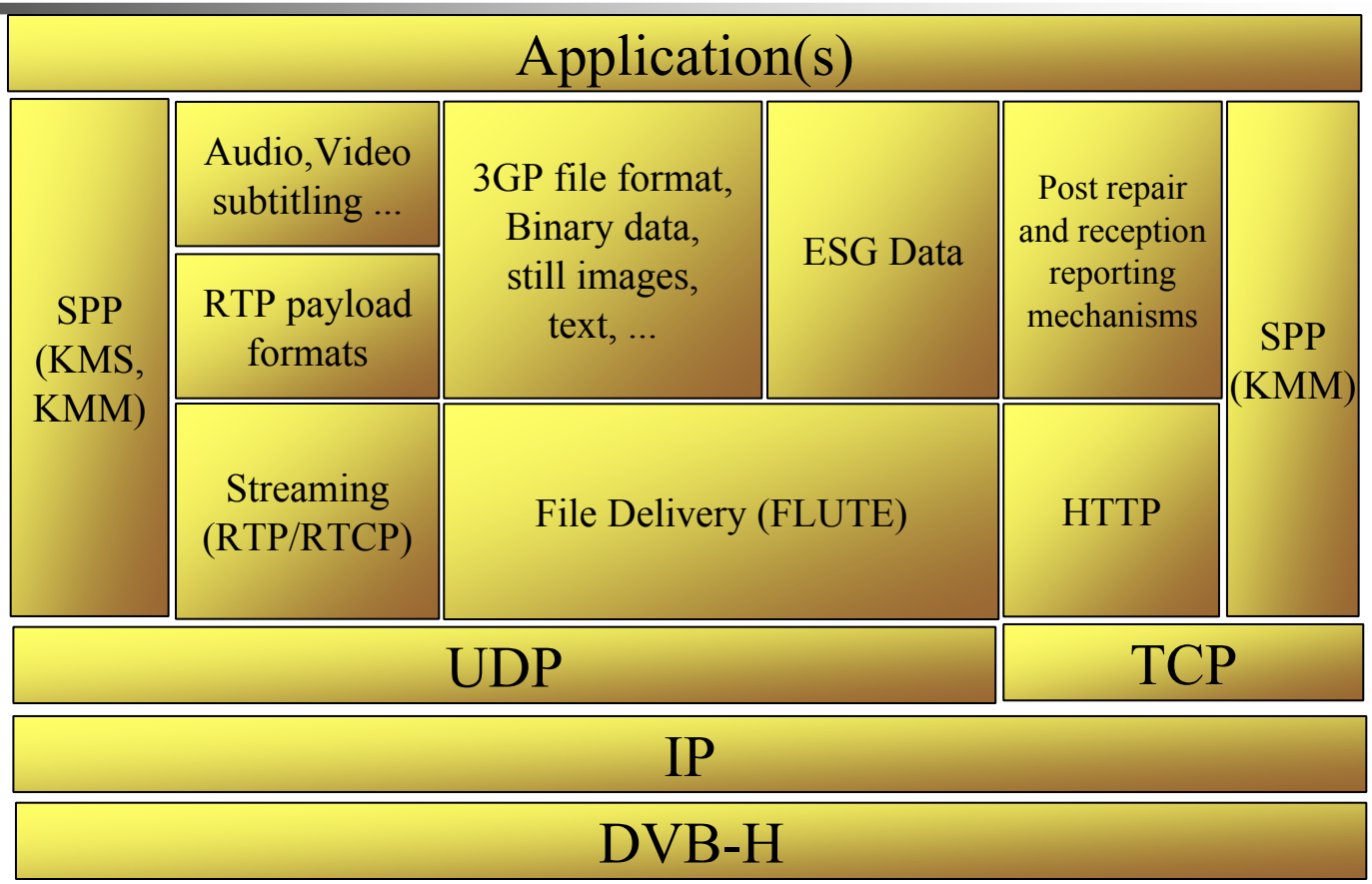
ESG Single Stream Transport



ESG Multiple Stream Transport



DVB-H MEDIA PROTOCOL STACK



For audiovisual RTP/UDP with SDP are used. For files (inc. ESG) FLUTE.
SPP – Service Purchase Protection with KMM Key Management Messages
Use TCP

Current Status of DVB-H

- Platform tested and ready
- Components available (transmitters, terminals, etc.)
- Counting to the commercial services launch. First service should be in Finland in the Fall of 2006

DVB-H testbed at Tampere

- FULLY OPERATIONAL TESTBED:

  50 W Transmitter

  DVB-H Encapsulator

  H.264 Realtime Encoder

  Laptop terminals

DVB-H TRANSMITTER ANTENNA AT TUT

for your attention!