MPEG-2 표준의 진화

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Backgrounds

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- ISO/IEC 13818-1 was published at 1996
- 6 Amendments until 2000
- 2nd edition at December 2000
- 4 Amendments after new edition
- MPEG-2 System can carry
  - MPEG-4 contents
  - MPEG-7 descriptions
  - IPMP Extenstion
  - AVC bytestreams
  - MPEG-21 (future)

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Contents

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- ISO/IEC 13818-1 AMD 7
  - Transport of ISO/IEC 14496 data over ISO/IEC 13818-1
  - Finalized at December 2000
- ISO/IEC 13818-1:2000 AMD1
  - Transport of Metadata
  - Finalized at July 2002
- ISO/IEC 13818-1:2000 AMD2
  - IPMP on MPEG-2 System
  - Will be finalized by December 2002
- ISO/IEC 13818-1:2000 AMD3
  - Carriage of AVC contents
  - Will be finalized by March 2003

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Carriage of ISO/IEC 14496 Data

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- IOS/IEC 13818-1:1996 AMD 7
- Using MPEG-4 contents in MPEG-2 System
- Done in early 2000.
- Latest reference : N3050 (FDAM)
- Real experiment by
  - AICi (Advanced Interactive Content Initiative)
  - NexTV project

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Two possible scenarios

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- Carriage of individual ISO/IEC 14496-2/3 ES.
  - Simple synchronized delivery of MPEG-4 contents over TS
  - No major features of MPEG-4
- Carriage of audio visual scene and associated ES contained in SL packetized streams or FlexMuxed streams.
  - MPEG-4 System is required.
  - Interactive rich-media over TS in one architecture.
  - Adding flexibility and extensibility of MPEG-4 to MPEG-2.

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MPEG-4 ES in PES packets

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- MPEG-4 Visual
  - Stream_type = 0x10
  - Stream_Id = 0b1110 XXXX
  - PTS/DTS refer the first VOP start code.
  - VOSH, VOH, VOLH.
- MPEG-4 Audio
  - Stream_type = 0x11
  - Stream_Id = 0b110X XXXX
  - LATM (Low-overhead MPEG-4 Audio Transport Multiplex)
  - PTS refer the first audio frame after the first syncword

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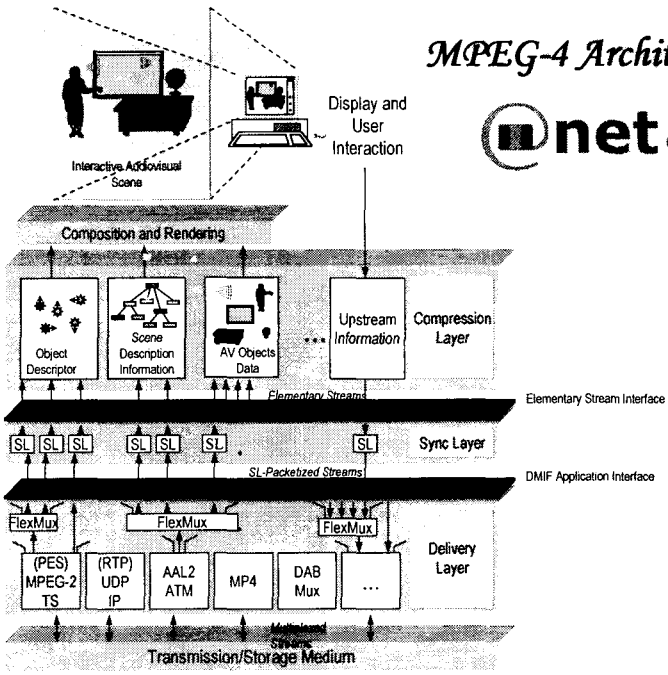
MPEG-4 Architecture



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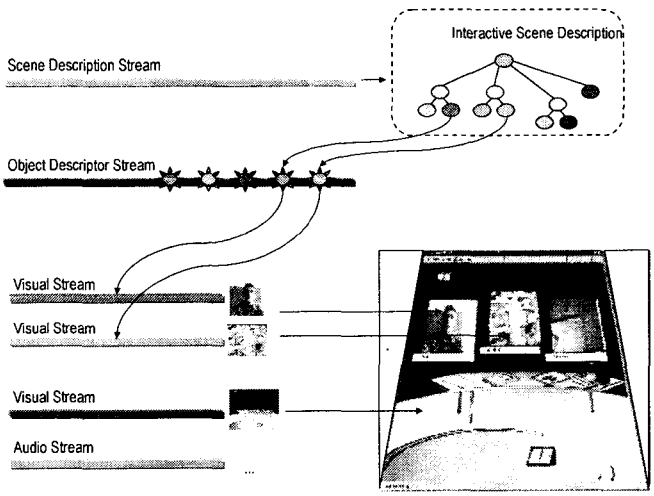
Audiovisual MPEG-4 scene



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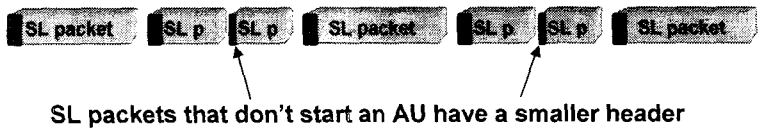
MPEG-4 SL packetized stream

- Synchronization layer (short: sync layer or SL)
  - SL packet = one packet of data
  - consists of configurable header and payload
  - Contains one AU or AU fragements.
- Indicates boundaries of access units
- Provides consistency checking for lost packets
- Carries object clock reference (OCR) stamps
- Carries decoding and composition time stamps (DTS, CTS)



SL packets that don't start an AU have a smaller header

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How is the sync layer designed?

- As flexible as possible to be suitable for
  - a wide range of data rates
  - a wide range of different media streams
- Time stamps have
  - variable length
  - variable resolution
- Same for clock reference (OCR) values
  - OCR may come via another stream
- Alternative to time stamps exists for lower bitrate
  - Indication of start time and
  - duration of units (accessUnitDuration, compositionUnitDuration)

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Wrap SL packets in a suitable layer!

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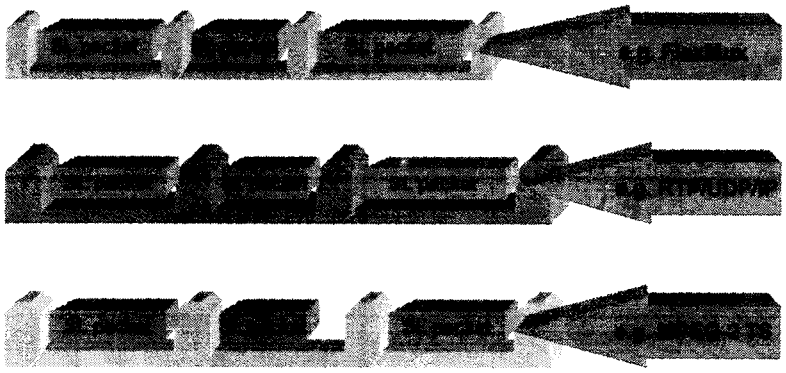

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Multiplex of elementary streams

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- Not a core MPEG task
- Just respond to specific needs for MPEG-4 content transmission
  - Low delay
  - Low overhead
  - Low complexity
- This prompted the design of the "FlexMux" tool

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Modes of FlexMux

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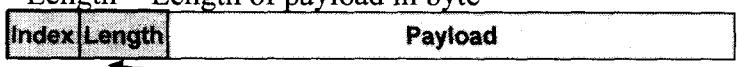
- Simple Mode **(if Index < 240)**

  Index = FlexMux Channel number

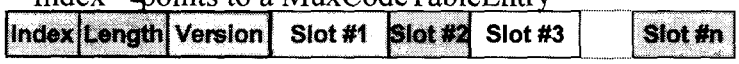
  Length = Length of payload in byte



FlexMux packet header

- MuxCode Mode **(if Index ≥ 240)**

  Index = points to a MuxCodeTableEntry



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How to configure MuxCode mode?

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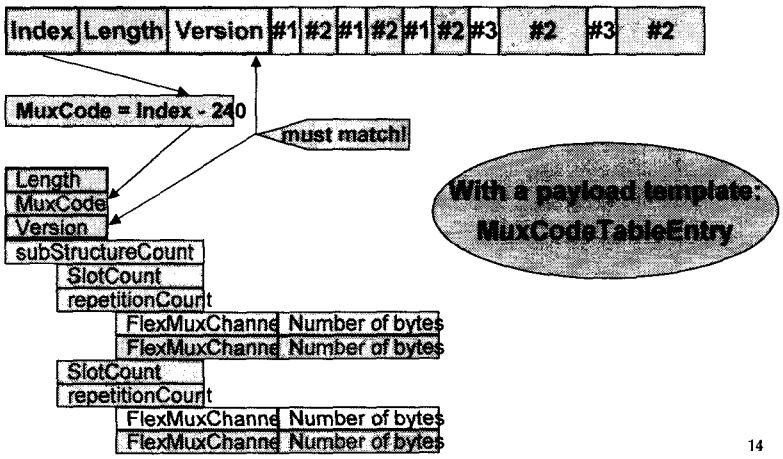

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Audiovisual MPEG-4 scene over TS

- A scene may also refer streams carried by other means.
- Timing relationship
  - MPEG-4 OTB (Object Time Base) is locked to the MPEG-2 STC (System Time Clock)
  - Number of restrictions are applied to MPEG-4 OTB
- SL-packetized streams in PES packets
  - Stream_id = 0xFA
  - A single SL-packetized stream may be mapped into a single PES
  - *One and only one* SL packet shall consist the payload of PES packet
- FlexMux streams in PES packets
  - Stream_id = 0xFB
  - An integer number of FlexMux packets per PES packet
- ObjectDescriptorStream or SceneDescriptionStream in sections

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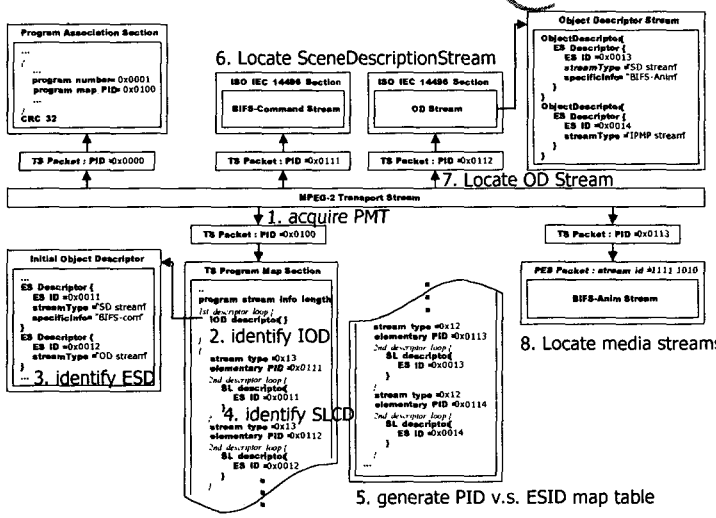
Content Access Procedure



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Carriage of Metadata

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- Using general metadata in MPEG-2 System architecture
- Latest reference : N5059 (Study of FPDAM)

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New IDs

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- Stream_id = 0b1111 1100 (descriptive data stream)
- table_id = 0x06 (Metadata Section)
- Stream type
  - 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
- Program descriptor tag
  - 36 : Content_labelling_descriptor
  - 37 : Metadata_pointer_descriptor
  - 38 : Metadata_descriptor
  - 39 : Metadata_STD_descriptor

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Content Labeling Descriptor

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- assigning a label to content
  - referenced by metadata
  - metadata format specific
  - located in the PMT
  - including information on the content time base
    - STC
    - NPT from DSM-CC
- content segment
  - a portion in time of a program
  - an ES or combination

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Metadata pointer descriptor

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- pointing to a single metadata service
- associating metadata service to audiovisual content
- located in the PMT

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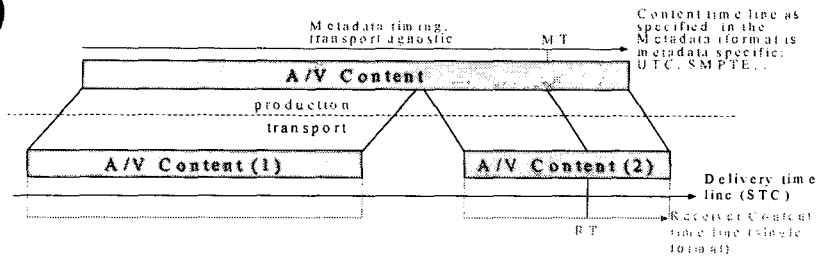
Timing model



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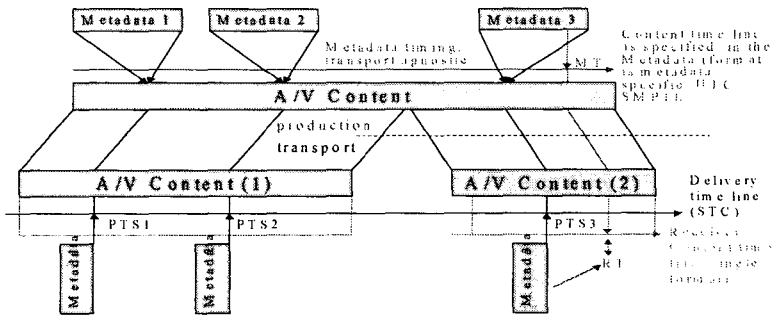
Delivery of metadata in PES packets



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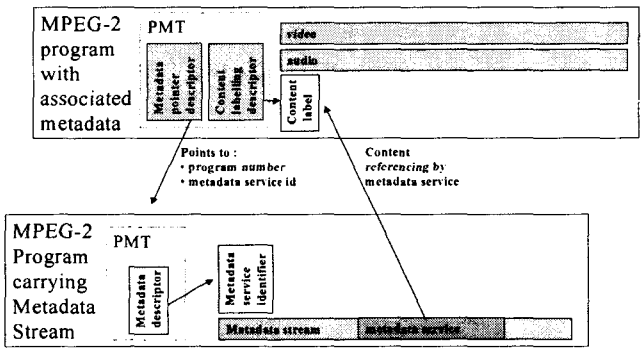
Metadata signaling and referencing



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Two parts for MPEG-2 IPMP

- ISO/IEC 13818-1:2000 Amendment 2
  - MPEG-2 specific extensions
  - Latest reference : N4986 (FPDAM)
- ISO/IEC 13818-11
  - MPEG-2 IPMP framework
  - Latest reference : N5063 (FCD)

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MPEG-2 Extensions for IPMP support

- PID = 0x03 (IPMP Control Information Table)
  - IPMP Tool List
  - Rights Container
  - Tool Container
- table_id = 0x07 (IPMP Control Information Section)
- stream_id = 0b1111 1101 (IPMP Control Information Stream)
- Program descriptor tag : 41 (IPMP Descriptor)
- Stream type = 0x1A (IPMP stream)

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Compatibility with CA

- Backward compatibility
  - No changes to CA_descriptor
  - In transport stream, a CA_PID value of 0x03 indicates that there is IPMP protection within the system.
  - In program stream, a CA_PID value of 0xFD indicates that there is IPMP protection within the system.
  - If the IPMP protection is signaled by use of CA_PID, the value of CA_System_ID should only be set to 0xFFFF
- Forward compatilbility
  - If a CA system wants to work in MPEG-2 IPMP, it should register a IPMP Tool ID
  - There should be an IPMP Descriptor
  - The control point should be set to 0x01

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Architecture

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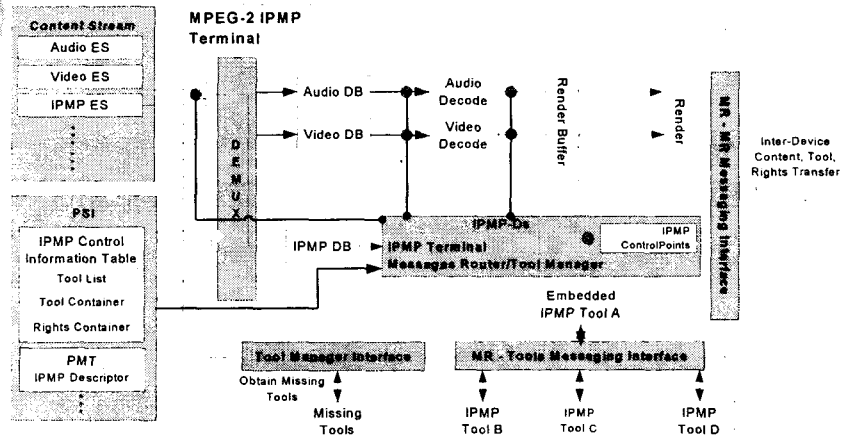

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MPEG-2 IPMP Architecture

Architecture for simple use case

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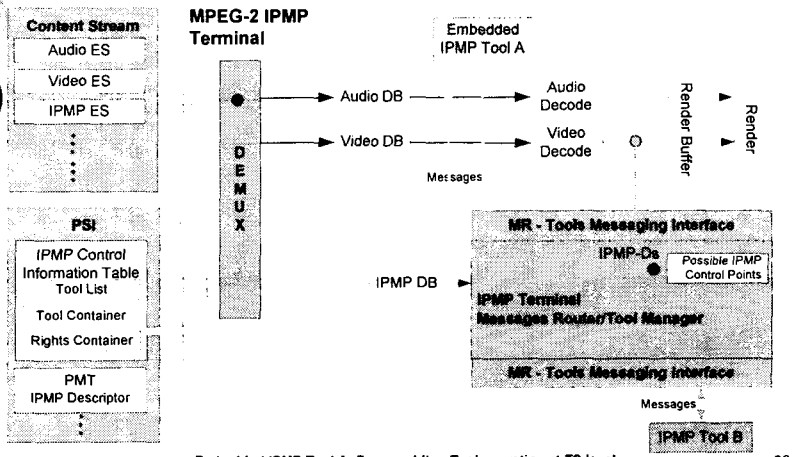

Embedded IPMP Tool A: Descrambling Tool operating at TS level

IPMP Tool B: Video Watermark retrieving tool operating after video decoder

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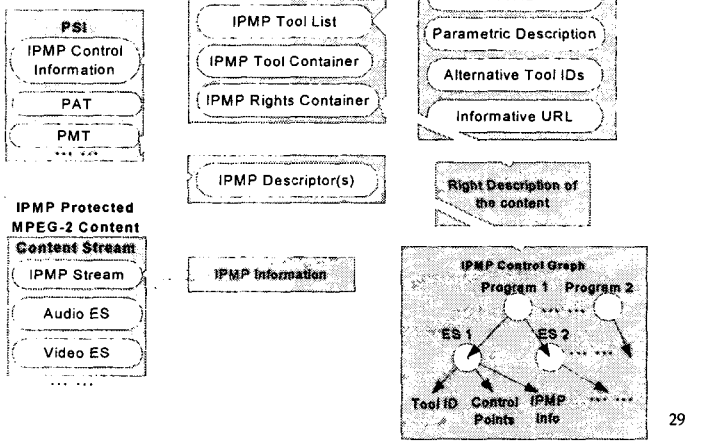
IPMP protected MPEG-2 Content



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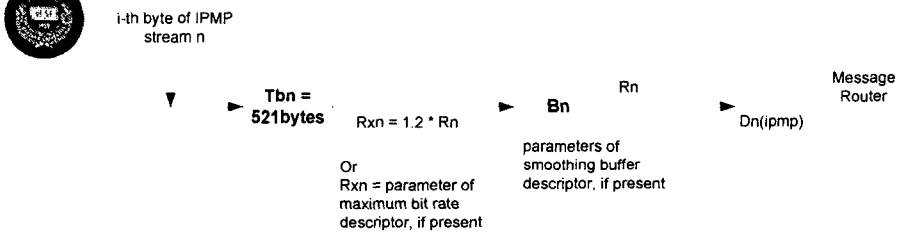
STD model for IPMP stream



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Timing of IPMP information routing

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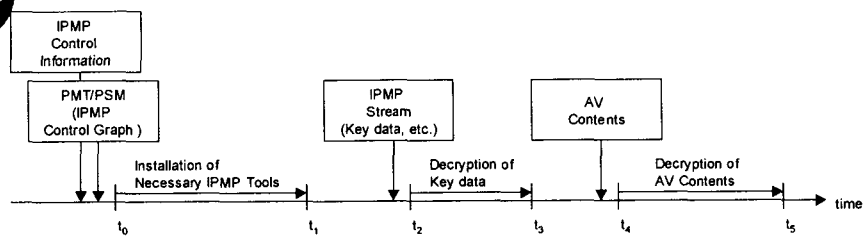

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Carriage of AVC over MPEG-2

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- ISO/IEC 13818-1:2000 Amendment 3
  - Carriage of AVC bytestream over MPEG-2 TS
  - FDAM at the next meeting
  - Latest reference : N5605 (Study of FPDAM)

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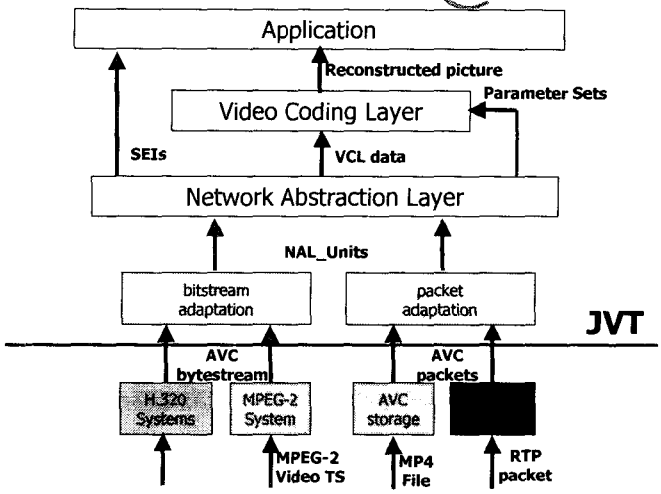
Architecture



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Video Coding Layer

- Task
  - Compress source pictures into Slices
- VCL is responsible for
  - Source coding based error resilience (Intra Refresh)
  - MTU Size match (spatial Slice boundary settings)
  - Collection of symbols in
    - Slices or
    - data partitioned Slices

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H.26L Network Abstraction Layer

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- Goals:
  - Network Friendliness
  - Facilitate Gateway Design
- Tasks
  - Mapping of slice structure on transport layer
  - Framing, Encapsulation, Interleaving, Timing issues
  - "Transport" of all header info above the Slice layer
  - Further network specific issues (feedback, prioritization,...)

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H.26L Network Abstraction Layer

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- Network independent part
  - "Conceptual Layer"
  - No signal processing, no syntax definition
  - Operates on NALP packets (and not a bit stream)...
  - ... and Parameter Sets

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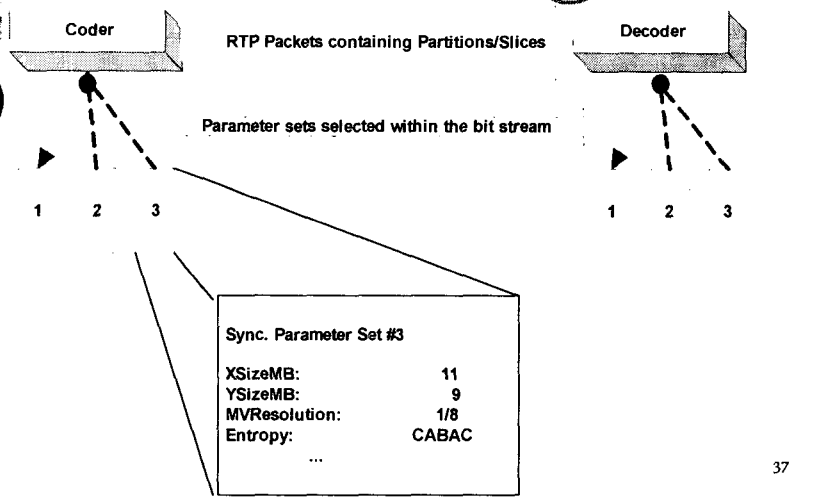
Parameter Set Concept



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Parameter Set Concept

- Encoder and Decoder maintain identical Parameter Sets
  - Typically established during capability exchange
  - Can be changed by control protocols
  - Asynchronous, reliable, out-of-band transmission
  - Special NALP type to change them in-band
    - Intended ONLY for those applications where no control protocol is available
    - Need for high protection, send multiple times and well in advance before first reference by a Slice header
- Parameter Sets reside in numbered locations
- Each Slice references the Parameter Set to be used
  - Normally short VLC code
  - Many application need only one Parameter Set: -> 1 bit

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Parameter Sets

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- Two sets of parameters:
  - Independent GOP parameter set, parameters remain the same within an independent GOP
  - Picture parameter set, parameters remain the same within a picture
- Limitation of maximum number of parameter sets
  - Independent GOP parameter sets: 16
  - Picture parameter sets: 64

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Parameter Sets

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- Nested references:
  - Slice header refers to a picture parameter set
  - Picture parameter set refers to an independent GOP parameter set
- Rules for referencing:
  - Every slice of a picture shall refer to the same picture parameter set (Word "picture" is intentional – a different picture parameter set may be referred from the two fields of a field-coded frame.)
  - Every picture parameter set referred from slices within an independent GOP shall refer to the same independent GOP parameter set.

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Parameter Sets

- Decoder process for incoming parameter set information:
  - Picture parameter set comes into effect just before starting the decoding of the next picture in reception order
  - Independent GOP parameter set comes into effect just before starting the decoding of the next IDR picture in reception order
- Coding of parameter sets:
  - Default parameter values are defined
  - Parameter sets can be coded relative to default values (so that default values do not have to be repeated) → "flagged format"
  - Parameter sets cannot be updated relative to earlier parameter sets

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NAL_Unit

- Common representation both for bitstream and packets including
  - VCL Data
  - Parameter Sets
    - are consumed by the decoder
    - are remained until the end of sequence but subject to change
    - are essential for the reproduction of picture
  - SEIs
    - are consumed by the application
    - can get lost

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Details of NAL_Unit

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- Normative definition of "syntax" or "structure" shall be specified.
  - Type indication (1byte)
    - slice and picture
    - Error indication
  - Timing indication
  - Framing indication
  - NAL payload (EBSP, one or more of following)
    - Single slice
    - Data partitions
    - Parameter Sets Update
    - SEIs

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First Byte of NAL Unit

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- error_flag replaced with forbidden_bit:
  - forbidden_bit shall always be zero in conforming streams
  - "The forbidden_bit may be used by system layer specifications to signal potentially corrupt NALUs. "
- Two priority bits:
  - Signals relative transport priority
  - 00 = Non-stored content
  - The use of 01, 10, and 11 undefined in the JVT standard → decoders shall treat 01, 10, and 11 equally

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NAL Unit Types

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- NAL unit types (5 bits):
  - One entry reserved for future extensions
  - IDR
  - Slice
  - DPA, DPB, DPC
  - SEI
  - PIP (Parameter Information for Pictures)
  - PIG (Parameter Information for Independent GOPs)
  - Picture delimiter (see next slide)
  - At least 4 reserved codepoints for systems use

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Definition of AU

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- Normative definition of Access Unit in AVC spec (2.12.1).
- Order of NAL Units
  - SPS (including VUI) NALU shall precede all the NALUs referring it.
  - PPS NALU shall precede all the NALUs referring it.
  - No interleaving of slices and data partitions from different primary coded pictures
  - Reference picture comes before the picture using it
  - Primary coded picture comes before the redundant pictures based on macroblock location (interleaving between slices are allowed)
  - In ascending order of picture order count.
  - SEI NALUs precedes corresponding NALUs
  - Picture delimiter precedes all the NALUs including SPS and PPS.
  - End of sequence NALUs before IDR.
  - All the preceding NALUs belong to the first following primary coded picture
  - End of stream NALU belongs to the primary coded picture

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Example of AU

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Definitions

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- AVC still picture
  - AVC AU containing an IDR picture
  - preceded by SPS and PPS NALU to correctly decode it
- Access Point (discontinuity)
  - The first byte of an AVC AU
  - SPS and PPS required to....
- random_access_indicator
  - The first bye of an AVC AU
  - SPS and PPS required to...

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PES packet alignment

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Alignment type	Description
00	Reserved
01	AVC slice or AVC access unit
02	AVC access unit
03-FF	Reserved

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Constraints to bytestream

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- Each AVC access unit shall contain an access_unit_delimiter NAL Unit.
- Each byte stream NAL Unit containing the access unit delimiter shall only contain one zero_byte preceding the start_code_prefix_one_3bytes.
- Sequence and Picture Parameter Sets (SPS and PPS) shall be present within each AVC video stream carried in Transport and Program streams (Note that ITU-T Rec. H.264 | ISO/IEC 14496-10 allows the delivery of SPS and PPS by external means). In addition, for applications that require display specific information such as aspect_ratio, the SPS shall include VUI with the appropriate flags to signal the presence of such data.

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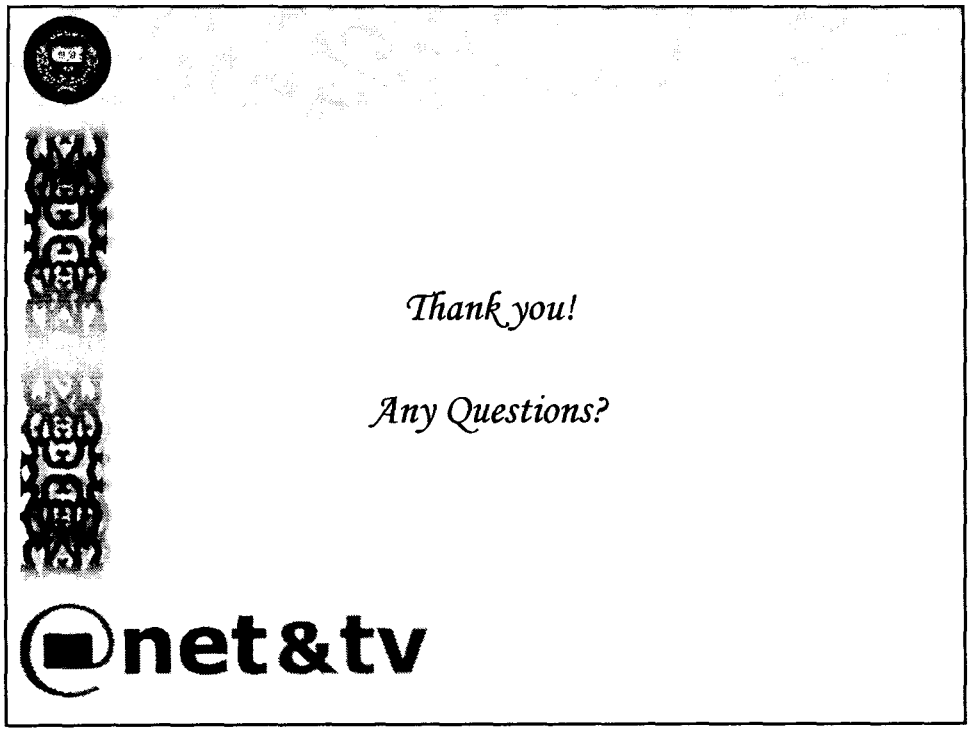
Thank you!
Any Questions?
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