MPEG systems technologies for advanced media synchronization

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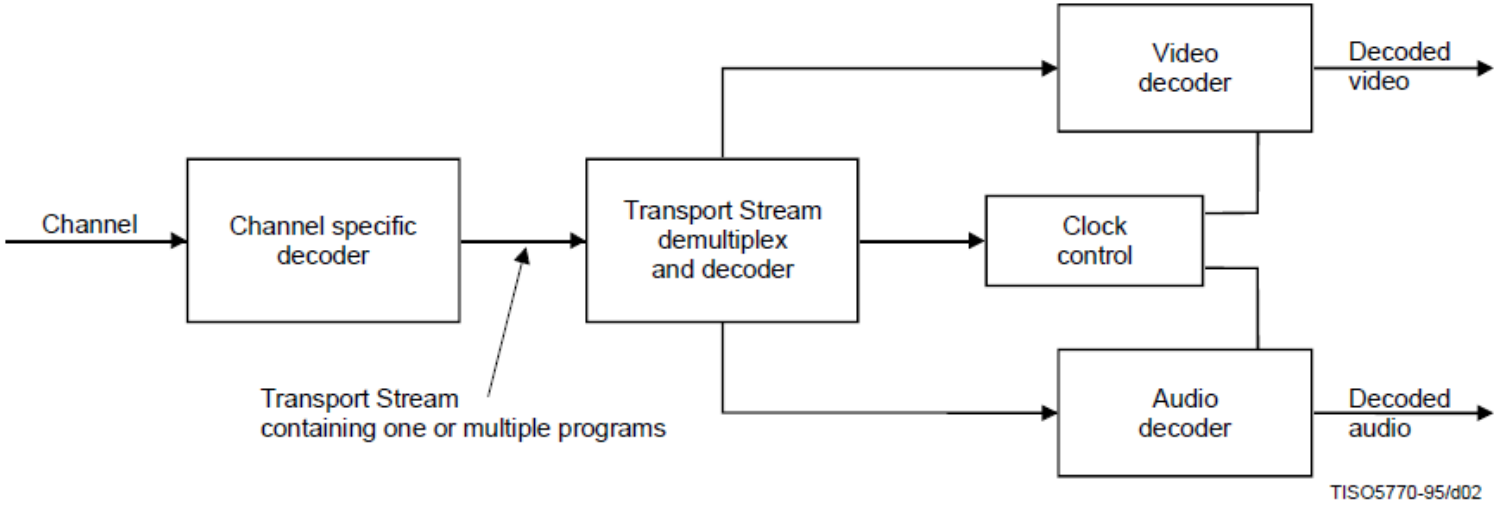
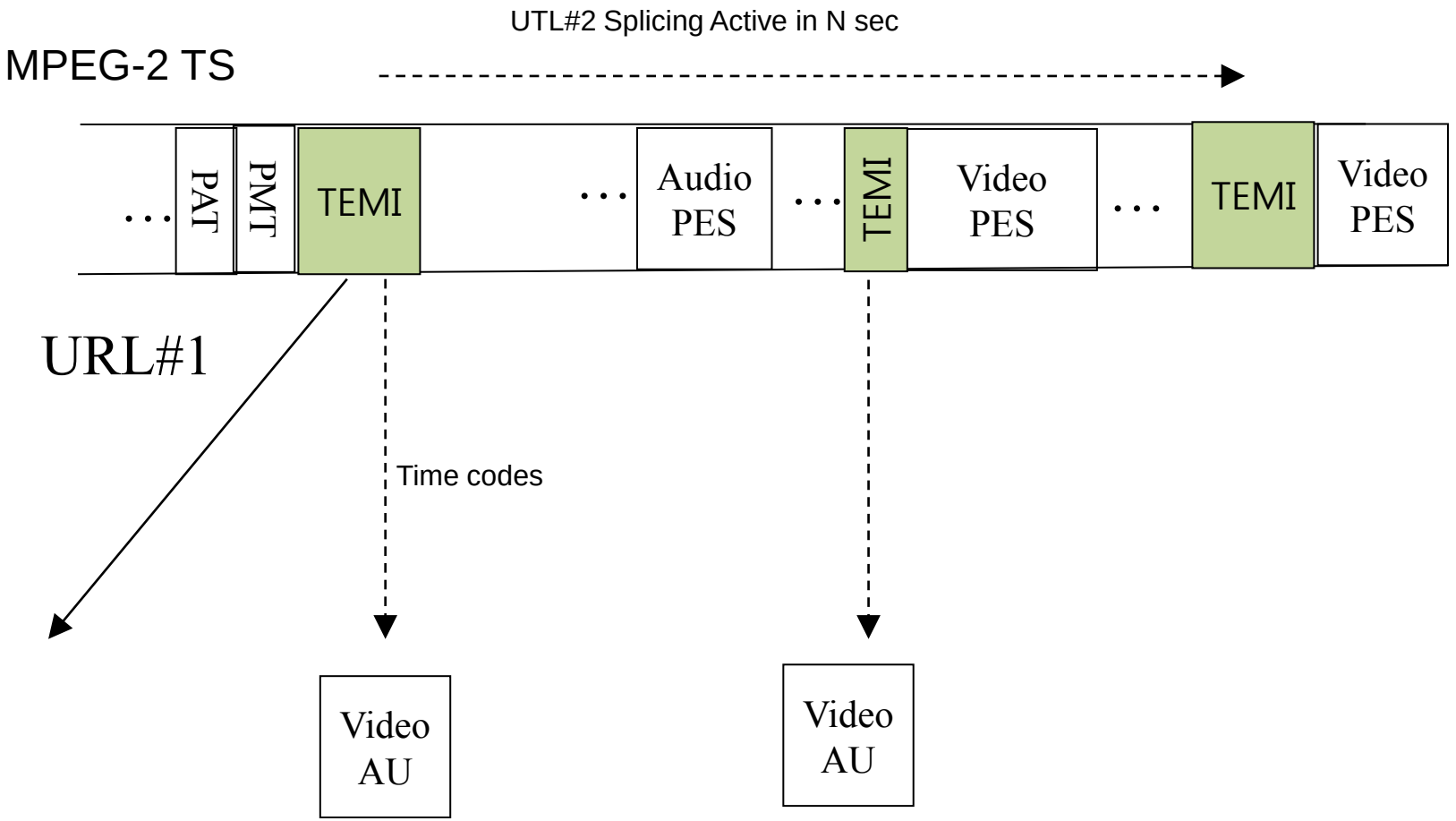
Basics of media synchronization in MPEG

Synchronization in MPEG-2 System (ISO/IEC 13818-1)

- Synchronization among multiple elementary streams is accomplished with Presentation Time Stamps (PTS), which is generally in units of 90 kHz
- Synchronization of a decoding system with a channel is achieved through the use of the Program Clock Reference (PCR) which has resolution of 27 MHz
- Each program in a Transport Stream, which may contain multiple programs, may have its own time base. The time bases of different programs within a Transport Stream may be different.

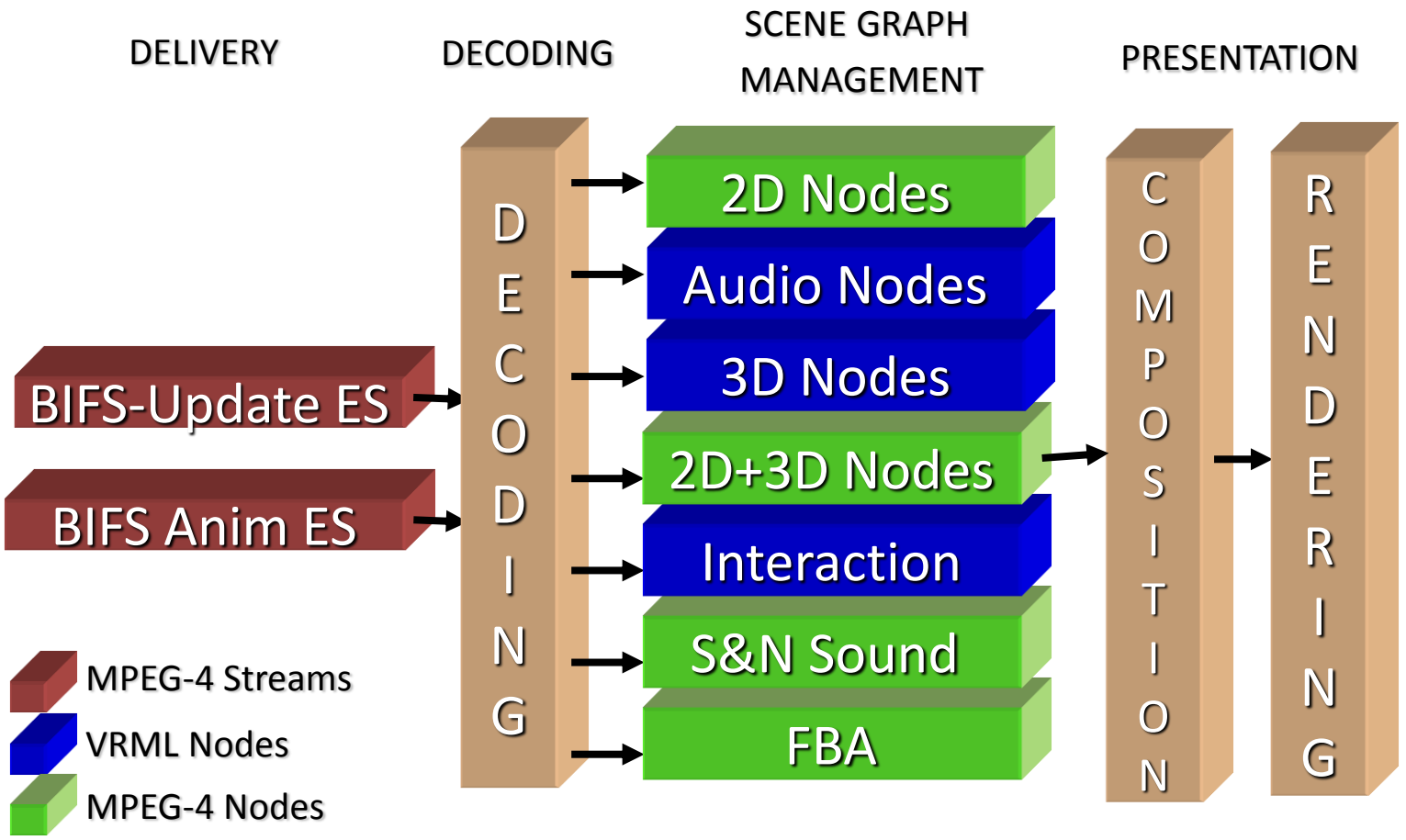


MPEG-2 TS Delivery of Timeline for External Data



Synchronization in MPEG-4 System (ISO/IEC 14496)

- "presentation time stamp" concept has been migrated to "composition time stamp"
- Multiple clock reference has been enabled by introduction of OCR (Object Clock Reference)
- Scene Description concept has been introduced by Part 11 BIFS (Binary Information For Scene)



Synchronization in ISOBMFF (ISO/IEC 14496-12)

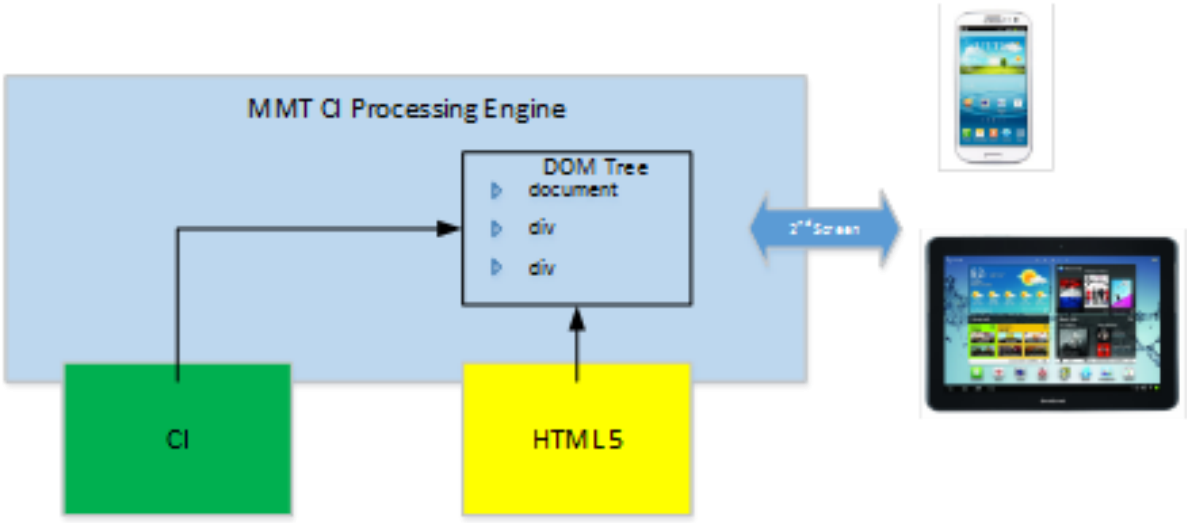
- **Decoding Time to Sample Box ('stts')**
  - Each entry gives the number of consecutive samples with the same time delta, and the delta of those samples
- **Composition Time to Sample Box ('ctts')**
  - This box provides the offset between decoding time and composition time.
  - The composition time to sample table is optional and must only be present if DT and CT differ for any samples
- **Edit List Box ('elst')**
  - This box contains an explicit timeline map.
  - Each entry defines part of the track time-line: by mapping part of the media time-line, or by indicating 'empty' time, or by defining a 'dwell', where a single time-point in the media is held for a period.

Synchronization in DASH

- Period@start
  - if present, specifies the PeriodStart time of the Period.
  - The PeriodStart time is used as an anchor to determine the MPD start time of each Media Segment as well as to determine the presentation time of each each access unit in the Media Presentation timeline.
- SegmentBase@presentationTimeOffset
  - specifies the presentation time offset of the Representation relative to the start of the Period.
- MPD@availabilityStartTime
  - the start time is the anchor for the MPD in wall-clock time (UTC) in live streaming

Synchronization in MPEG-H (ISO/IEC23008)

- **Part 1 MMT**
  - MPU_timestamp_descriptor : provides presentation time of the first AU of MPU in presentation order after application of any offset such as the one provided by ‘elst’ box.
- **Part 11 MPEG Composition Information**
  - Companion document to HTML5 providing complicated media synchronization in XML



- **More information**
  - Tutorials on MMT & MPEG CI will appear MPEG web site soon (mpeg.chiariglione.org)
  - Demos of MMT implementations are available outside.

Exploration on Timeline Alignment in MPEG

Use Cases (1/2)

- **Categorization factors of timeline alignment cases**
  - Number of different contents
  - Type of the content e.g. audio, video, etc…
  - Format of the content
  - Number of devices playing-out at least one of the content
  - Physical locations of the devices
  - Physical networks the devices are connected to
  - The requirement on the synchronization accuracy (frame accurate or not)

Use Cases (2/2)

#	Category Description	Synchronization			End-to-end delay under one threshold
		Across Devices	Across Streams	Across Clients	
1	One device, One stream, Offline communication	No	No	Yes	No
2	One device, Multiple streams, No communication	No	Yes	No	No
3	One device, Multiple streams, Offline communication	No	Yes	Yes	No
4	One device, Multiple streams, Online communication	No	Yes	Yes	Yes
5	Multiple devices, One stream, No communication	Yes	No	No	No
6	Multiple devices, One stream, Offline communication	Yes	No	Yes	No
7	Multiple devices, Multiple streams, No communication	Yes	Yes	No	No
8	Multiple devices, Multiple streams, Offline communication	Yes	Yes	Yes	No
9	Multiple devices, Multiple streams, Online communication	Yes	Yes	Yes	Yes

Timestamps…

- Normal Play Time (NPT), as defined in section 3.6 RFC2326: a timestamp indicating the stream absolute position relative to the beginning of the presentation, in a lossless way.
- Wallclock Time (WCT): absolute clock tick that can be associated with a media frame. This can be in the form of UTC clock, NTP timestamp or PTP timestamp.
- Time Code (TC): another form of NPT with more details on the source, typically taking into account frame rates and drop-frames video formats.

Standard	NPT	WCT	TC
ISOBMFF	- Media Time -Presentation Time (Media Time after edit list)	Producer Reference Time box	No (Could be added in a meta-data track)
MPEG-2 TS TEMI	- timestamps in TEMI - PES PTS if no clock discontinuities	- NTP/PTP timestamp in TEMI	TC_S and TC_L in TEMI
MPEG-DASH	- Media Presentation Time in period - Media Presentation Time in MPD (continuous throughout periods)	- Mapping of media presentation time to UTC through segment availabilityStartTime	No (Could be added in a meta-data track)
MMT	- Media Time -Presentation Time (Media Time after edit list)	- Mapping of presentation time of the first AU in MPUs to UTC through signaling messages	No (Could be added in a meta-data track)
RTP+RTCP	No	RTCP SR map RTP time to NTP	Yes with RFC5484
RTP+RTCP+RTSP	RTSP explicitly gives NPT to RTP time mapping	RTCP SR map RTP time to NTP	Yes with RFC5484

Summary

Summary

- MPEG has defined standards to describe synchronized presentation of multimedia element streams by using a clock reference and time stamps
- MPEG has also defined standards to describe spatio-temporal composition of multimedia objects which have number of independent clock references
- Latest MPEG standards assumes environments with device clocks locked to UTC and HTML5 based presentation.

- MPEG is exploring a gap regarding advanced synchronization of numerous multimedia in hybrid environments involving multiple source, multiple delivery networks and multiple clients


Q&A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