Overview of
MPEG-DASH
ISO/IEC 23009-1
Dynamic Adaptive Streaming over HTTP

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8/11/2011

Streaming Standardization Evolution

HTTP Live Streaming (HLS)

Publish

IETF TOOLS

First Informational Draft
May 2009

IIS Smooth Streaming

Microsoft

Publish
Under Community Promise (royalty free)

Smooth Streaming Transport Protocol
Protected Interoperable File Format
Sept 2009

Microsoft Interoperability

Contribute

Digital Entertainment Content Ecosystem

UV

Publish

Common File Format
Estimated. Q1 2011

Liaison relationship

IPF OPEN IPTV FORUM

Publish

Adaptive HTTP Streaming (AHS)
March 2010

Publish

3GPP A GLOBAL INITIATIVE

HTTP Adaptive Streaming (HAS)
Sept 2010

ISO International Organization for Standardization

Liaison relationship

Liaison relationship

Liaison relationship

Liaison relationship

MPEG - ISO/IEC JTC1/SC29 WG11

Publish

Dynamic Adaptive Streaming over HTTP (DASH)
2nd Draft International Standard – July 2011

14496-12 ISO Base Media File Format
Draft Amendment - July 2011
23001-6 Common Encryption

MPEG-DASH Standard Development

Stage	Steps	Approval Process	Timeline (date of issue)
Exploration	1st Workshop on MMT	-	July 2009
	1st Draft CFP	-	October 2009
	2nd Workshop on MMT	-	January 2010
Committee Stage	Call for Proposals	MPEG consensus	April 2010
	Working Draft	MPEG consensus	July 2010
	Committee Draft	SC29 Ballot	October 2010
Approval Stage	Draft International Standard	JTC1 Ballot	January 2011
	2nd Draft International Standard	JTC1 Ballot	July 2011
	International Standard		Dec 2011 (expected)

DASH is an example of developing the standard in the shortest

Standard Participation

- 15 complete proposals.
- Over 200 line proposals.
- 17 Evaluation Experiments.
- 40-70 contributions at each meeting.
- 50-90 participants at each meeting.
- Ad-hoc meeting frequency at least twice of regular MPEG meeting.
- Close collaboration with 3GPP.

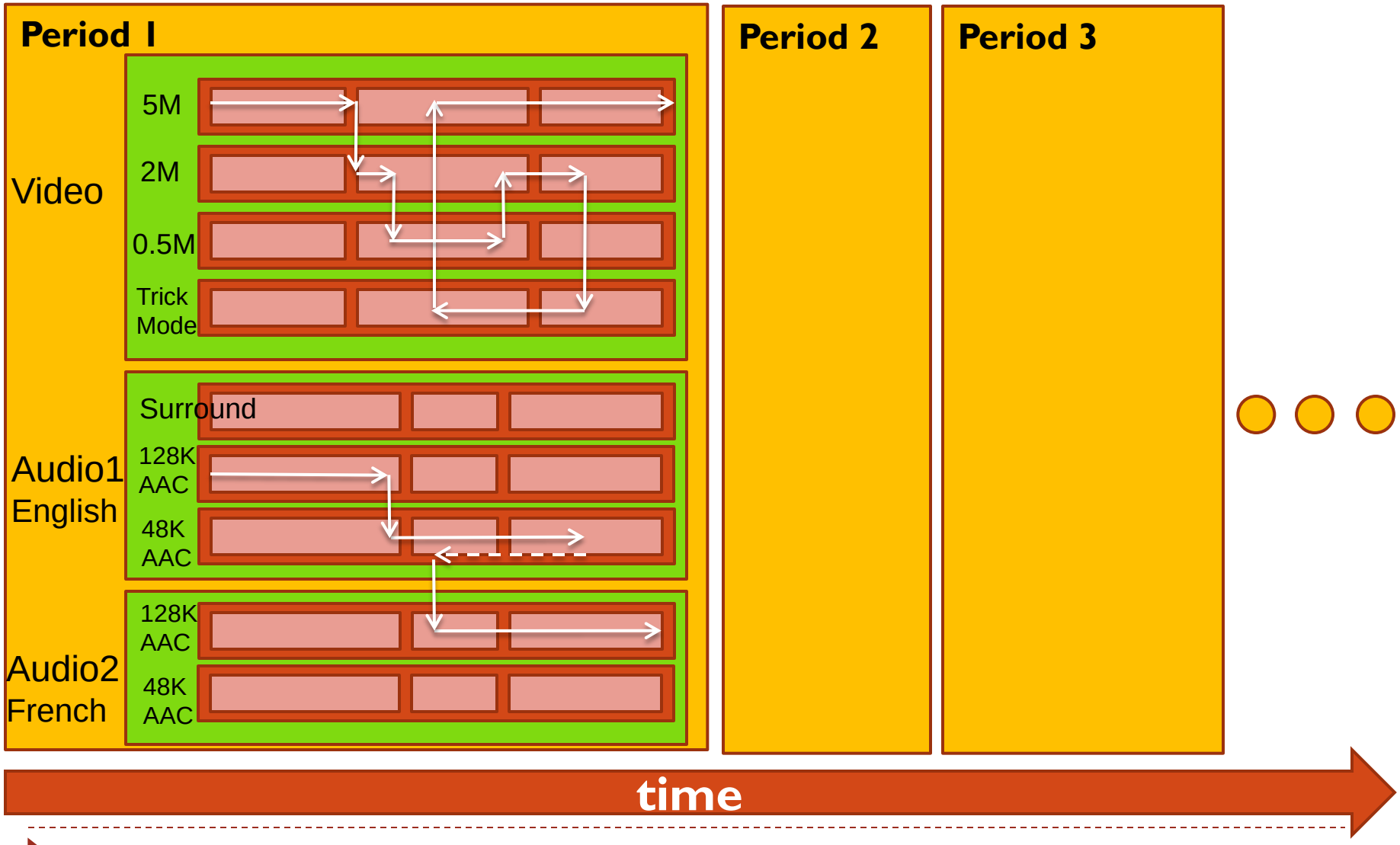
Highlighted Features

- Supports adaptive on demand and live streaming such as MPEG-4 file format and MPEG-2TS.
- Efficient and ease of use of existing CDNs, proxies, caches, NATs and firewalls.
- Control of entire streaming session by the client.
- Support of seamless switching of tracks.
- The concept of switching and selectable streams.
- Signaling, delivery, utilization of multiple DRM schemes.
- Supports ad-insertion.
- Segments with variable durations.
- Sub-segment alignment indication to simplify switching and avoiding overlapping fragments.

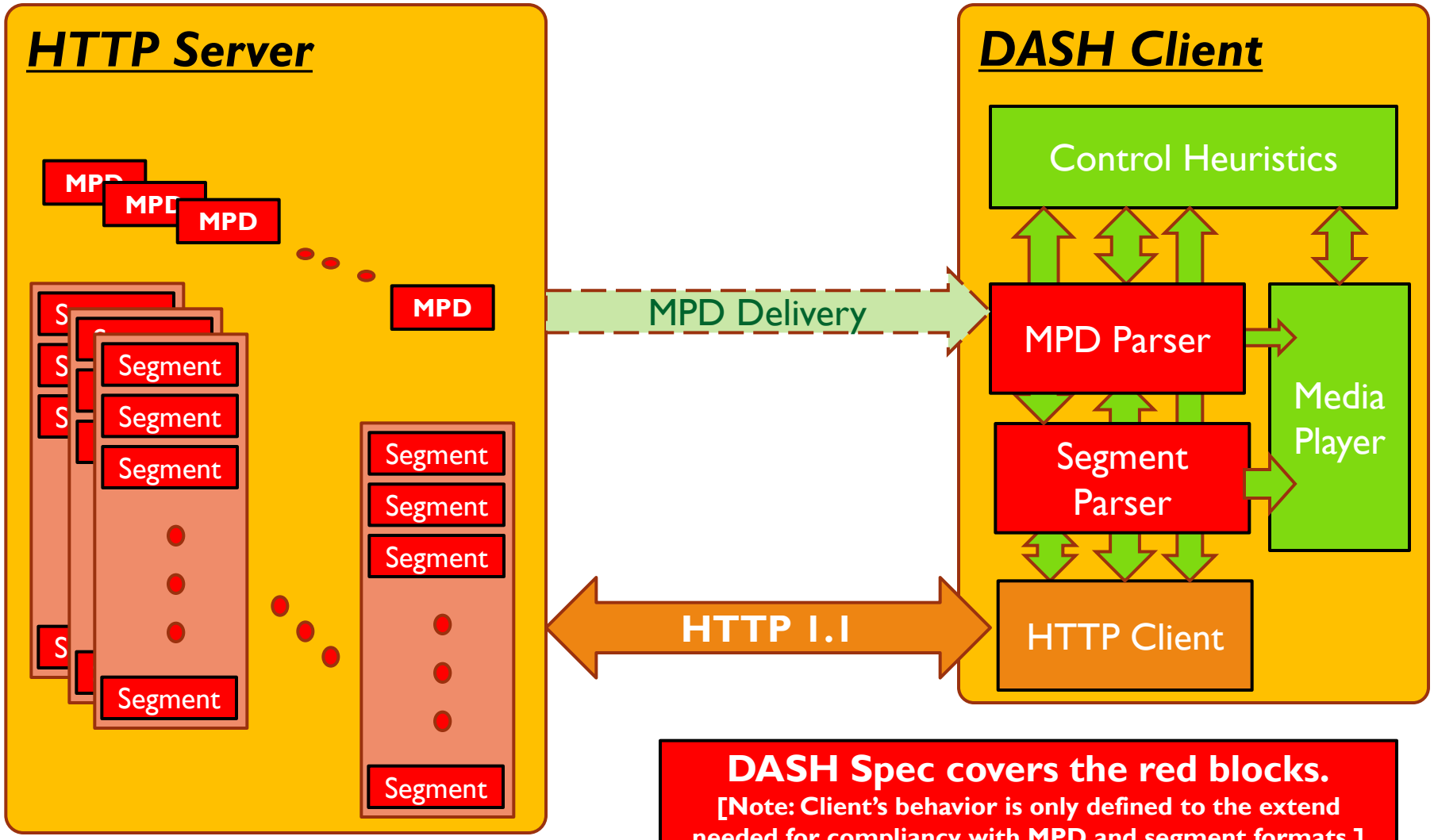
Highlighted Features

- Manifest fragmentation and assembly for external inclusion of elements.
- Content Descriptors for Accessibility, Rating and camera views.
- Multiple base URLs for the same content.
- Clock drift control for live sessions.
- Scalable Video Coding (SVC) and Multiview Video Coding (MVC).
- Subseting of representation groups according to the content author's guidance.
- Quality metrics for reporting the session experience.

Adaptive Dynamic Streaming Temporal Model



DASH Standard's Scope



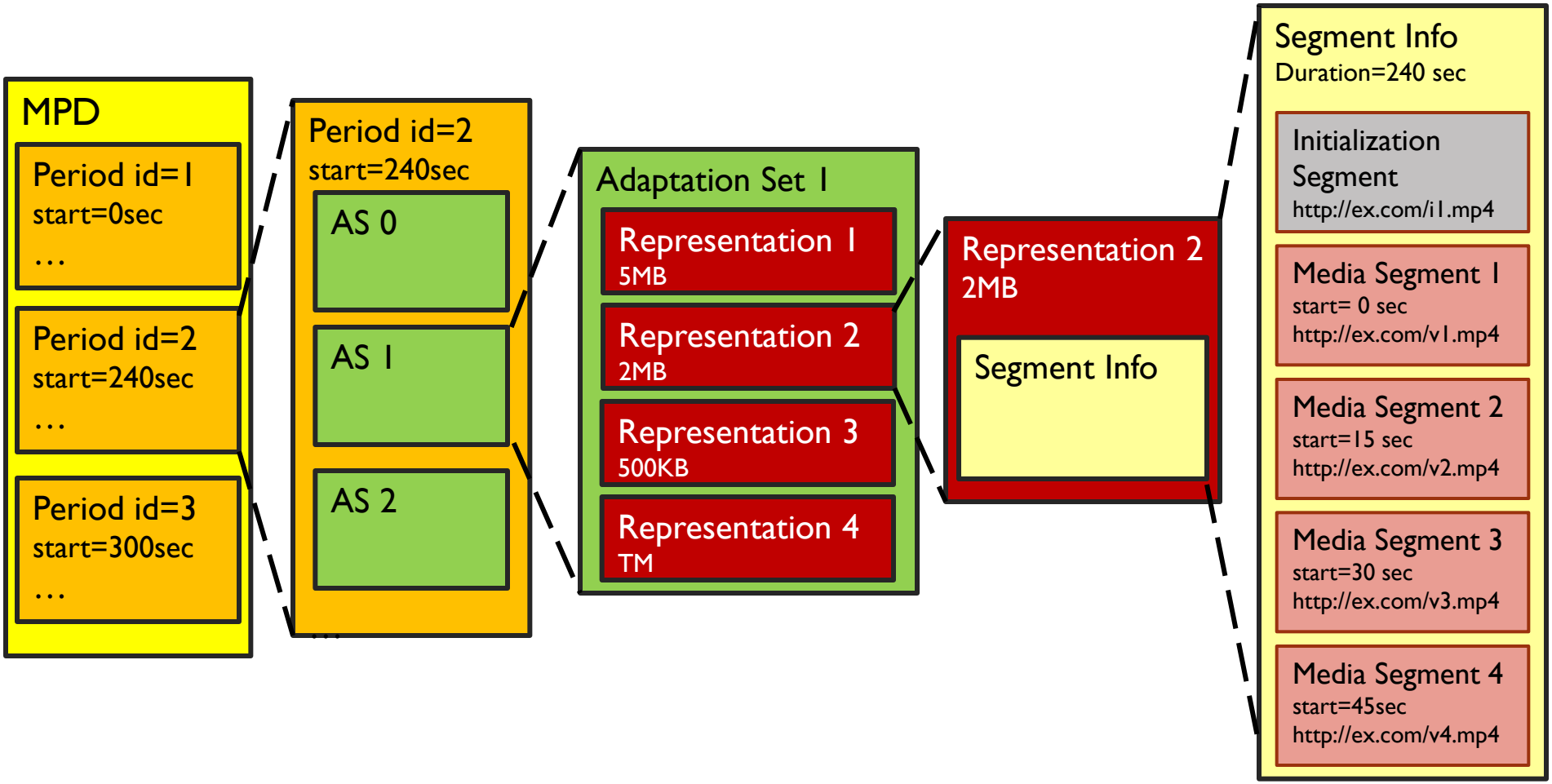
DASH Spec covers the red blocks.
[Note: Client's behavior is only defined to the extend needed for compliancy with MPD and segment formats.]

Media Presentation Description (MPD)

- XML document containing metadata to construct appropriate HTTP-URLs to access media segments.
  - HTTP-URLs absolute or relative.
  - Containing exactly one MPD element
  - Actual playback is not controlled.
- The MIME type of the MPD is defined.
- Delivery of the MPD not in scope of this standard.

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema targetNamespace="urn:mpeg:mpegB:schema:DASH:MPD:DIS2011"
           attributeFormDefault="unqualified"
           elementFormDefault="qualified"
           xmlns:xs="http://www.w3.org/2001/XMLSchema"
           xmlns:xlink="http://www.w3.org/1999/xlink"
           xmlns="urn:mpeg:mpegB:schema:DASH:MPD:DIS2011">
           <xs:import namespace="http://www.w3.org/1999/xlink"
schemaLocation="xlink.xsd"/>
     <xs:annotation>
           <xs:appinfo>Media Presentation Description</xs:appinfo>
           </xs:annotation>
     ...
     <!-- MPD: main element -->
     <xs:element name="MPD" type="MPDtype"/>
     ...
</xs:schema>
```

Media Presentation Data Model



URL Addressing

- URLs at each level of the MPD are resolved with respect to the **BaseURL** elements of levels above.
- The base URL information may present on the following levels:
  - MPD, Period, AdaptationSet, Representation
- Alternative base URLs may be are provided through the **BaseURL** element
  - the identical segments are accessible at multiple locations.

Remote MPD Elements

- Elements can get embedded in MPD with remote addressing using XLINK:

@xlink:href	Identifies the remote Element by URI.
@xlink:actuate	onLoad: dereference the remote element immediately on loading the MPD. onRequest (default): dereference the remote element only when needed.

- Unresolved, inconsistent, self-referencing will be considered invalid.
- No conflict between internal and remote elements.
- Only a single element shall be included in a remote element.

Periods

- A Media Presentation consists of one or more Periods.
- Period elements are physically ordered in MPD in increasing order of their time.
- Main attributes: @start, @duration, and

@segmentAlignment	this specifies that for any two Representations in this Period, of the same media type, the m-th segment of X and the n-th segment of Y are non-overlapping whenever m is not equal to n.
@bitstreamSwitching	The concatenation of any Initialisation Segment within the same AdaptationSet in a Period, if present, with all consecutive Media Segments from any Representation within this same AdaptationSet, starting with the first Media Segment, results in a conforming segment sequence.

AdaptationSets

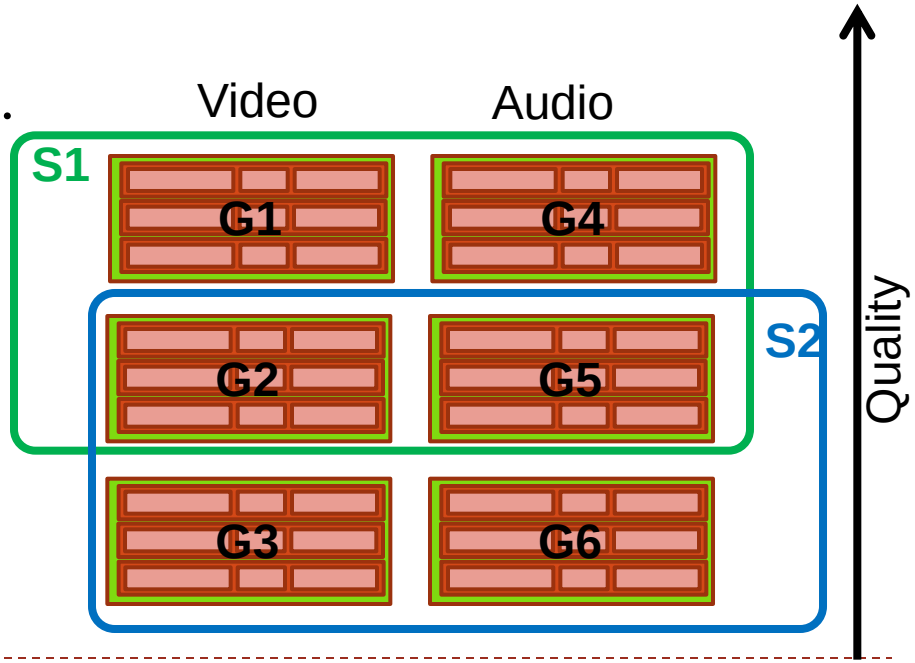
- Each Period consists of one or more *AdaptationSets*, which each consists of one or more Representations.
- Representations in the same Adaptationsets are alternatives to each other and typically contain different encoded versions of the same source:
  - Such as language, media component type, picture aspect ratio, role, accessibility, viewpoint, rating.
- Adaptationsets can be arranged using @group:
  - Either one Representation from group 0, or the combination of at most one Representation from each non-zero group.
- Main attributes:
  - @group, @lang, @mediaComponentTytpe, @par, @minBandwidth,@maxBandwidth,@minWidth, @maxWidth, @minHeight, @maxHeight, @minFrameRate, @maxFrameRate, @segmentAlignment, @bitStreamSwitching, @subsegmentAlignment, Accessibility, Role, Rating, Viewpoint, MultipleViews
- Common between Adaptationsets, Representations and SubRepresentations

Representations & Sub-representations

- A Representation:
  - One of the alternative choices of the media content typically differing by encoding parameters such as bitrate, resolution, language, codec, etc.
  - Aligned within the period's boundaries.
  - Consists of one or more Segments.
  - Contains an initialisation segment or all segments are self-initialising.
  - May contain zero or more SubRepresentations.
- A SubRepresentation:
  - Provide the ability for accessing a lower quality version of the Representation. Examples:
    - Audio track in a multiplexed Representation.
    - Lower frame rate for efficient fast-forward.

Subsets

- An optional mechanism for the content creator to create collections of media presentations for various application/devices within the same MPD.
- Restrict the combination of active AdaptiveSets.
- DASH client must use one subset.
- Empty subsets are not allowed.
- No subset can contain all groups.



S1: HDTV with surround sound.
S2: Tablet with SD video and high quality audio.

Segments

- A Segment is a unit that can be referenced by an HTTP-URL included in the MPD.
  - "http://" and optionally with a byte range.
- Segments' availability duration: the time window at which the Segments can be accessed by the HTTP-URL.
- Each representation has at most one SegmentInfo element which provides:
  - Presence or absence of Initialisation and Index Segment information.
  - HTTP-URL and byte range for each segment.
  - Segment availability start time and availability end time for live case.
  - Approximated media start time and duration of each segment.
    - Fixed or variable duration.

Initialization & Media Segments

- Initialization Segment:
  - Each representation may have at most one Initialisation Segment to initialise the media engines for play-out.
  - If no Initialisation Segment URL is present, then each Media Segment is self-initializing.
- Media Segment:
  - Each representation has a list of consecutive Media Segments.
  - Media segment information:
    - URL, possibly restricted by a byte range.
    - Index of segment.
    - Approximate start time and duration.

Descriptors

- No normative information on how to use these elements.

Descriptor		Provides information about a descriptor
	@schemeIdUri	a URI to identify the scheme.
	@value	The value and semantics must be defined by the owners of the scheme identified in the @schemeIdUri.

- Content protection: specific schemeIdUri for MP4 and M2TS.
- FramePacking: specific schemeIdUri for AVC and MPEG-2.
- Role: specifc schemeIdUri for defined table.
- Accessibility
- Rating
- Viewpoint
- AudioChannelConfiguration: specific schemeIdUri from 23002-3.

Segment Formats

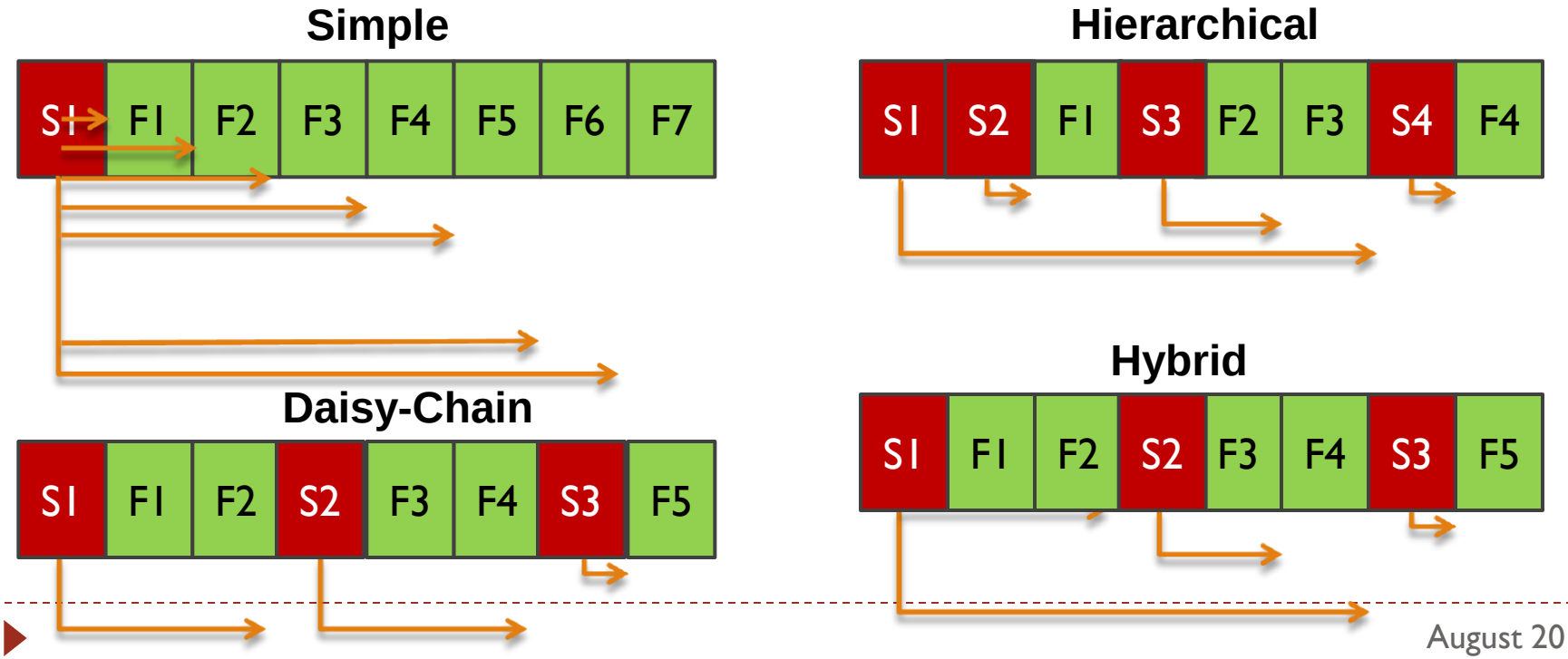
- Segment: The entity body of the response when issuing a HTTP GET or a partial HTTP GET
- Initialisation Segment contains initialisation information for Representation and contain no media data.
- A Media Segment contains media components and
  - is assigned an MPD URL Element.
  - is explicitly or implicitly assigned a start time
  - the first Media Segment always start with a RAP.
- Segment formats that are defined:
  - ISOBFF
  - MPEG2TS

ISOBFF Segment Formats

- Initialization Segment
  - 'ftyp' box, 'moov' box and optionally 'pdin' box.
- Media Segment
  - Self contained movie fragments ('moof' and 'mdat')
  - Optionally 'styp' box for file branding.
  - 'tfad' box for random access.
  - Optionally 'sidx' box for time/byte range of movie fragments and Stream Access Points (SAPs).
- Self-initializing Media Segment
  - Union of the above definitions.

Segment Index Information

- Describes sub-segments and Stream Access Points (SAP)s in the segment.
  - Byte offset and duration.
- Enables DASH Client to access the sub-segments by the use of HTTP partial GET.



Common Encryption

- Encrypted once, deliver licenses many ways
  - Provides a mechanism for delivering same encrypted segments to various client supporting different proprietary DRM systems.
- Can be applied to media segments, subsegments or individual samples.
- Signals algorithm identifier, key identifier and initialization vector size.
  - Using track encryption box or sample groups.
- Use 'pssh' box for opaque information of each specific DRM scheme.
- A new standard: ISO/IEC 23001-7

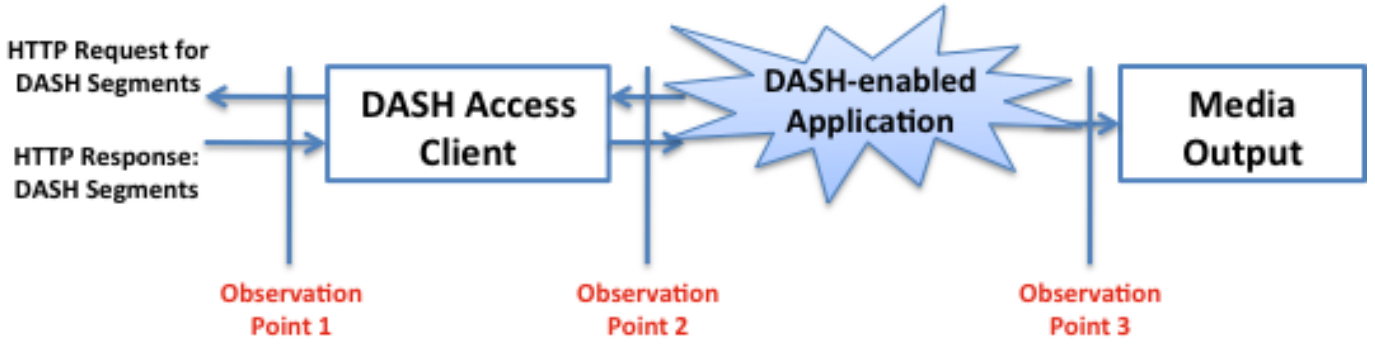
ISOBFF File Format Amendments for DASH

- Part of the 3rd amendment to 14496-12.
- Currently at similar process stage as DASH's specification.
- Some of new boxes for DASH:

Box Type	Container	Function
tfdt	traf	Decode time of the 1st sample in the track fragment. Useful for random access.
styp	file	Similar to 'ftyp', but for segments.
sidx	file	Indexing subsegments and SAPS inside a segment.
ssix	file	Indexing subsegments according to the media's levels (for scalable or view dependent streams)
prft	file	UTC-synchronized NTP clock. For clock drift control.

Quality Metrics

- To report back the Quality of Experience (QoE) to the reporting server.
- Three conceptual observation points for measurements:



Example of OP1 metrics

Key	Description
TcpList	List of HTTP request/response transactions
Entry	An entry for a single HTTP request/response
Tcpid	Identifier of the TCP connection.
dest	IP Address of the interface.
Topen	The time at which the connection was opened.
Tclose	The time at which the connection was closed.
TConnect	Connect time in ms

Example of OP3 metrics

Key	Description
RepSwitchList	List of representation switch events
Entry	A representation switch event.
T	Time of the switch event.
Mt	The media time of the earliest media sample
To	Representation id identifying the switch-to representation.

Profiles

- Profiles enable interoperability and conformance.
  - A profile refers to a set of defined restrictions.
  - Scope: this specification, i.e. MPD and segment formats.
- A profile is a claim and a permission.
  - claims MPD document and segment formats conforms to the profile.
  - permission to the client to read the media presentation, interpret what it recognizes, and ignore the material it does not understand.
- Signaled at MPD level. Can be multiple.
- Currently five profiles:
  - M2TS Simple and Main
  - ISOMFF On-Demand, Live and Main

ISOBMFF Profiles

MPD item	On Demand	Live	Main
MPD@type	Static	Dynamic or Static	Dynamic or Static
Segmentation	Single	Single or multiple	Single or multiple
Alignment	Yes (subsegment)	Yes (segment)	Static: Any Dynamic: Yes (segment)
StartWithSAP (1, 2, 3*)	Yes (subsegment)	Yes (segment)	Static: 1,2,3 Dynamic: Yes (segment)
StartWithSAP (>3)	No		No
Segment Timeline	No	Yes	Yes
Subsets	May be ignored		
Multiple Periods	Yes		
Multiplexed	Yes		
Non-multiplexed	Yes		

MPEG-2 Profiles

MPD item	M2TS Simple	M2TS Main
MPD@type	Dynamic or Static	Dynamic or Static
Segmentation	Single or multiple	Single or multiple
Alignment	Yes (subsegment) Yes (segment)	Any
StartWithSAP (1, 2, 3*)	Yes (subsegment) Yes (segment)	Any
StartWithSAP (>3)	No	Yes
Segment Timeline	May be ignored	
Subsets	May be ignored	
Multiple Periods	Yes	
Multiplexed	Yes	
Non-multiplexed	No	

Software, Conformance and TR

- Conformance and Software:
  - New part of standard: 23009-2.
  - 2st Working Draft.
  - Conformance tools, documents and examples.
  - Software architecture and modules.
  - Workplan for both.
- TR: Implementation Guidelines for DASH
  - Informative.
  - Guidelines on how to create content, timing, MPD generation, choice of parameters, storing streams into file.

Collaboration with Other SDOs

- 3GPP
  - Collaboration on specifications alignment.
  - Release 9: a subset of MPEG's DASH.
  - Release 10: as close as possible to DASH.
  - Profiling yet to be decided.
- DECE
  - Recently established the liaison.
  - ISOBFF for common encryption & multi-DRM support.
  - DASH as the candidate for streaming (to be decided).
- W3C Web & TV Interest Group (IG)
  - Newly established IG.
  - Collaboration hopefully to start soon.
  - DASH possibly the main candidate for the streaming protocol.
- Liaisons with HbbTV, OIPF, DTG, DVB, etc. on

What's Next

- 23009-1: 2nd DIS balloting starts soon.
  - Expected IS in December 2011
- 14496-12 AMD 3 to ISOBMFF & 23001-7 Common Encryption
  - Expected IS in December 2011
- Complete the reference software and conformance.
- Complete the technical report.

Thanks for your attention!