

Emmy Tutorial 1: Introduction to MPEG DASH

March 2, 2022

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DASH-IF Interoperability WG Chair
Co-editor of MPEG-DASH ISO/IEC 23009-1 1st to 5th edition



Today's agenda

- Chronical Matters and Anecdotes (getting old)
- The core principles of DASH
- What is new in the 5th edition
- DASH-IF Interoperability Guidelines v5
- Tools
- What's next to come
- DASH Deployments
- Thank you



Presenter

Dr. Thomas Stockhammer

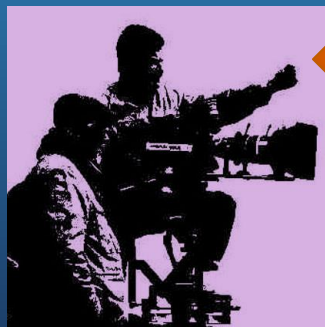
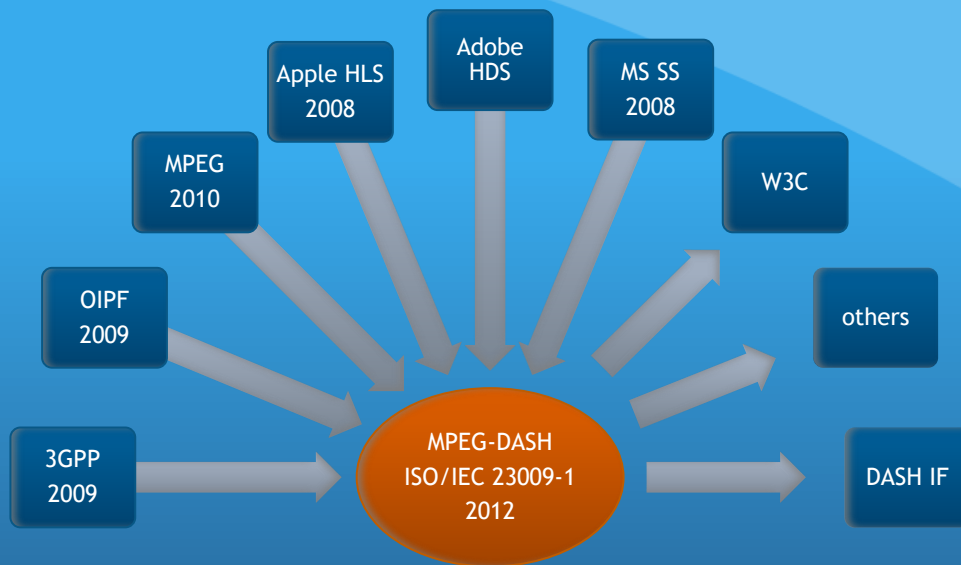
Director, Technical Standards
Qualcomm Europe, Inc.

Leading and driving among others

- DVB: 5G TF, DVB-I
- MPEG: MPEG-I, CMAF and DASH
- 3GPP: XR over 5G, 5G Video, 5GMS
- DASH-IF: Interop WG, Test
- ETSI: 5G Broadcast
- CTA WAVE: CMAF Device PB, Test



The history - why a standard?



History

CFP Completed April 2010 in Dresden – the Volcano Eyjafjallajökull meeting

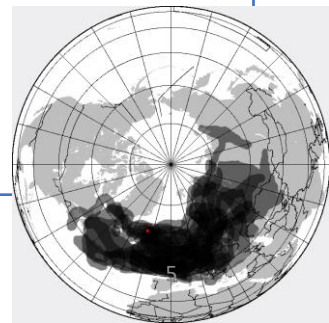
**INTERNATIONAL ORGANISATION FOR STANDARDISATION
ORGANISATION INTERNATIONALE DE NORMALISATION
ISO/IEC JTC1/SC29/WG11
CODING OF MOVING PICTURES AND AUDIO**

**ISO/IEC JTC1/SC29/WG11
MPEG2010/M 17875
July 2010, Geneva, Switzerland**

Source:	Thomas Stockhammer (c_tstock@qualcomm.com), Mark Watson (watson@qualcomm.com), Marta Karczewicz (marta@qualcomm.com), Ying Chen (cheny@qualcomm.com), Yuriy Reznik (yreznik@qualcomm.com), Ye-Kui Wang (yekuiwang@huawei.com), Shaobo Zhang (zhangshaobo@huawei.com), David Furbeck (dfurbeck@RIM.COM), Amol Shukla (ashukla@REAL.COM), Clinton Priddle (clinton.priddle@ericsson.com), Per Fröjdh (per.frojdh@ericsson.com), David Singer (singer@apple.com)
Status	Input
Group	All Systems Requirements
Title	Reply to CFP on HTTP Streaming: 3GPP Adaptive HTTP Streaming

MPEG and 3GPP Meetings in 2010/2011:

- Geneva, July 2010 => CD
- Erlangen, August 2010
- Paris, September 2010
- Guangzhou, October 2010
- Barcelona, November 2010
- San Francisco, December 2010
- Berlin, January 2011
- Daegu, January 2011 => DIS
- Sanya, February 2011
- Geneva, March 2011
- San Diego, April 2011
- Berlin, June 2011
- Torino, July 2011 => FDIS









MHV: Emmy MREG RASH



MHV: Emmy MPEG-DASH









The Standards

- Personal Warning:**
Process
not recommended
to be repeated
- Based on the results of the collaboration, MPEG and 3GPP developed jointly the work and published the specifications as
 - TS 26.247: 3GPP Dynamic Adaptive Streaming over HTTP (3GP-DASH)
 - ISO/IEC 23009-1: Dynamic Adaptive Streaming over HTTP: Media presentation description and Segment formats
 - Since then
 - 5 editions of DASH part 1 are completed
 - The DASH standard has 8 parts
 - DASH is adopted by many organizations

Editions, Parts and Editors

1	2011	ISO/IEC 23009-1 Media Presentation Description and Segment Formats	Thomas Stockhammer and Per Fröjdh
1	2012	ISO/IEC 23009-1:201x 2 nd edition	Thomas Stockhammer, Per Fröjdh
1	2013	ISO/IEC 23009-1:2014 AMD 1 Extended profiles and time synchronization	Thomas Stockhammer, Alex Giladi
1	2014	23009-1:2014 AMD 2 Spatial Relationship Description, Generalized URL parameters and other extensions	Emmanuel Thomas, Sylvain Kervadec, Cyril Concolato
1	2014	23009-1:2014 AMD 3 Authentication, Access Control and multiple MPDs	Thomas Stockhammer, Alexander Giladi
1	2014	23009-1:2014 AMD 4 Segment Independent SAP Signalling, MPD chaining and other extensions	Thomas Stockhammer, Iraj Sodagar, Alex Giladi
1	2015	23009-1 3 rd edition Media presentation description and segment formats	Thomas Stockhammer
1	2016	23009-1 3 rd edition AMD 1 on device information and other extension	Ali C. Begen, Thomas Stockhammer
1	2019	23009-1 4 th edition	
1	2020	23009-1 4 th edition AMD 1 CMAF support, events processing model and other extensions	Iraj Sodagar, Thomas Stockhammer, Mike Dolan
1	2021	23009-1 5 th edition	Thomas Stockhammer, Mike Dolan
1	2022	23009-1 4 th edition AMD 2 Preroll, nonlinear playback and other extensions	Iraj Sodagar, Thomas Stockhammer
1	2023	23009-1 5 th edition AMD Extended Dependent Random Access Representations and other extensions	Ye-Kui Wang, Iraj Sodagar
2	2012	ISO/IEC 23009-2 DASH Conformance and reference software	Thomas Stockhammer and Christian Timmerer
2	2017	23009-2 2 nd edition DASH Conformance and reference software	Christian Timmerer, Waqar Zia, Brendan Long
2	2017	23009-2 AMD 1 Conformance vectors and reference software for SRD, SAND and Server Push	Emmanuel Thomas
2	2020	23009-2 3 rd edition	
3	2012	23009-3 DASH Implementation Guidelines	Yuriy Reznik, Kilroy Hughes, Thomas Stockhammer
3	2014	23009-3 2 nd edition DASH Implementation Guidelines	Thomas Stockhammer, Alex Giladi
3	2014	23009-3 2 nd edition AMD 1 DASH Implementation Guidelines	Iraj Sodagar
3	2015	23009-3 3 rd edition DASH Implementation Guidelines	Ali C. Begen
4	2013	ISO/IEC 23009-4 Segment encryption and authentication	Alex Giladi
4	2018	23009-4 2 nd edition Segment encryption and authentication	Alex Giladi and Yasser Syed
5	2017	23009-5 Server and Network Assisted DASH	Mary-Luc Champel, Emmanuel Thomas
5	2020	23009-5 AMD 1 Improvements on SAND messages	Mary-Luc Champel
6	2017	23009-6 DASH with Server Push and WebSockets	Viswanathan (Vishy) Swaminathan, Kevin Streeter, Imed Bouzazi, and Franck Denoual
7	2023	23009-7 Delivery of CMAF contents with DASH	Iraj Sodagar
8	2020	23009-8 Session based DASH operation	Ali C. Begen, Iraj Sodagar, Alex Giladi
8	2022	23009-8 AMD 1 URL customization other extensions	Iraj Sodagar

A few others on standards development

Jean Le Feuvre

Dave Singer

DF /QC colleagues
Mark Watson and
Mike Luby

Harry Piles and
Paul Higgs – the
masters of the
XML

Waqar Zia for all of
his work on
conformance and
reference software

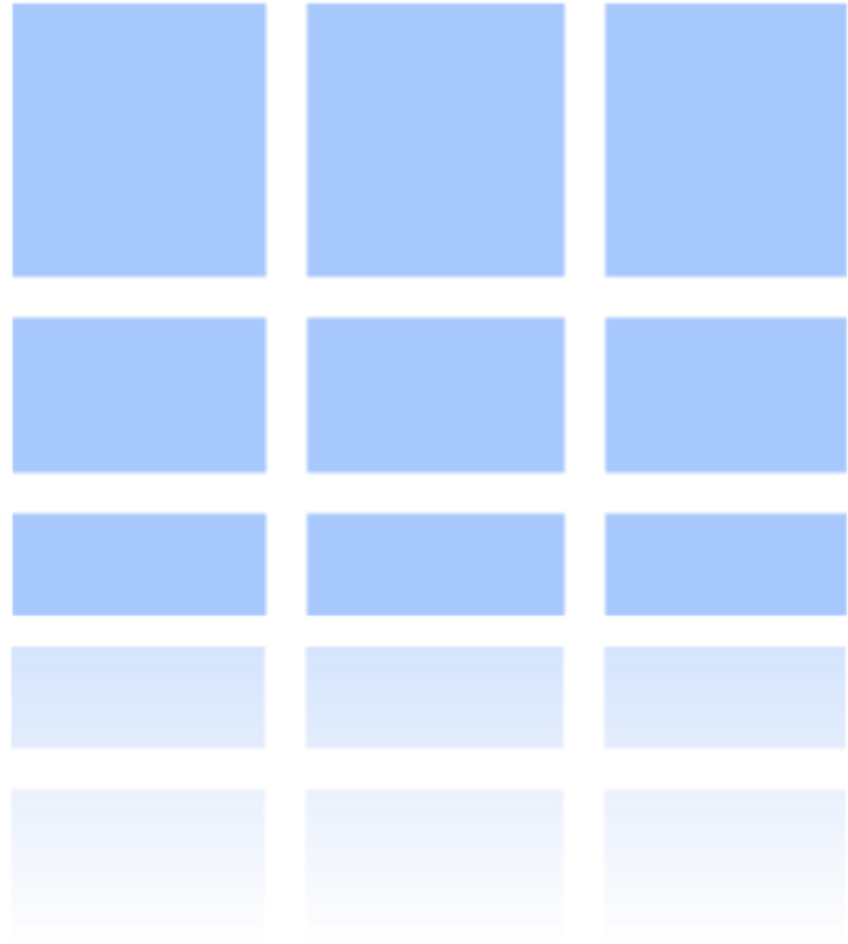
The colleagues
from DVB and
OIPF/HbbTV

The Korean gang
who made MASH
into DASH

Youngkwon and
Leonardo

And many many
more

Some Fundamentals of DASH





Core Principles of DASH

CDN and Cache
friendly

Stateless Server

Client-driven

Low manifest
traffic (small size
and low update
frequency)

Carrying ISO BMFF
and CMAF

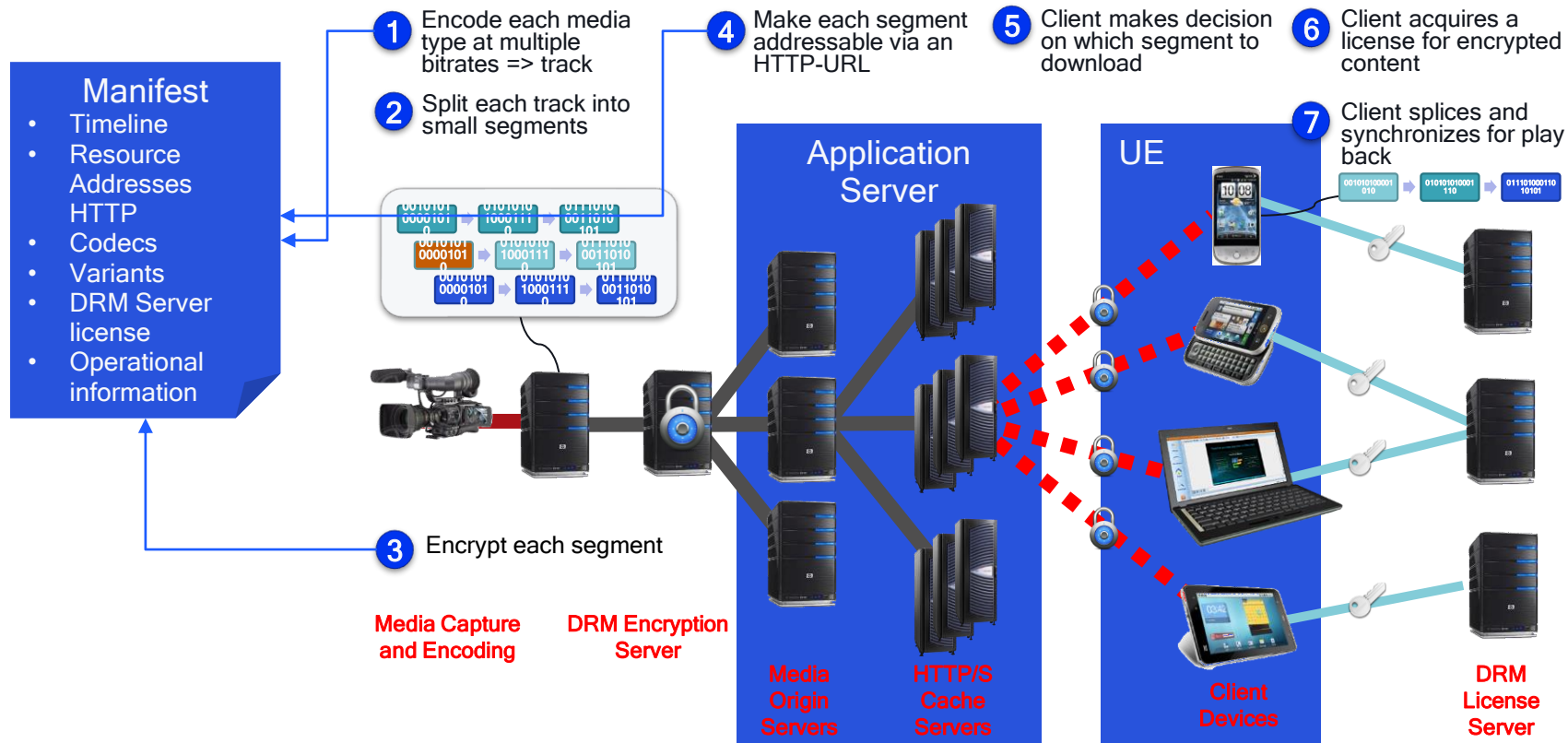
Late Binding

Works with HTML-
5 and MSE

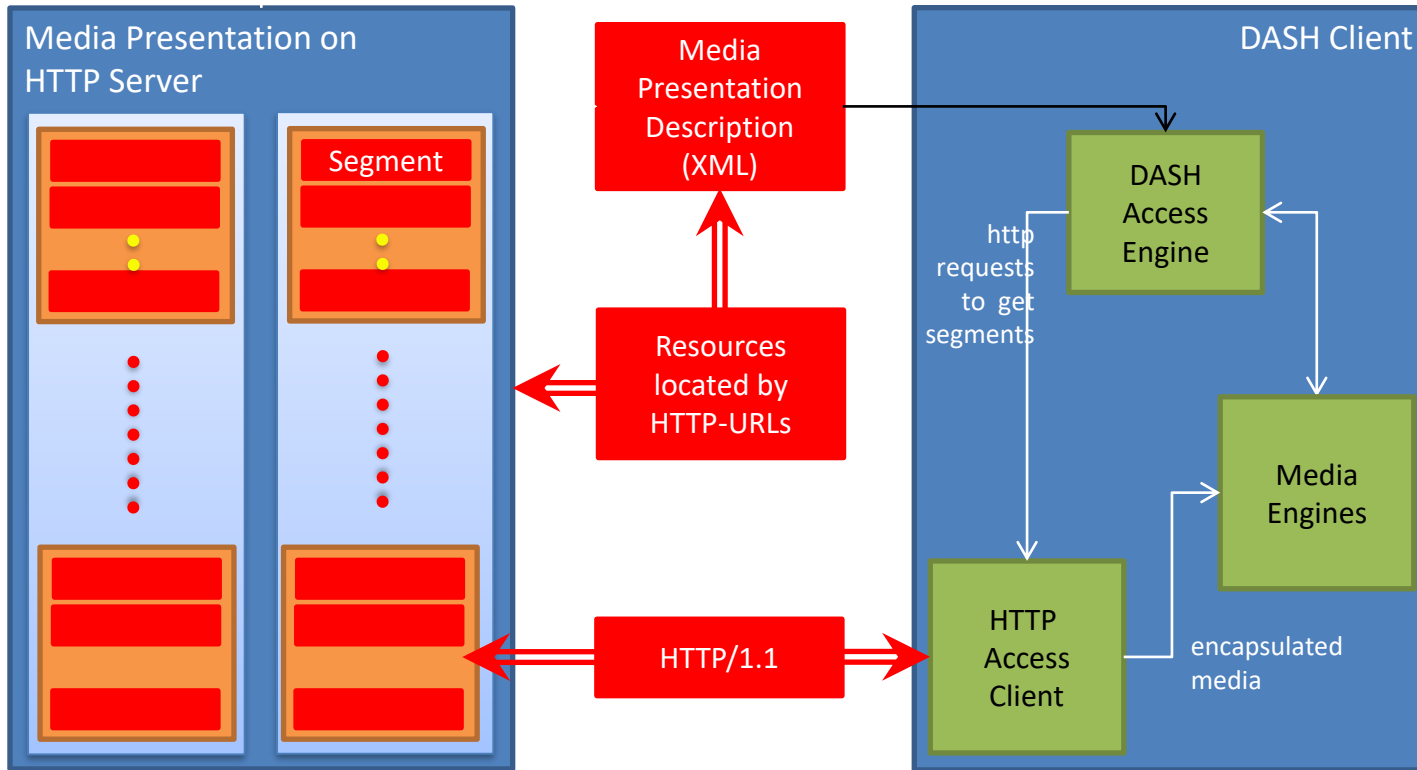
HLS Convergence

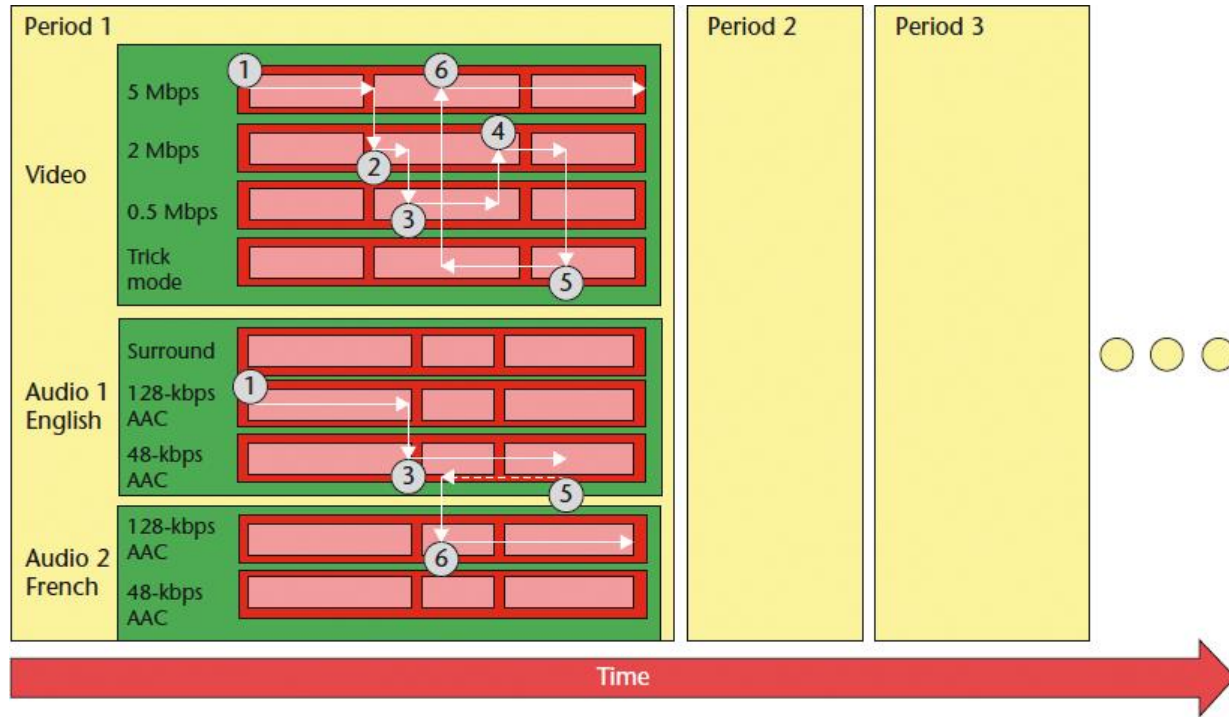
Live and On-
Demand

CDN Friendly



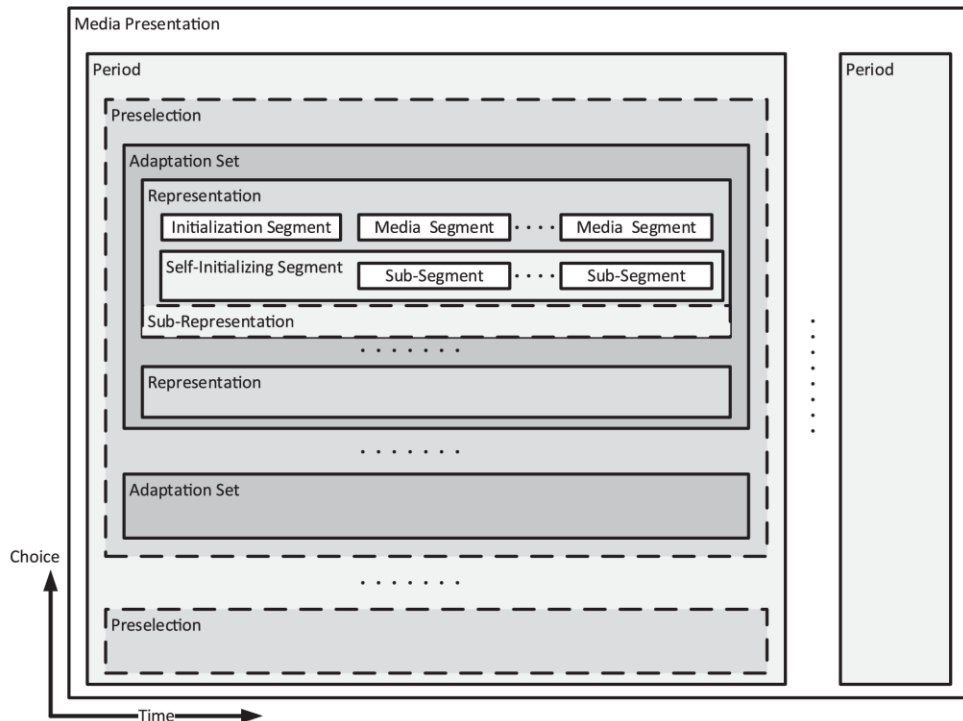
What is **specified** – and what is **not**?





Data Model

Mapping to DASH



```
<MPD xmlns="urn:mpeg:DASH:schema:MPD:2011"
mediaPresentationDuration="PT0H3M1.63S" minBufferTime="PT1.5S"
profiles="urn:mpeg:dash:profile:isoff-on-demand:2011"
type="static">
  <Period duration="PT0H3M1.63S" start="PT0S">
    <AdaptationSet>
      <ContentComponent contentType="video" id="1" />
      <Representation bandwidth="4190760" codecs="avc1.640028"
height="1080" id="1" mimeType="video/mp4" width="1920">
        <BaseURL>car-20120827-89.mp4</BaseURL>
        <SegmentBase indexRange="674-1149">
          <Initialization range="0-673" />
        </SegmentBase>
      </Representation>
      <Representation bandwidth="2073921" codecs="avc1.4d401f"
height="720" id="2" mimeType="video/mp4" width="1280">
        <BaseURL>car-20120827-88.mp4</BaseURL>
        <SegmentBase indexRange="708-1183">
          <Initialization range="0-707" />
        </SegmentBase>
      </Representation>
      <Representation bandwidth="100000" codecs="avc1.4d4015"
height="144" id="5" mimeType="video/mp4" width="256">
        <BaseURL>car-20120827-160.mp4</BaseURL>
        <SegmentBase indexRange="671-1146">
          <Initialization range="0-670" />
        </SegmentBase>
      </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

DASH MANIFEST FOR LIVE

Key issue for reducing latency is the reduction of segment duration w/o losing scalability

HLS Manifest states what is available on the server and only provides information on the past, which results in the following

1. Client sending uplink requests for Manifest prior to each Segment request
2. A full new manifest needs to be delivered for each new Segment (which also grows over time, so short Segments and Late Binding are more difficult to realize)
3. The manifest needs to be parsed and processed by client for every request
4. For each new segment, a new Manifest needs to be written on the server

DASH MPD provides information of the past and **permits promises for the future**

- If used properly, several or all of the above can be mitigated or at least reduced
- Functions to support this:
 - Templates in URLs and predictive segment availability times → small manifests and lower segment sizes
 - Flexible MPD validity expiration mechanisms → MPD updates only when necessary
 - Time-synchronized server and client → no requests are necessary

SEGMENT ADDRESSING

```
<Representation mimeType="video/mp4"
    frameRate="24"
    bandwidth="1558322"
    codecs="avc1.4d401f" width="1277" height="544">
  <SegmentList duration="10">
    <Initialization sourceURL="http://cdn.bitmovin.net/bbb/video-1500/init.mp4"/>
    <SegmentURL media="http://cdn.bitmovin.net/bbb/video-1500/segment-0.m4s"/>
    <SegmentURL media="http://cdn.bitmovin.net/bbb/video-1500/segment-1.m4s"/>
    <SegmentURL media="http://cdn.bitmovin.net/bbb/video-1500/segment-2.m4s"/>
    <SegmentURL media="http://cdn.bitmovin.net/bbb/video-1500/segment-3.m4s"/>
    <SegmentURL media="http://cdn.bitmovin.net/bbb/video-1500/segment-4.m4s"/>
  </SegmentList>
</Representation>
```

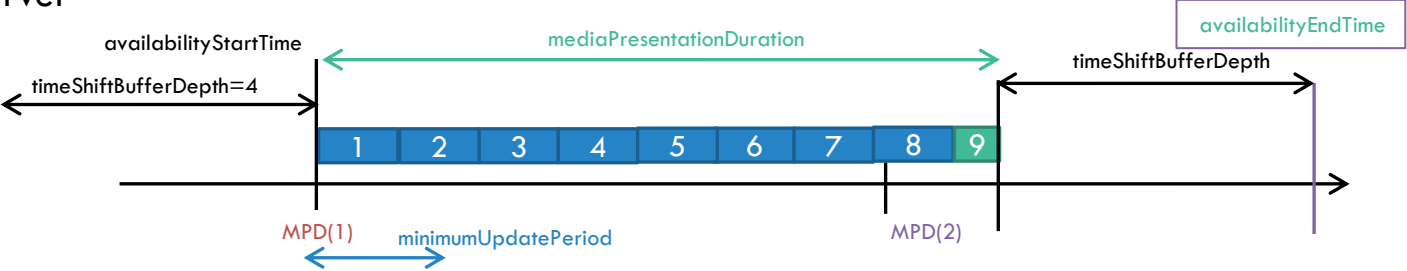
List

```
<Representation mimeType="video/mp4"
    frameRate="24"
    bandwidth="1558322"
    codecs="avc1.4d401f" width="1277" height="544">
  <SegmentTemplate media="http://cdn.example.net/bbb/segment-$Number$.m4s"
    initialization="http://cdn.example.net/bbb//init.mp4"
    startNumber="0"
    timescale="24"
    duration="48"/>
</Representation>
```

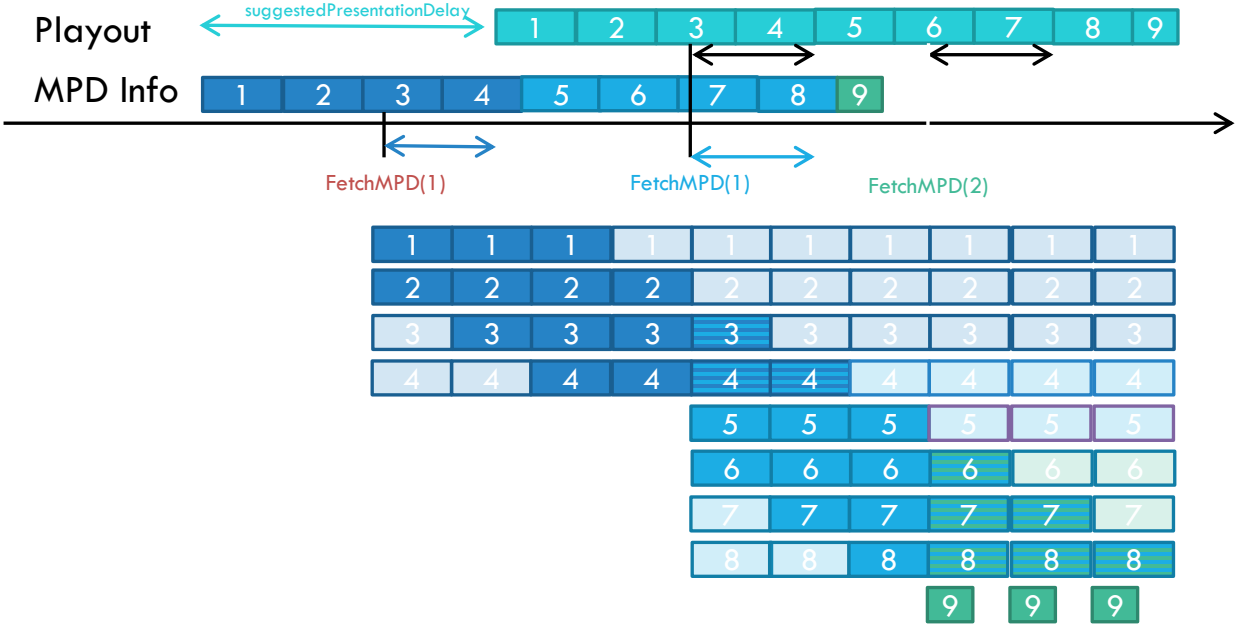
Number template

Segment-0
Segment-1
Segment-2
.....

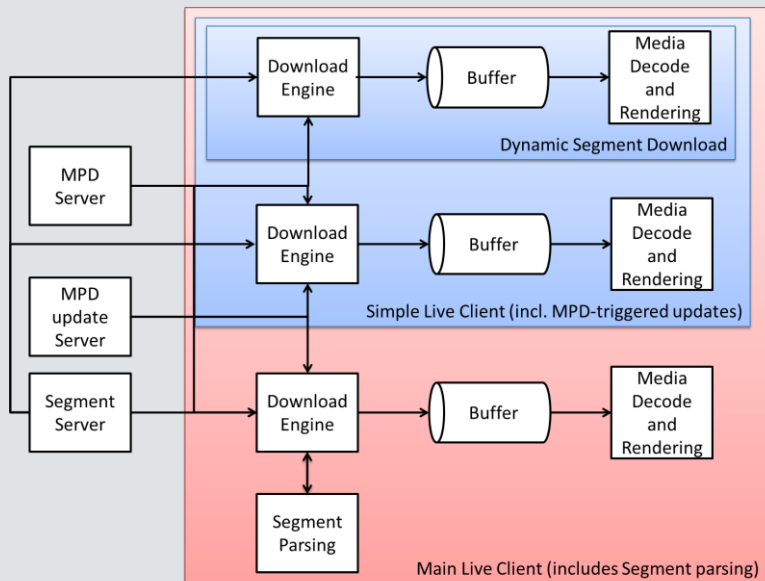
Server



Client



ADVANCED CLIENT

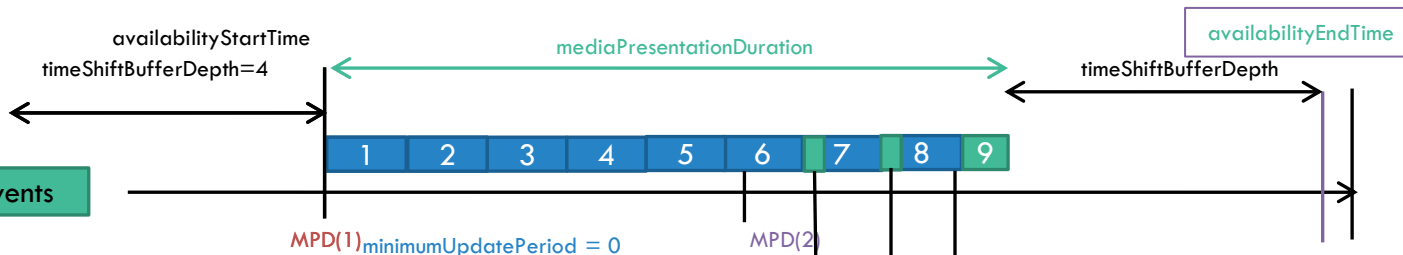


<InbandEventStream MPD Validity Expiration>

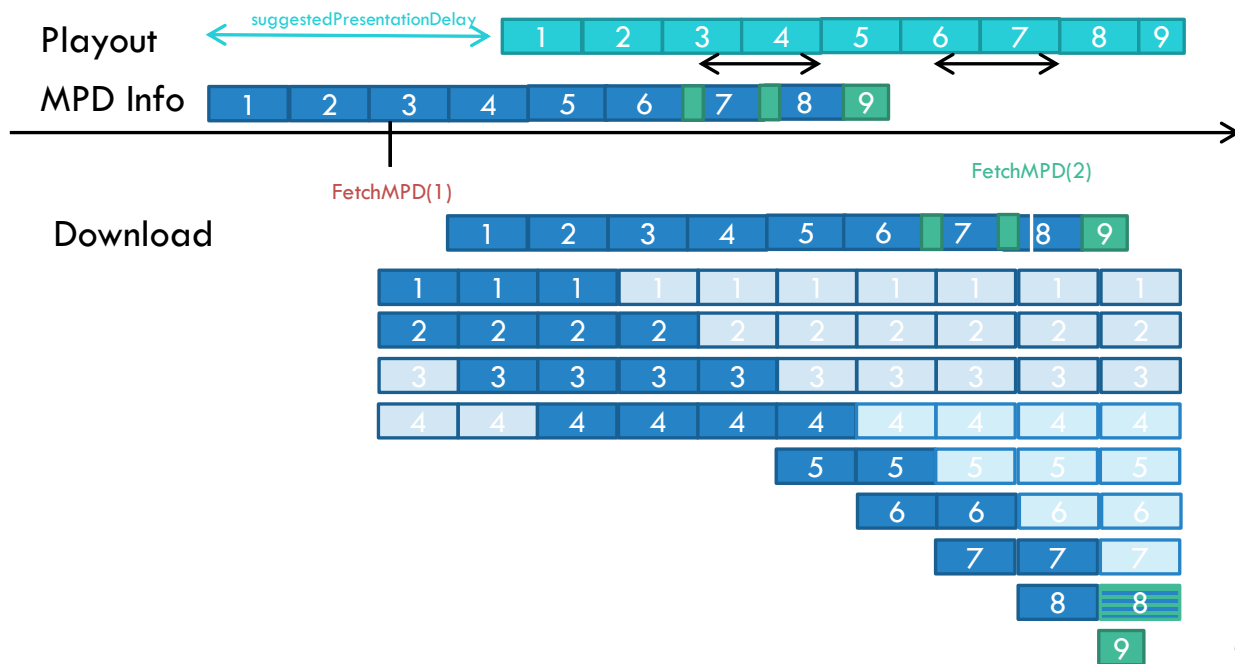
```
<Representation mimeType="video/mp4"
  frameRate="24"
  bandwidth="1558322"
  codecs="avc1.4d401f" width="1277" height="544">
  <SegmentTemplate media="http://example.net/video/segment-$Time$.m4s"
    initialization="http://example.net/video/segment-/init.mp4"
    timescale="24">
    <SegmentTimeline>
      <S t="0" d="48" r="5"/>
    </SegmentTimeline>
  </SegmentTemplate>
</Representation>
```

Segment-0
Segment-48
Segment-92
.....

Server



Client

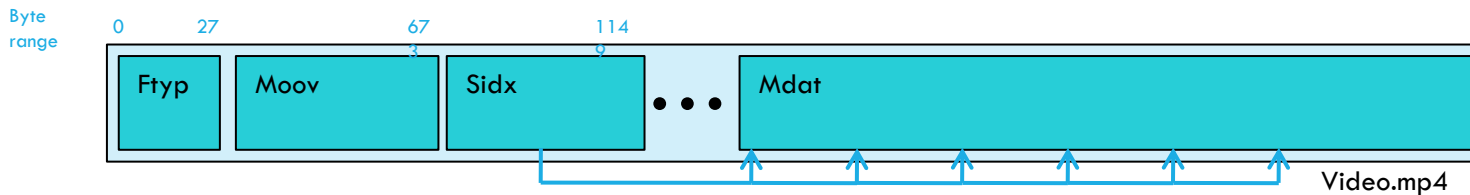


HYBRID MANIFESTS

```
<Representation id="3" width="1920" height="1080" frameRate="25/1" bandwidth="8000000" codecs="avc1.4D4028">
  <SegmentTemplate timescale="25" media="multiperiod_video_1_2_${Number$.mp4?m=1521455401" initialization=
    "multiperiod_video_1_2_init.mp4?m=1521455401" startNumber="19" presentationTimeOffset="51">
    <SegmentTimeline>
      <S t="901" d="50" r="14"/>
    </SegmentTimeline>
  </SegmentTemplate>
</Representation>
</AdaptationSet>
<AdaptationSet mimeType="audio/mp4" segmentAlignment="0" lang="eng">
  <Representation id="4" bandwidth="98605" audioSamplingRate="48000" codecs="mp4a.40.2">
    <SegmentTemplate timescale="48000" media="multiperiod_audio_1_5_${Number$.mp4?m=1521455401" initialization=
      "multiperiod_audio_1_5_init.mp4?m=1521455401" startNumber="19" presentationTimeOffset="96320">
      <SegmentTimeline>
        <S t="1730624" d="96256"/>
        <S t="1826880" d="95232"/>
        <S t="1922112" d="96256" r="2"/>
        <S t="2210880" d="95232"/>
        <S t="2306112" d="96256" r="2"/>
        <S t="2594880" d="95232"/>
        <S t="2690112" d="96256" r="2"/>
        <S t="2978880" d="95232"/>
        <S t="3074112" d="96256"/>
      </SegmentTimeline>
    </SegmentTemplate>
  </Representation>
```


OPTIMIZED ON-DEMAND ADDRESSING

```
<Representation bandwidth="4190760" codecs="avc1.640028"  
height="1080" id="1" mimeType="video/mp4" width="1920">  
  <BaseURL>car-20120827-89.mp4</BaseURL>  
  <SegmentBase indexRange="674-1149">  
    <Initialization range="0-673" />  
  </SegmentBase>  
</Representation>
```



Segment Index is a binary description of accessible units (Fragments/Segments) the Representation

Provides an accurate bitrate over time profile

Can be used by the client for optimized request scheduling

LATE BINDING

To avoid combinatorial complexity or useless downloads, tracks are offered individually on cloud

Client selects relevant tracks and synchronizes playout

Audio
Selection
Set

English AAC stereo CMAF Switching Set (single Track)
French AAC stereo CMAF Switching Set (single Track)
English multichannel CMAF Switching Set (single Track)
French multichannel CMAF Switching Set (single Track)

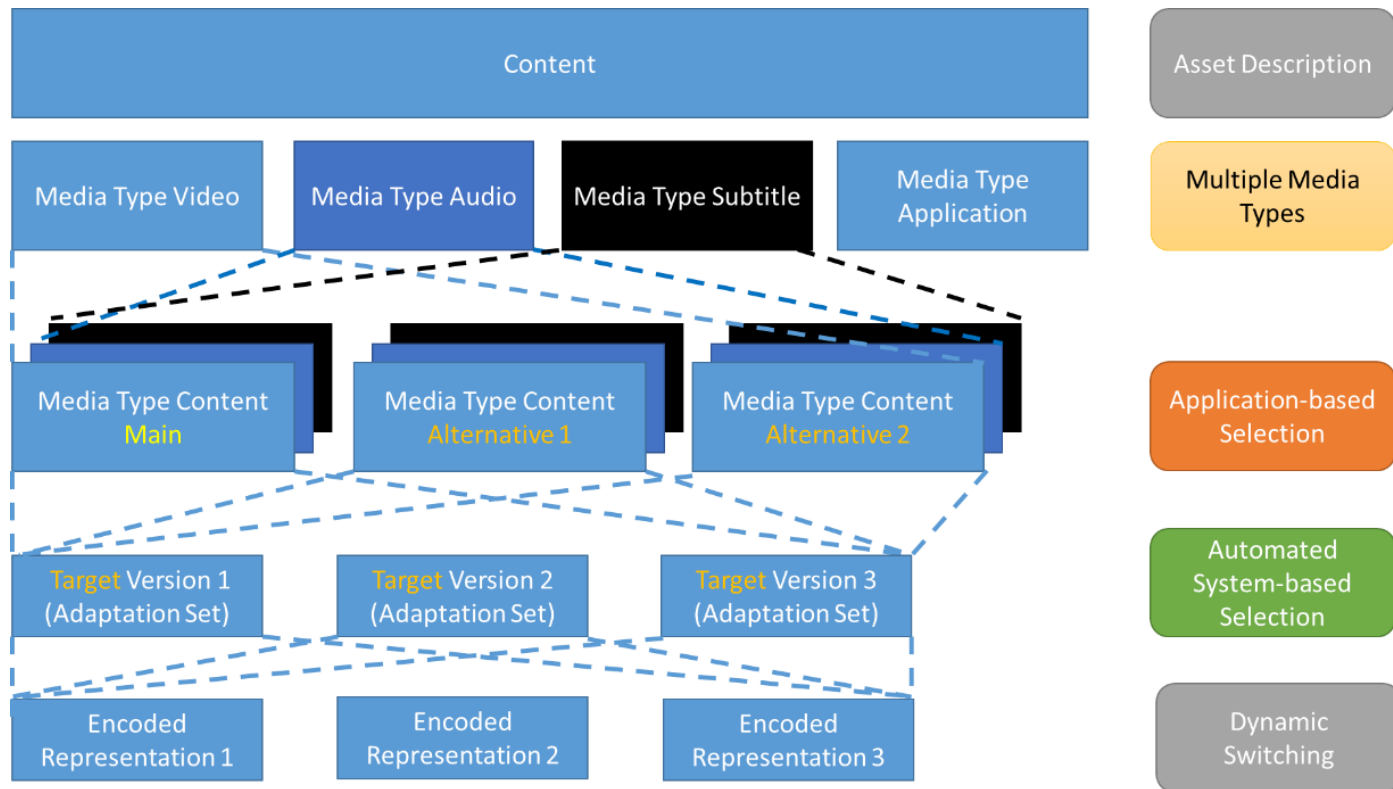
Subtitle
Selection
Set

English WebVTT description CMAF Switching Set (single Track)
English TTML description CMAF Switching Set (single Track)
French WebVTT dub CMAF Switching Set (single Track)
French TTML dub CMAF Switching Set (single Track)

Video
Selection
Set

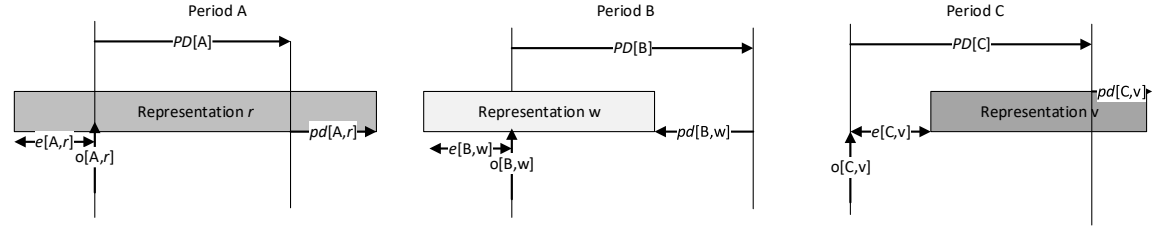
SD Media Profile CMAF Switching Set (multiple Tracks)
HD Media Profile CMAF Switching Set (multiple Tracks)
UHD10 Media Profile CMAF Switching Set (multiple Tracks)

MULTITRACK MODEL



DETAILS ON TIMING MODEL ACROSS PERIODS

Element or Attribute Name	Use
SegmentTemplate	M1,2,3
@presentationTimeOffset	OD1,2,3 0
@eptDelta	OD1,2,3
@pdDelta	OD1,2,3



Restrictions needed – see later

ISO/IEC 23009-1:2021(X)

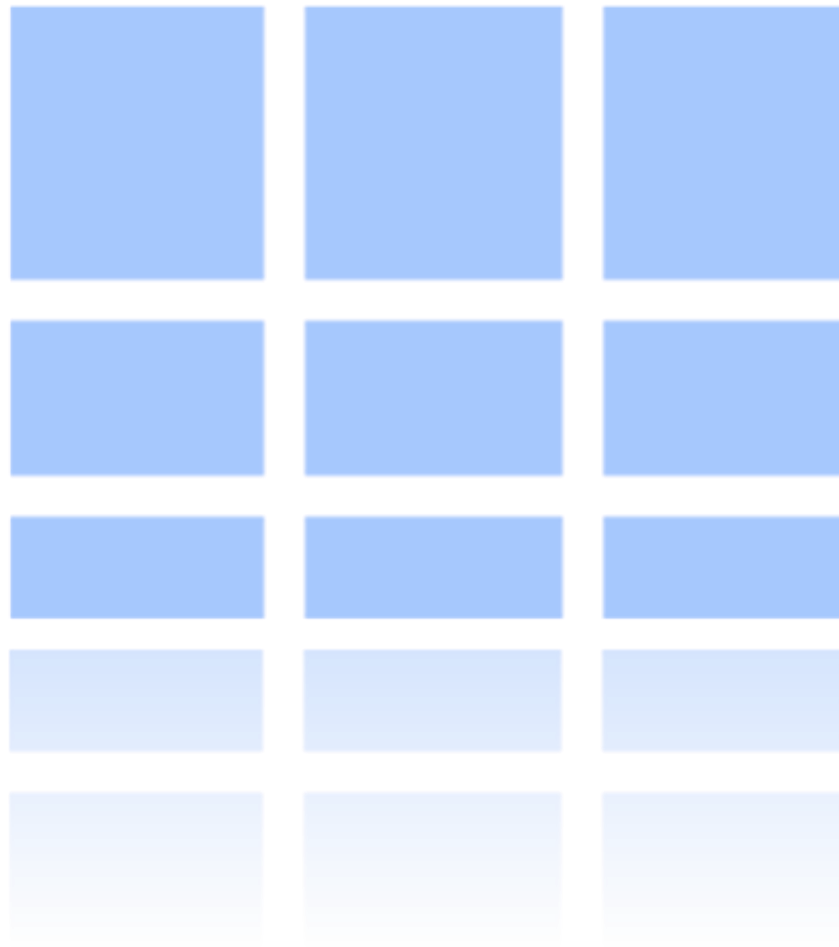
ISO/IEC JTC 1/SC 29/WG 3

Date: 2021-10-04

**Information technology — Dynamic adaptive streaming over
HTTP (DASH) — Part 1: Media presentation description and
segment formats**

FDIS stage

The 5th edition



5th Edition Extensions



DASH profile for using Common Media Application Format (CMAF) are added;

the concept Resynchronization is added in order to identify stream access points in Segments;

Daniel & Zach

MPD patching is updated to support explicit MPD updates of smaller size, not only as inband messages;

Iraj

a client processing model for Event Streams and Timed Metadata tracks is introduced;

Extensions are added to content protection for efficient signalling and to support robustness levels.

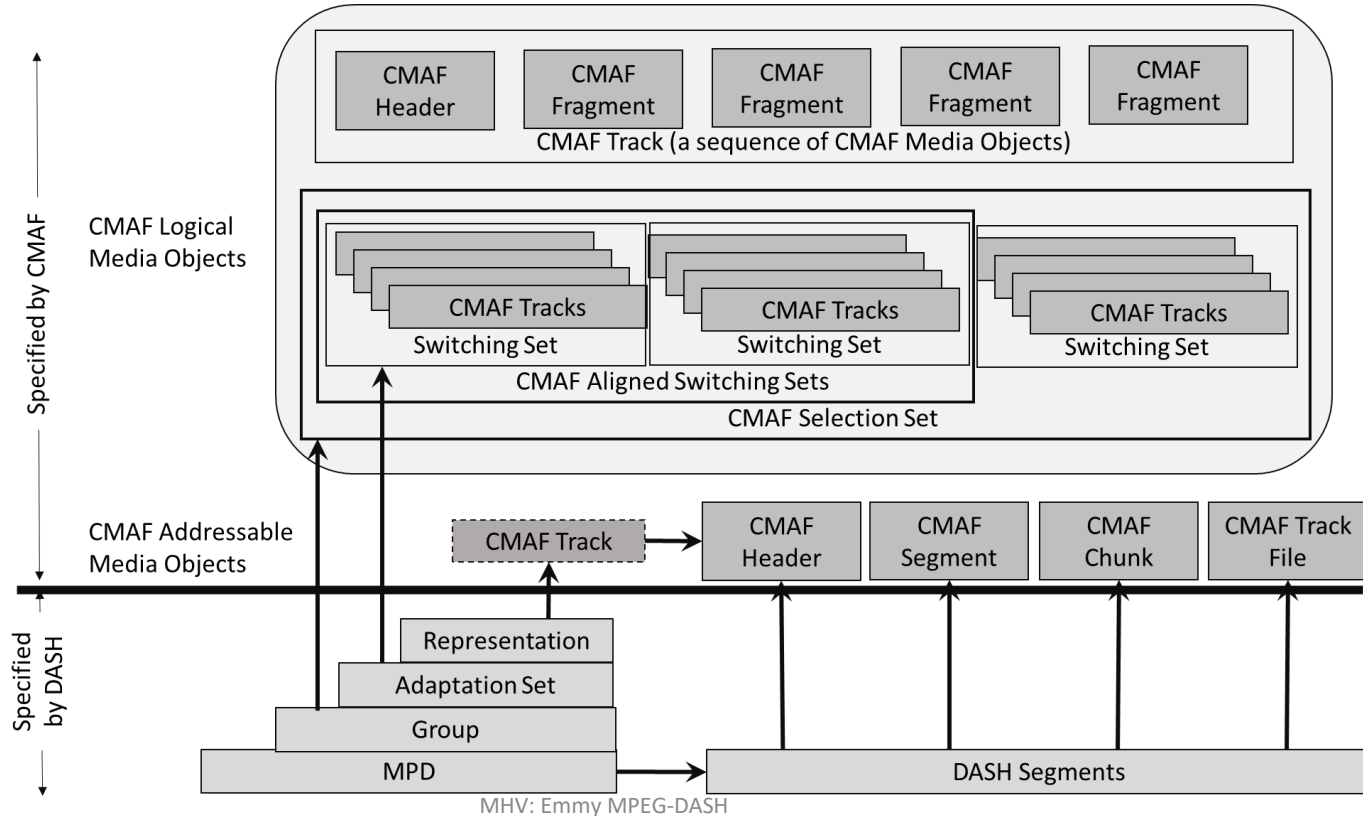
Alex

A descriptor is added in order to describe the minimum required device output protection security.

Ali

More flexible bandwidth signalling is provided to signal variable bitrate encoding.

DASH Profiles for CMAF content



Constraints – Documenting the obvious

Segment and Representation Constraints

- Mapping of CMAF Resources to DASH Manifest Signaling according to diagram
- Mapping of CMAF internal parameters to MPD

Adaptation Set Constraints

- Signaling of internal parameters to MPD Adaptation Set parameters for different media type
- Content Protection Signaling

Period Constraints

- One or multiple CMAF Presentations, differentiated by a Subset
- Time line Mapping, including presentation time offset

Multi-Period and Media Presentation Constraints

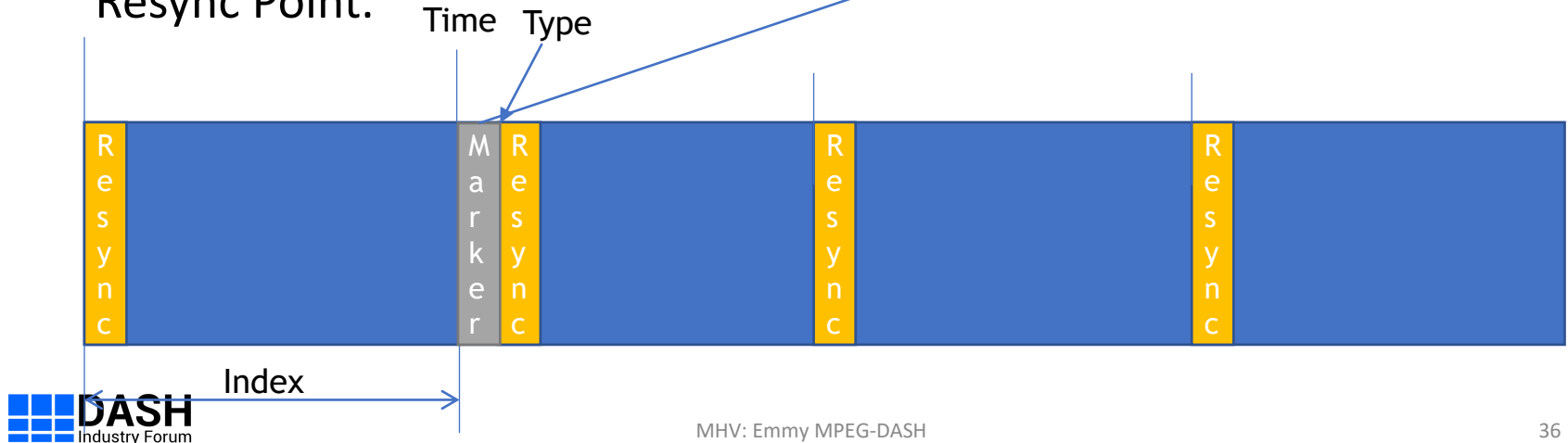
- Detailed sequencing requirements, only overlaps, no gaps
- Core Profile: Video Adaptation Set shall be exactly the Period duration
- Extended Profile: Video Adaptation Set may overlap at the Period end

MSE and dash.js compatible

Resync – Chunk Signaling

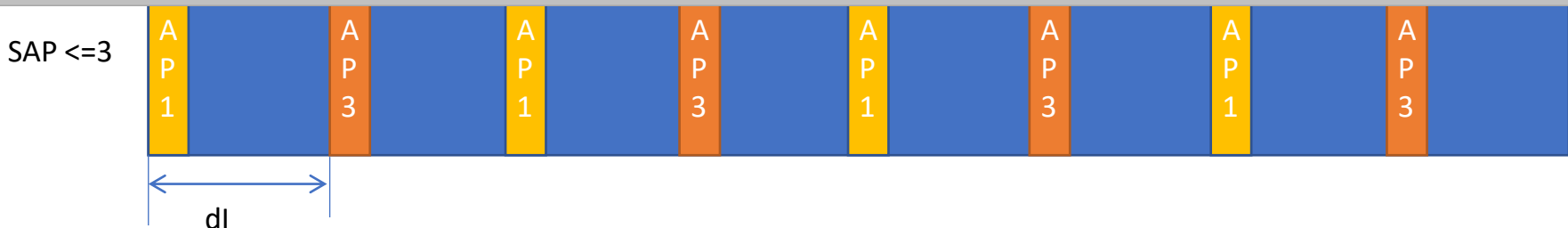
- signaling the existence of Resynchronization Points in a Media Segment with additional information that permits to easily locate the Resync Point.

NL 0	Cardinality	Specification	Constraints	Description
styp	0/1	ISO/IEC 14496-12	DASH/CMAF constraints	Segment Type Signalling compatibility to CMAF Chunk
prft	0/1	ISO/IEC 14496-12	DASH/CMAF constraints	Producer Reference Time
emsg	*	ISO/IEC 23009-1	DASH/CMAF constraints	Event Message
free	*	ISO/IEC 14496-12	none	free box
skip	*	ISO/IEC 14496-12	none	skip box
moof	1	ISO/IEC 14496-12	DASH/CMAF constraints	Movie Fragment box and the boxes it contains
mdat	1	ISO/IEC 14496-12	DASH/CMAF constraints	Media Data container for media samples





```
<AdaptationSet id="0" contentType="video" segmentAlignment="true" frameRate="10/1" maxWidth="960" maxHeight="400" par="12:5">
  <ProducerReferenceTime id="0" inband="true" type="encoder" wallClockTime="2020-02-19T10:42:02.667Z" presentationTime="0">
    <UTCTiming schemeIdUri="urn:mpeg:dash:utc:http-xsdate:2014" value="http://time.akamai.com"/>
  </ProducerReferenceTime>
  <Resync type="0" dT="500000" dImIn="0.03125" dImax="0.09375"/>
  <SegmentTemplate timescale="1000000" duration="8000000" availabilityTimeOffset="7.500" availabilityTimeComplete="false" initialization="init-
stream$RepresentationID$.m4s" media="chunk-stream$RepresentationID$-$Number%05d$.m4s" startNumber="1"/>
  <Representation id="0" mimeType="video/mp4" codecs="avc1.640016" bandwidth="500000" width="960" height="400" sar="1:1" qualityRanking="5"/>
  <Representation id="1" mimeType="video/mp4" codecs="avc1.640016" bandwidth="200000" width="720" height="300" sar="1:1" qualityRanking="2"/>
  <Representation id="2" mimeType="video/mp4" codecs="avc1.640016" bandwidth="300000" width="720" height="300" sar="1:1" qualityRanking="1">
    <Resync type="2" dT="1000000" dImIn="0.1" dImax="0.15" marker="true"/>
  </Representation>
</AdaptationSet>
```



Resynchronization

Use cases

- Low latency streaming and fast access to the service
- Fast channel acquisition in broadcast services
- Low latency streaming and resynchronization after losses or buffer underruns
- Fast down-switching in low duration buffer cases
- Fast and efficient seeking to time

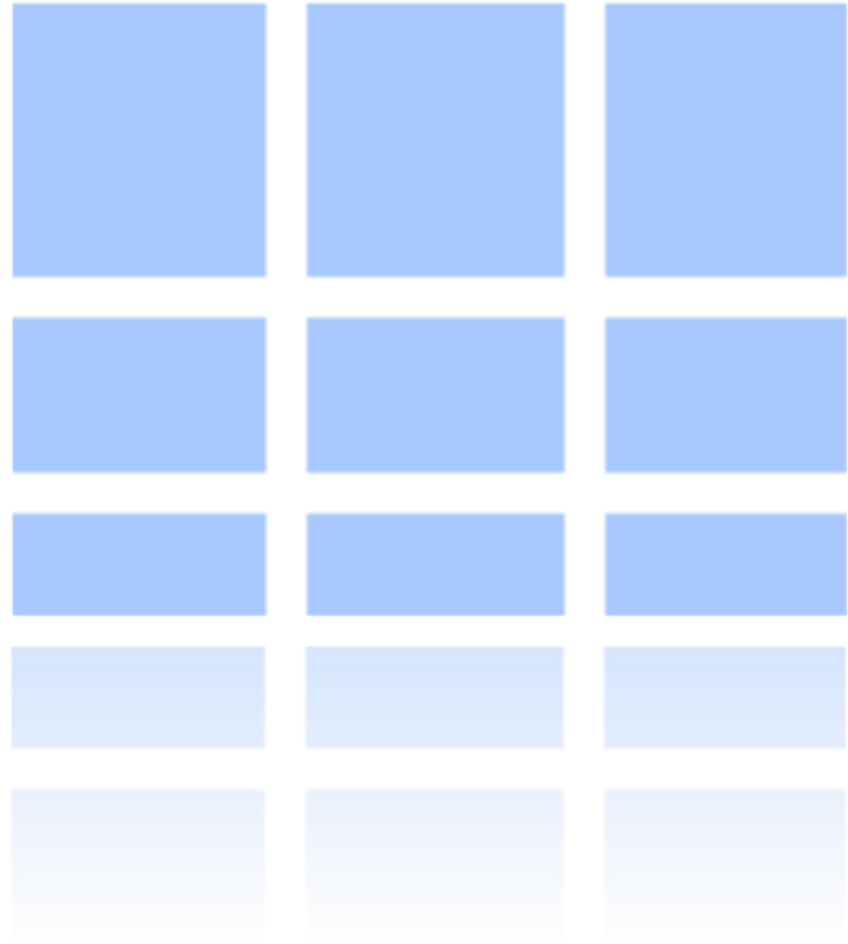
Client Processing Resync and Restart

- Finding the box structure within the Segment
- Finding a proper Resynchronization Point including with all relevant information that are needed to start parsing and decoding
- Finding the earliest presentation time that is presented
- Processing of Event messages, if applicable
- Obtaining all decryption relevant information, if applicable
- Start decoding on elementary stream level

Content Protection

Element or Attribute Name		Use	Description
	ContentProtection		specifies information regarding a content protection or encryption scheme used to encrypt and/or protect the associated Representation(s)
	@schemeIdUri	M	identifies a content protection or encryption scheme.
	@value	O	provides additional information specific to the content protection or encryption scheme. For example, it may provide information such as DRM version, encryption mode, etc. For details, refer to 5.8.4.1.6.
	@ref	O	<p>If present, makes this a referencing content protection descriptor that inherits from a “source” content protection descriptor which is identified by the equivalent value of @refId attribute. For details, refer to 5.8.4.1.3.</p> <p>The attribute shall not be present if the @refId attribute is present.</p>
	@refId	O	<p>specifies an identifier of this descriptor. The identifier shall be unique within an MPD.</p> <p>The attribute shall not be present if the @ref attribute is present.</p>
	@robustness	OD	<p>specifies the robustness level required for this content protection scheme for accessing content represented by the associated Representation(s). For more details refer to 5.8.4.1.2 and 5.8.4.1.6.</p> <p>If not present, then the lowest robustness level for the identified content protection scheme applies.</p>

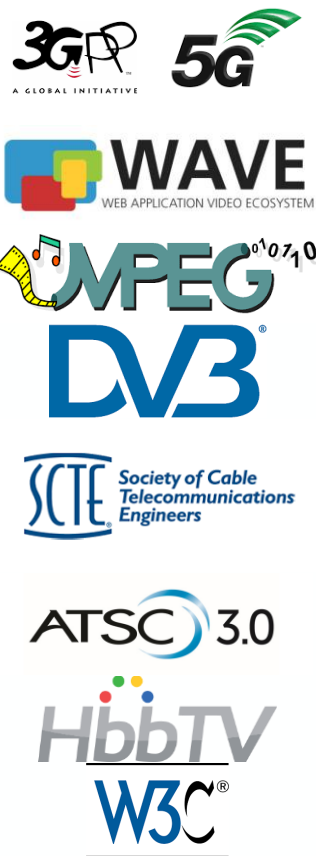
DASH-IF



Who we are?

<http://www.dashif.org>

- DASH Industry Forum (DASH-IF) was founded in 2012 to promote and catalyze the adoption of MPEG-DASH and help transition it from a specification into a real business.
- With more than 80 members, DASH-IF represents a large footprint of the ecosystem, including service providers, content delivery network operators and broadcasters, as well as technology providers in different domains, and connects the dots in an otherwise fragmented world of internet streaming services.
- DASH-IF also serves as the point of contact for other standards organizations when introducing new DASH-based distribution means.



CHARTER MEMBERS



CONTRIBUTOR MEMBERS



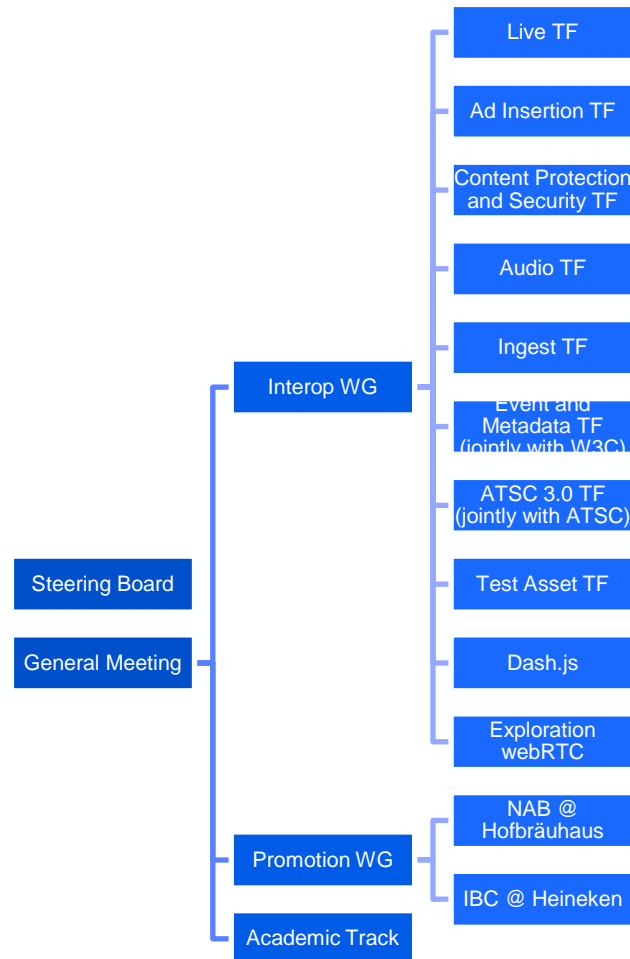
ASSOCIATE MEMBERS



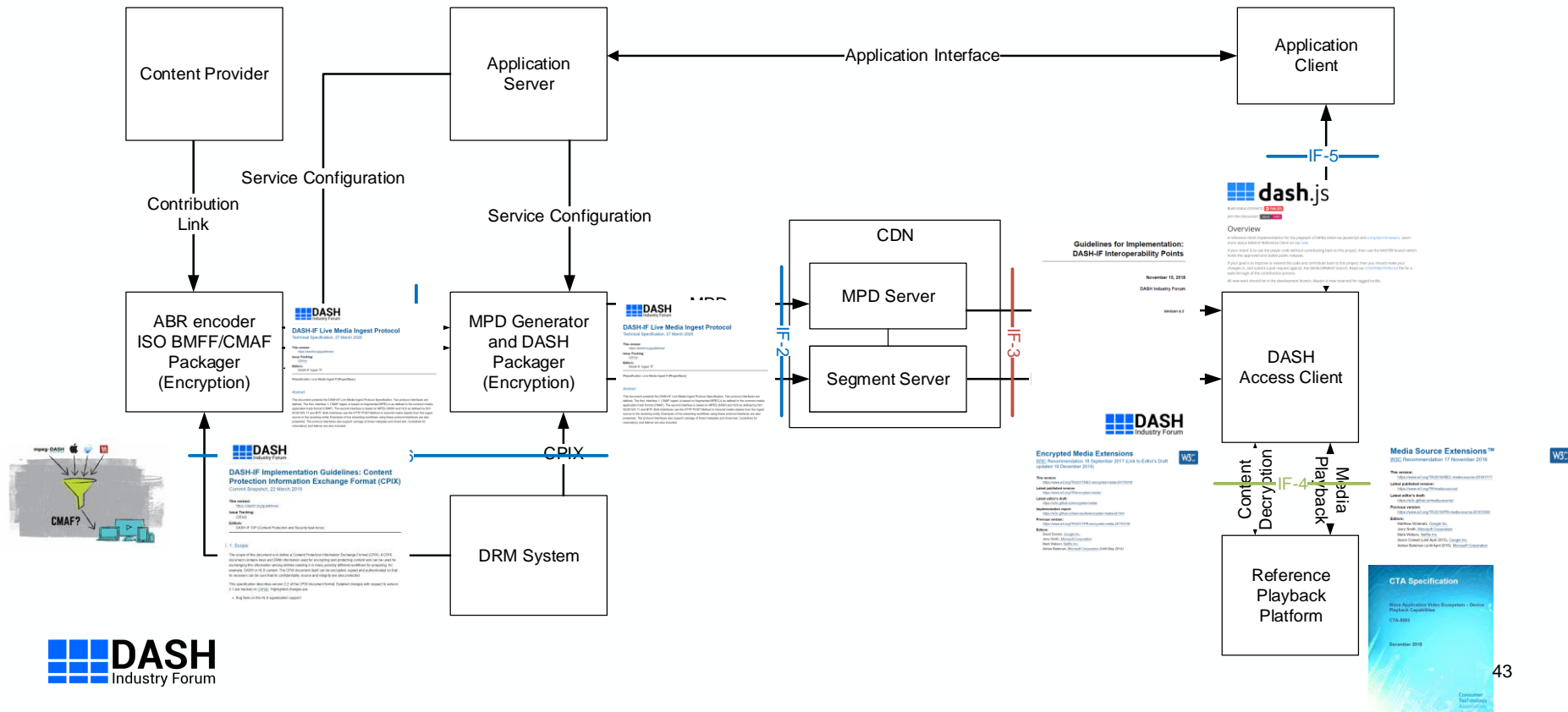
How do we operate?

We try to be lean, agile, flexible and open ...

- Weekly or bi-weekly calls in working groups and active task forces. Two annual f2f meetings.
- Development of specifications, guidelines, liaison based on work items and github issues
- Publication of guidelines through DASH-IF web page: <http://www.dashif.org>
- Community Reviews for public
- PAS Agreement with ETSI established to publish specifications.
- Commissioning and sponsoring of conformance, reference and test tools



DASH-IF IOP Guidelines



12 parts: <https://dashif.org/guidelines/iop-v5/>

Part 1: Overview, Architecture and Interfaces

Part 2: Core Principles and CMAF Mapping

Part 3: DASH On-Demand Services

Part 4: DASH Live and Low Latency Services

Part 5: Ad Insertion and Content Replacement

Part 6: Content Protection and Security

Part 7: Video

Part 8: Audio

Part 9: Text

Part 10: Events

Part 11: Additional Technologies

Part 12: Conformance and Reference Software

Low-Latency Streaming with Chunking

MPD

IS

Encoder



CH = CMAF Header

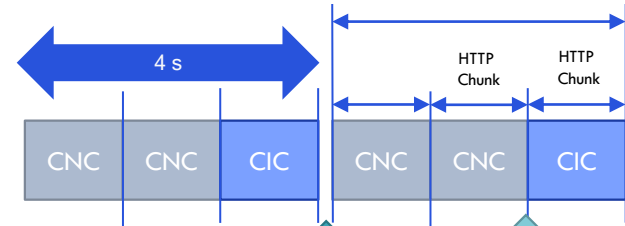
CNC = CMAF non-initial chunk

CIC = CMAF initial chunk

Many technical details are in
DASH-IF IOP v5
<http://www.dashif.org/guidelines>

Service
Description

DASH
Packager



10s

Regular
DASH
Client

3s

Low-Latency
DASH
Client

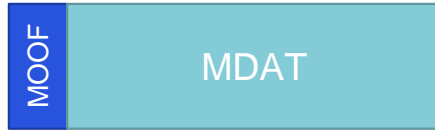
Segments

CDN stores
Segments

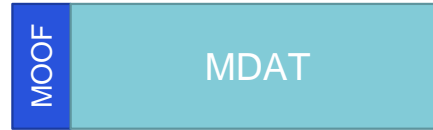
Chunks

Chunked Segment Distribution

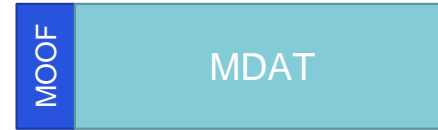
ENCODER



CDN



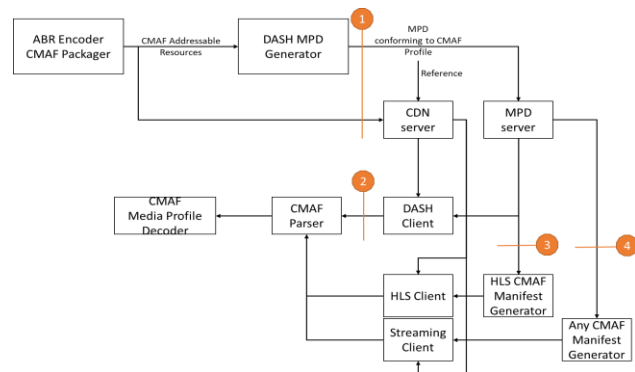
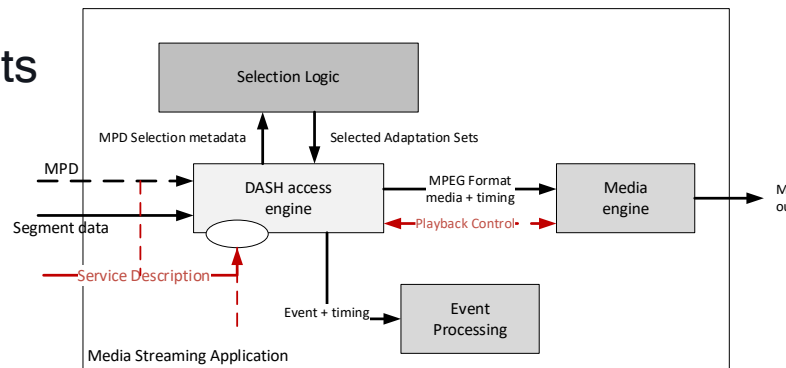
PLAYER



MPEG DASH supporting work

- As part of ISO/IEC 23009-1 4th and 5th edition
- Producer Reference Time in MPD and segments
 - Enables media encoding including wall-clock anchor times
 - Permits DASH client to determine, monitor and control latency.
- Service Description
 - Addresses service provider's influence on DASH client operation
 - Target Latencies, Playback Control
- Updates on Event Processing
- DASH Profile for CMAF Content
- Resynchronization
 - Enables chunk signaling
 - Enables fast downswitching and random access

CHANGE REQUEST					
DASH-IF IOP	CR	rev	-	Current version:	V4.3
Status: <input type="checkbox"/> Draft <input type="checkbox"/> Internal Review <input checked="" type="checkbox"/> Community Review <input type="checkbox"/> Agreed					
Title:	Low-latency Modes for DASH				
Source:	Live TF				
Supporting Companies:	Akamai, Amazon Elemental, castLabs, Comcast, Elemental Technologies, Ericsson, Frontier Communications, Harmonic, Hulu, Qualcomm Incorporated, Sony, TNO, Unified Streaming,				
Category:	A			Date:	2020-02-21



Advantages of Chunked Segments

- Legacy Player Support with the same content/infra
- CDN friendly: Cacheability and Scalability
- Decoupling of latency from segment duration
- Reuse or Automatic support of existing DVB-DASH
 - Codecs and formats
 - Common Encryption
 - Ad Insertion
 - Events
- Standards-based and promise for convergence
- Works also with ABR Multicast and Broadcast

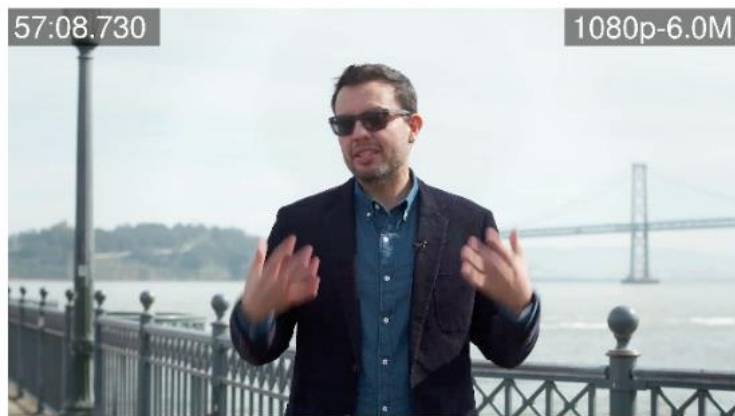


Akamai TEST PLAYER FOR CHUNK-ENCODED CHUNK-TRANSFERRED DASH (v4.3.0)

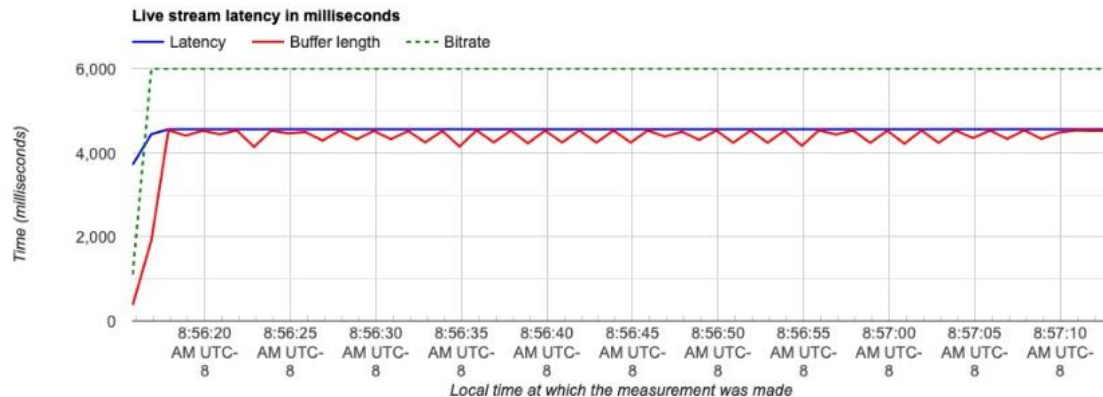
Enter the mpd to test:

Target latency in seconds:
Maximum catch-up rate (%):

START



Latency estimate: 4.556 secs
Buffer level: 4.523 secs
Startup time: 2.1 secs
Playback rate: 1
Current representation: [1920x1080](#), 29.97 fps, 6000 kbps





Other highlights

Content Protection

- MPEG CMAF format protected by MPEG CENC
- Support of key rotation
- Enhanced Clear Key Content Protection (ECCP)
- DASH-IF XML schema with elements related to content protection

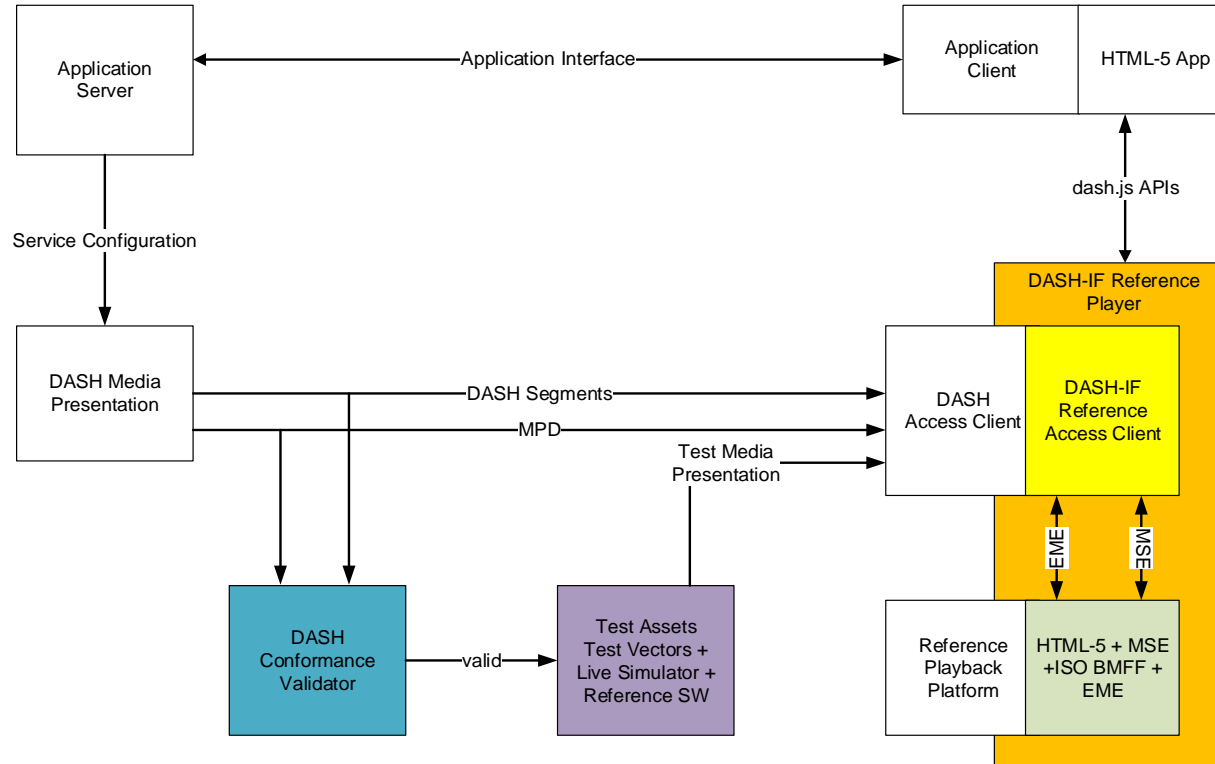
Audio/Video/Text

- Addition of CMAF Profiles
- Codecs Registration for DASH: <https://dashif.org/codecs/introduction/>

Updates to Ingest specifications

- Encoder synch based on epoch lock
- Manifest description/restriction for CMAF ingest
- Encoder input loss and last segment signaling
- MPEG-B part 18 support and other improvements signaling emsg and timed metadata
- Example reference implementation (e.g., FFmpeg)
- Segment per post, several other media restrictions usage of common encryption
- Deprecate some smooth legacy (mfra, Streams(), etc.)

More than just specs: Test, Reference and Conformance



Dash.js by Numbers

261

Github watchers

1500

Github forks

1100

Github projects
that use dash.js

4.2k

Github Stars

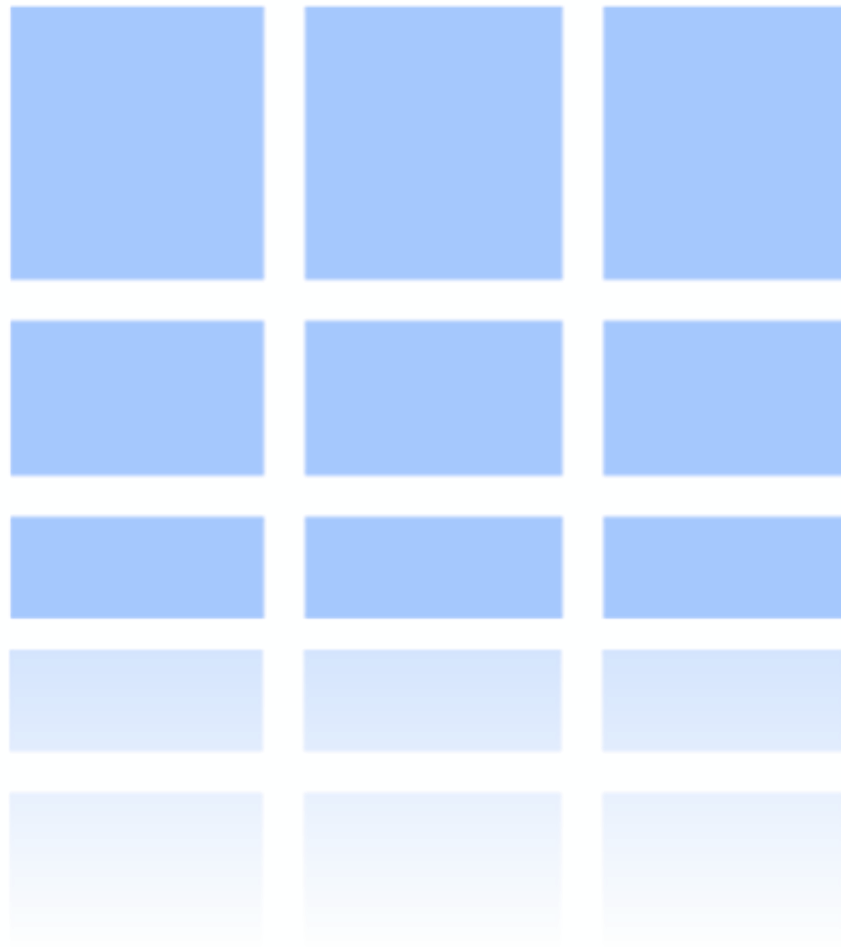
159

Github
contributors

42

releases

What's next?



MPEG and DASH-IF

MPEG Amd.1

- Alternative MPD Events for Server Guided Ad Insertion
- Nonlinear playback
- Addressable Resource Index Track
- DASH Period Event

DASH-IF

- Content Steering
- Low-Latency and Fast Joining using Addressable Resync Representations
- Server Guided Ad Insertion
- Server-based Watermarking
- DASH and webRTC streaming

Input from other organizations

- CTA WAVE and CMAF
- 3GPP, 5G-MAG, DVB and ATSC

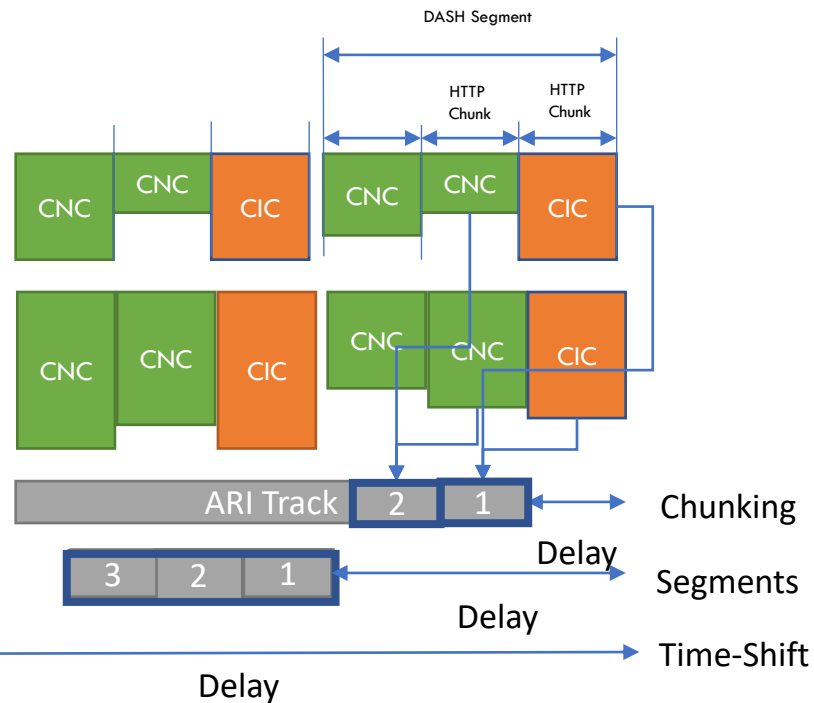
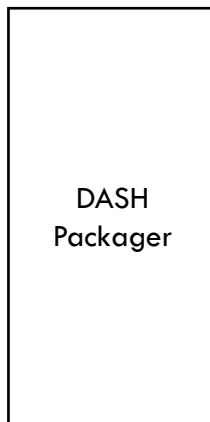
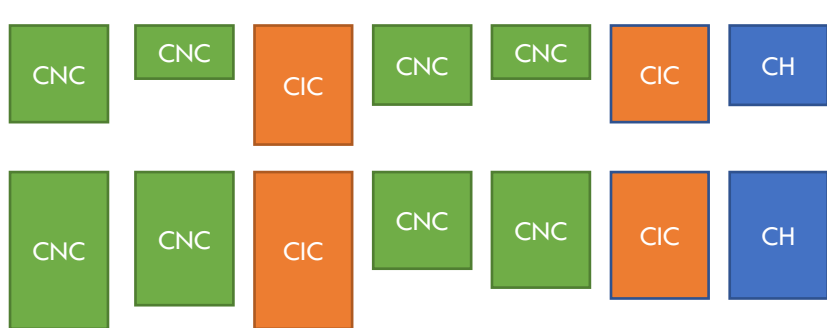
MPEG, Emmy MPEG-DASH

ARI Track

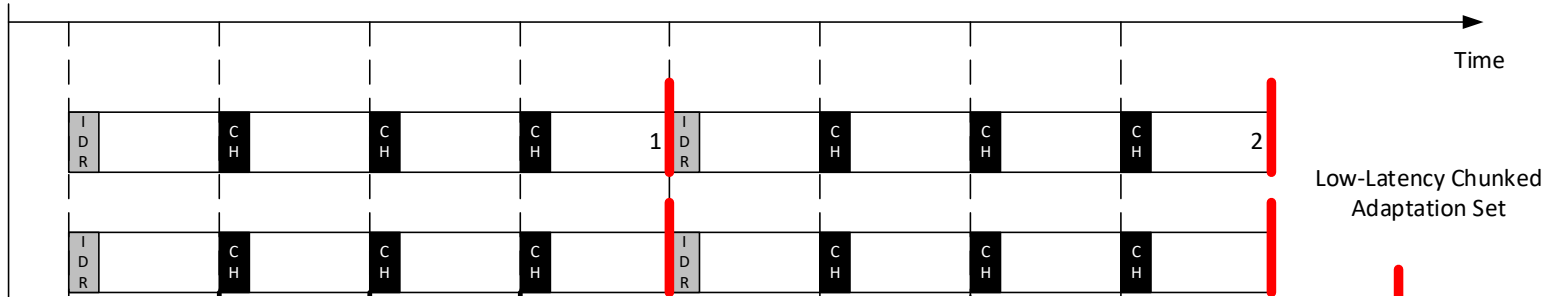
- The ARI Track is time-aligned with the tracks of the CMAF Switching Set.
- The ARI Track documents properties of all tracks of the CMAF Switching Set
- One sample represents a CMAF chunk in a time-aligned manner.
- The sample contains detailed information for the chunk in each of the tracks in the switching set
 - size, timing, SAP types, quality, predictive bitrate into the future
- This track may even be used to carry for example Events or Producer Reference time for the Media Presentation.
- A client may use the Track for fast random access, optimized scheduling, variable bitrate streaming.
- The ARI Track may also be used by network entities to predict bitrate

ARI Track in live mode

Encoder



Addressable Resync Representation



Issues:

- If in low-latency operation, client may need to down-switch
- When joining, client may have to wait for segment boundary
- In seek mode, the segment duration determines the frequency

Idea:

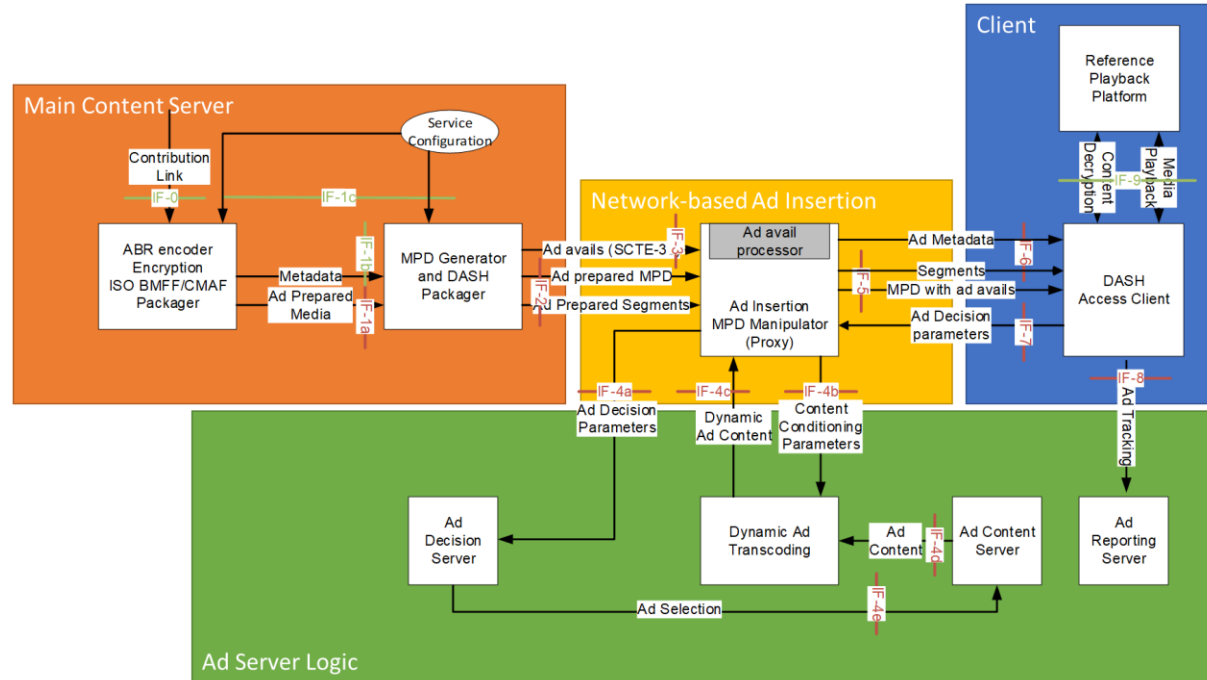
- Add dedicated Addressable Resync representations into Adaptation Sets
- In combination with ARI Track, even more advanced operation possible

Content Steering

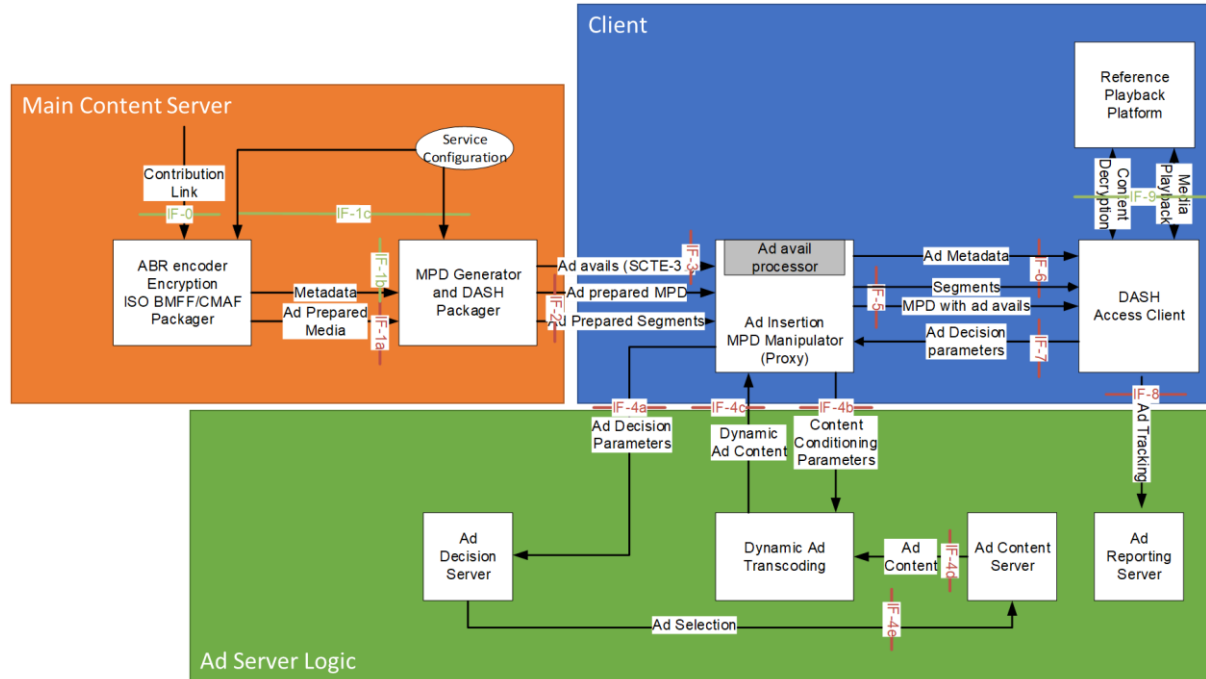
```
<MPD xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="urn:mpeg:dash:schema:mpd:2011"
xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 DASH-MPD.xsd" type="dynamic" minimumUpdatePeriod="PT30S"
timeShiftBufferDepth="PT30M" availabilityStartTime="2022-02-25T12:30:00" minBufferTime="PT4S"
profiles="urn:mpeg:dash:profile:isoff-live:2011">
  <ContentSteering defaultServiceLocation="beta"
queryBeforeStart="true">https://steeringservice.com/app/instance12345</ContentSteering>
  <BaseURL serviceLocation="alpha">https://cdn1.example.com/</BaseURL>
  <BaseURL serviceLocation="beta">https://cdn2.example.com/</BaseURL>
  <Period id="1">
    <AdaptationSet mimeType="video/mp4" codecs="avc1.4D401F" frameRate="30000/1001" segmentAlignment="true" startWithSAP="1">
      <BaseURL>video/</BaseURL>
      ...
    </AdaptationSet>
  </Period>
</MPD>
```

```
{
  "VERSION": 1,
  "TTL": 250,
  "RELOAD-URI": "https://steeringservice.com/instance12345?session=abc"
  "PATHWAY-PRIORITY": ["alpha", "beta"]
}
```

Server Guided Ad Insertion



Server Guided Ad Insertion





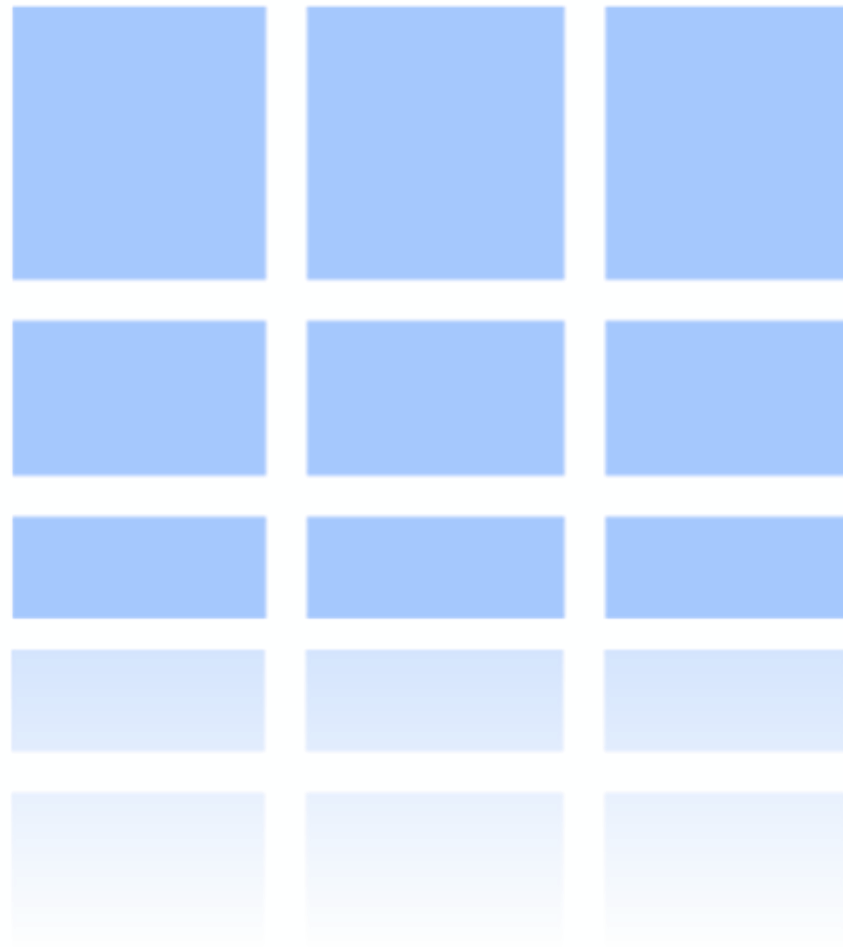
DASH and webRTC

- On March 1st, 2022, DASH-IF published a first [report on combining DASH and webRTC-based streaming](#).
- This report describes use cases made possible by integrating WebRTC Streaming into the DASH workflows as well as the technical considerations that should be taken into account in order to achieve successful integration. The document is primarily informative and information-collecting.
- It serves as a preparation and guidance for future technical work in the context of DASH and webRTC-based Streaming.
- The report was developed by public collaboration under the auspices of DASH-IF in an [exploration TF](#) lead by [Julia Kenyon](#) and [Ali C. Begen](#).
- Any comments may be submitted through the [github issues](#).
- Based on these recommendations, along with the report, DASH-IF also launched a [survey on potential next steps](#) - please respond by April 15, 2022.

Selected other presentations and posters

1. "Overview of the DASH-HLS Interoperability Specification, 2021 Edition", Zachary Cava (Disney Streaming)
2. "Session-Based DASH Streaming: A new MPEG standard for customizing DASH streaming per session", Iraj Sodagar (Tencent America); Alex Giladi (Comcast)
3. "Latest Advances in the Development of the Open-Source Player dash.js", Daniel Silhavy, Stefan Pham, Stefan Arbanowski, Stephan Steglich (Fraunhofer FOKUS); Bjoern Harrer (Deutsche Telekom AG)
4. "Extend CMAF Usage for Large Scale Video Delivery", Lucas Gregory, Khaled Jerbi, Mickael Raulet, Eric Toullec (ATEME)
5. "Marrying WebRTC and DASH for Interactive Streaming", Julia Kenyon (Phenix RTS); Thomas Stockhammer (Qualcomm); Ali C. Begen (Ozyegin University / Networked Media); Ofer Shem Tov (Edgecast); Louay Bassbouss, Daniel Silhavy (Fraunhofer FOKUS)

Wrap up



Market Adoption

- DASH used in major companies, very much so in Europe.
- Which of the top 10 broadcasters in any country are not using DASH?
- In the US, HLS is still quite dominant, but DASH/HLS convergence accelerates DASH
- Questions about license and royalty fees for DASH seemed to have vanished.
- Significant adoption in application standards: DVB, HbbTV, SCTE, ATSC, 5G, TV 3.0

DASH is a collaborative effort

- Not a single sponsor
- Coordination across SDOs
- Very mature for large scale deployments
- Still full of ideas and innovation
- Please join us in DASH-IF <http://dashif.org>



Thank
you

