# MPEG's Dynamic Adaptive Streaming over HTTP (DASH) – Enabling Formats for Video Streaming over the Open Internet

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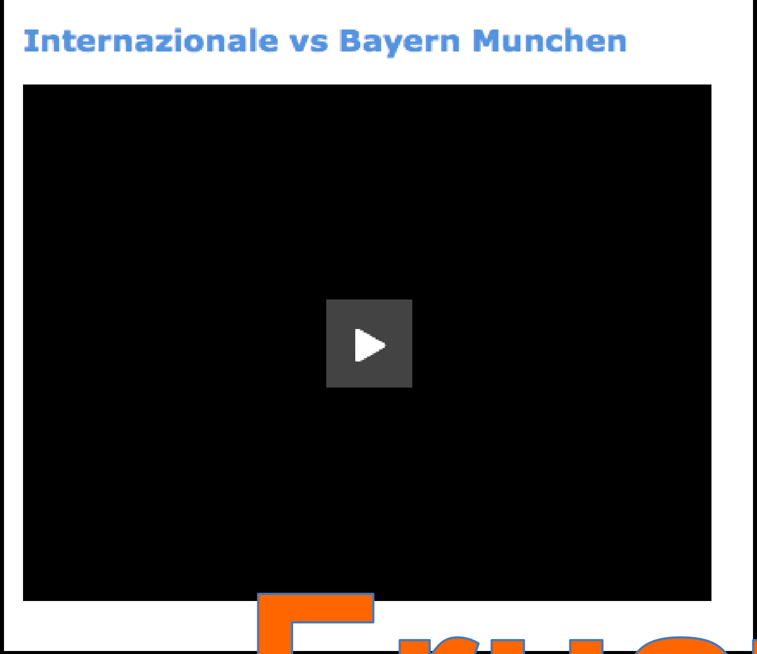
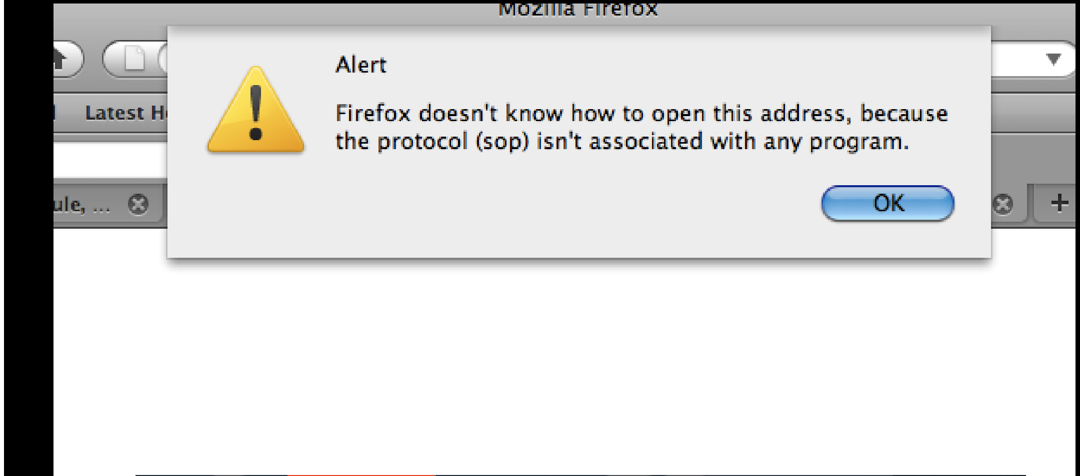
Qualcomm Incorporated

Webinar at EBU - Nov 22, 2011



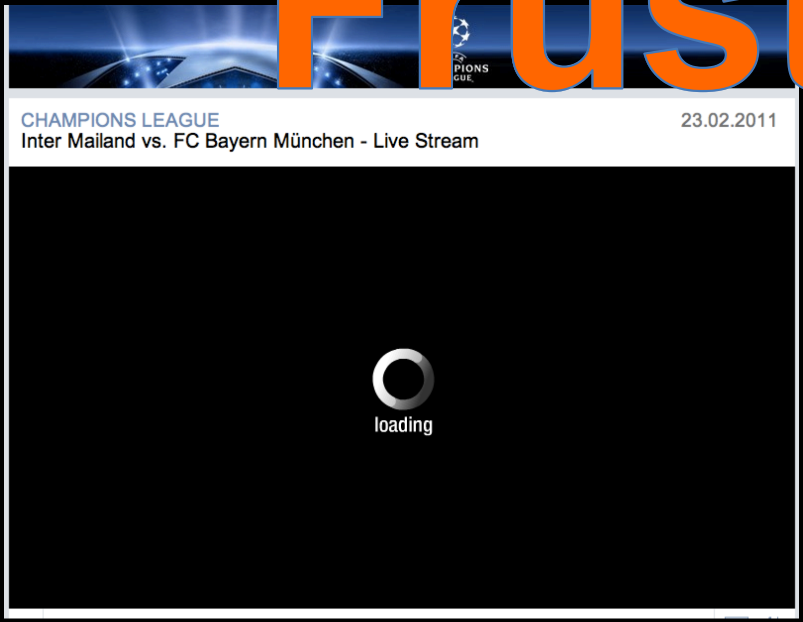
Internazionale vs Bayern Munchen



Alert

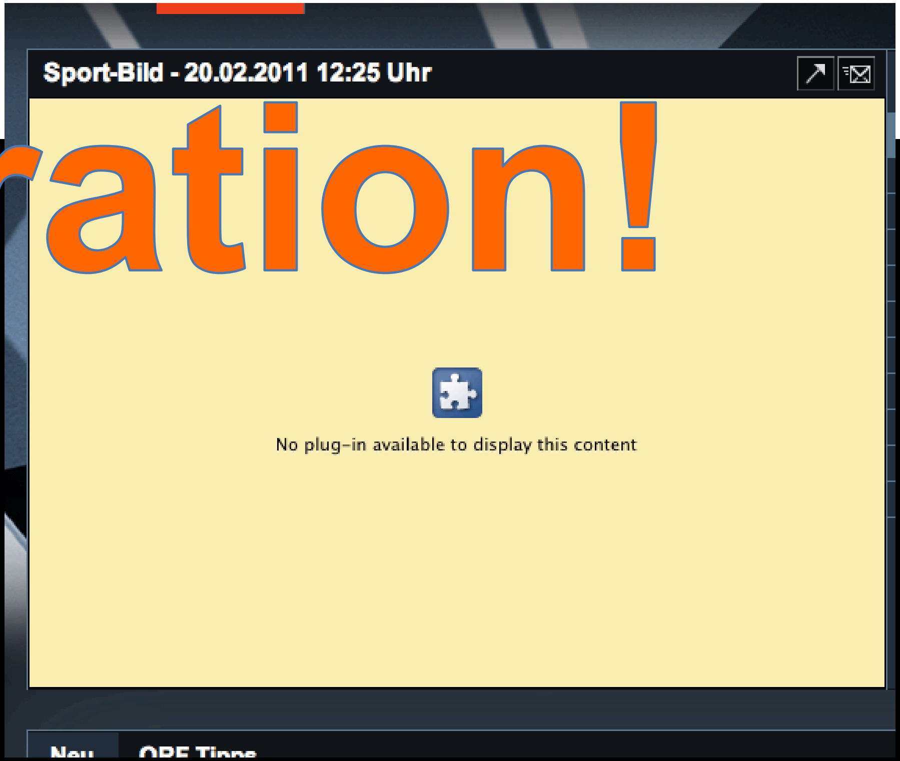
Firefox doesn't know how to open this address, because the protocol (sop) isn't associated with any program.

# Frustration!



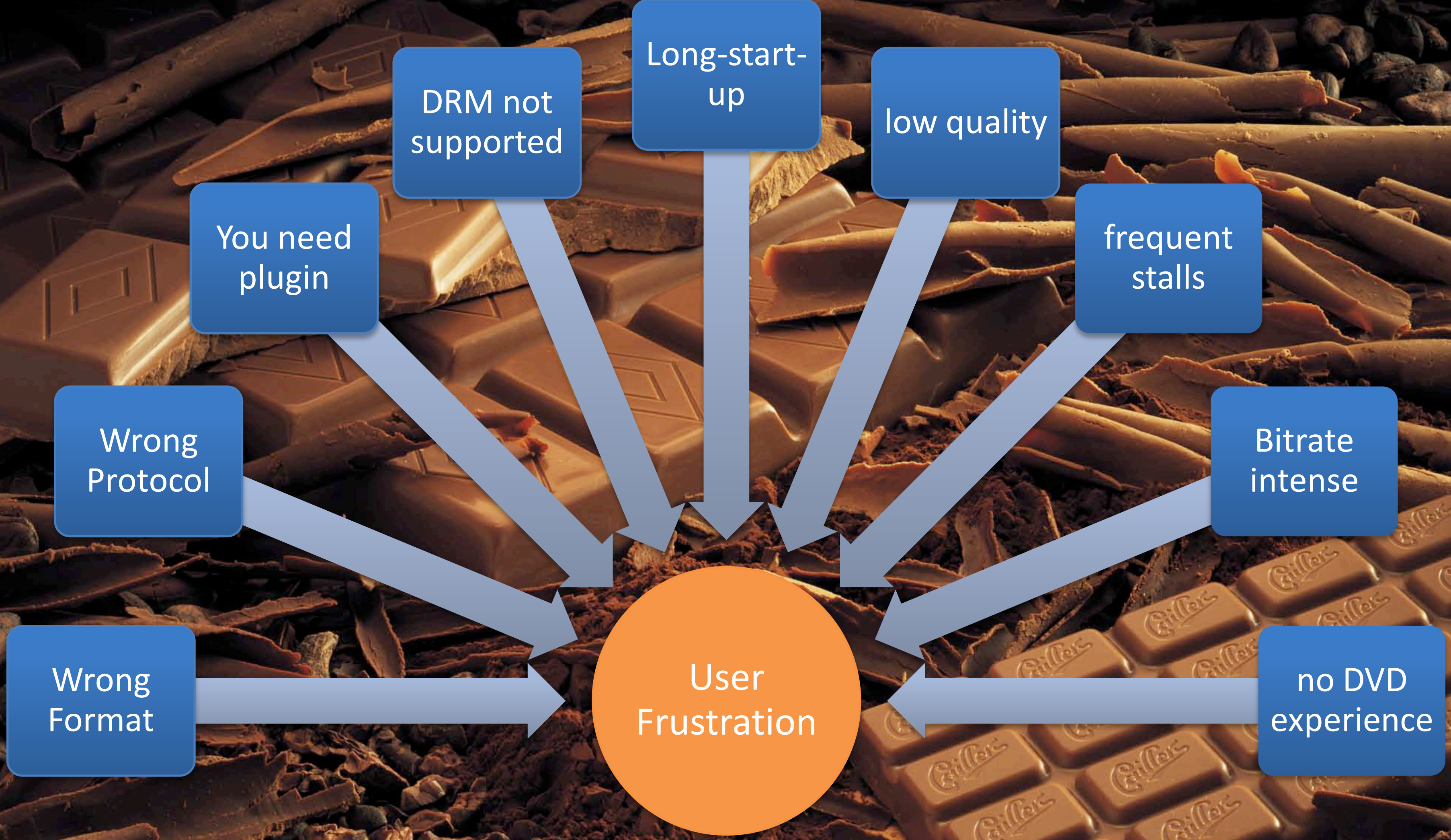
CHAMPIONS LEAGUE 23.02.2011

Inter Mailand vs. FC Bayern München - Live Stream



Sport-Bild - 20.02.2011 12:25 Uhr

No plug-in available to display this content



Wrong Format

Wrong Protocol

You need plugin

DRM not supported

Long-start-up

low quality

frequent stalls

Bitrate intense

no DVD experience

User Frustration

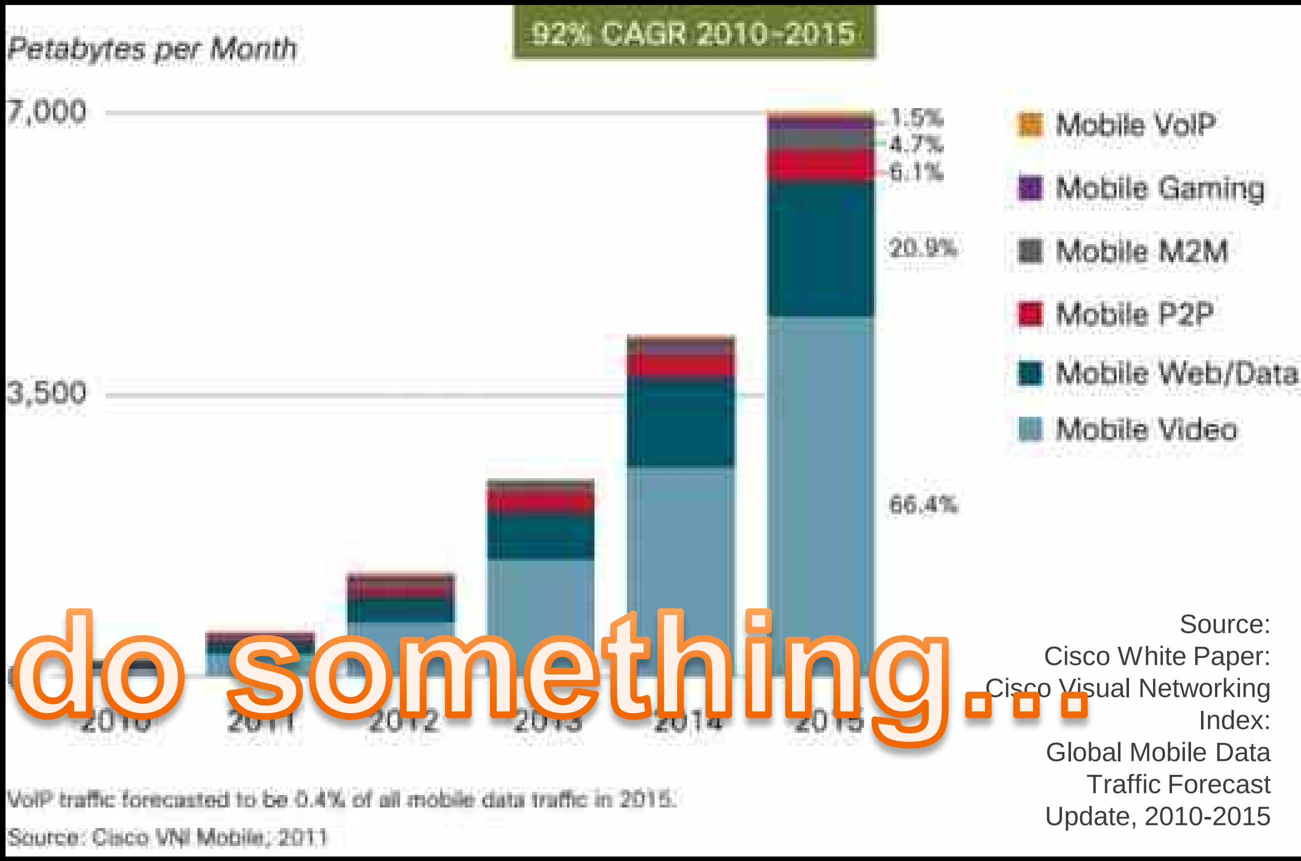
let‘s do something...

# Video is dominating the Internet

- Internet: Real-time video is 50% of the traffic at peak periods
  - notably 30% from Netflix and 11% from Youtube
- Mobile: Video traffic is growing exponentially & is a large portion.

every year mobile video traffic doubles

66% mobile video by 2015

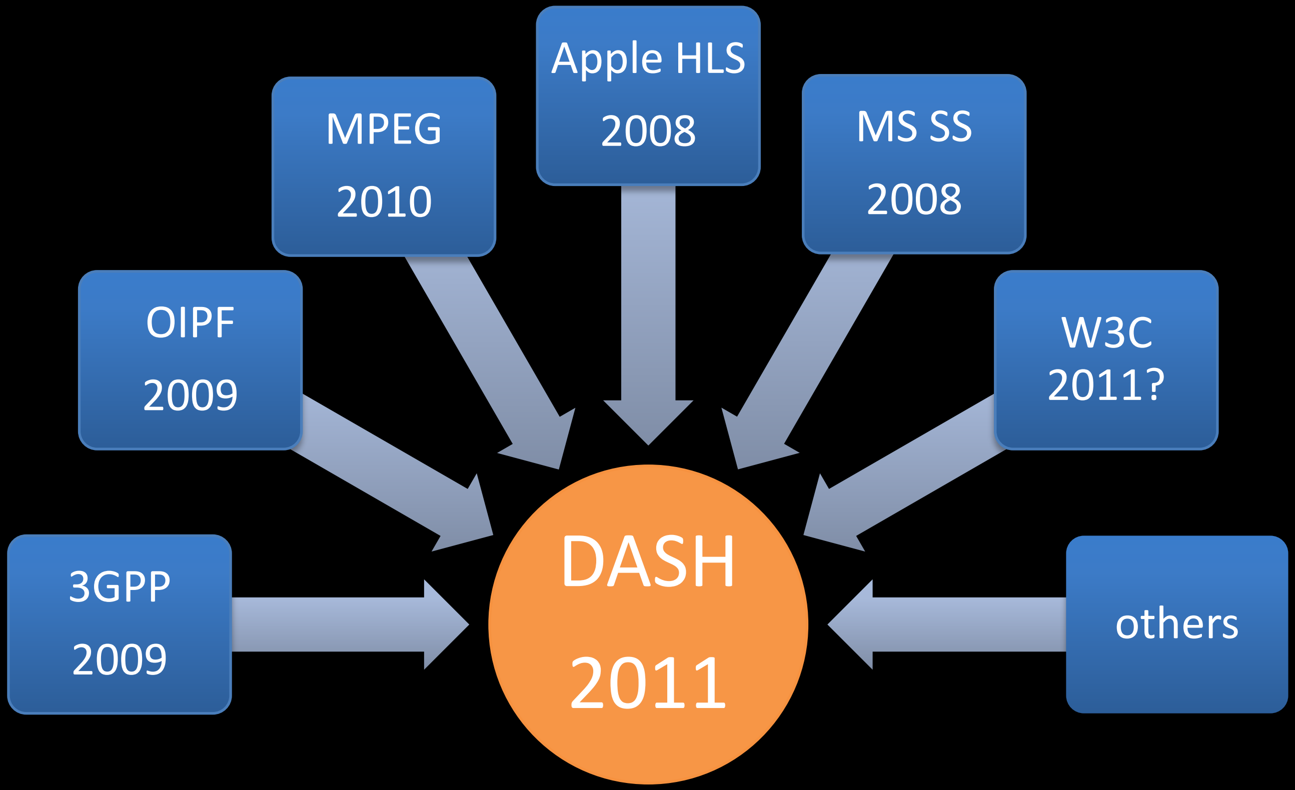


VoIP traffic forecasted to be 0.4% of all mobile data traffic in 2015.

Source: Cisco VNI Mobile, 2011

Source:
Cisco White Paper:
Cisco Visual Networking Index:
Global Mobile Data Traffic Forecast Update, 2010-2015

let's do something...



Apple HLS 2008

MPEG 2010

MS SS 2008

OIPF 2009

W3C 2011?

3GPP 2009

others

DASH 2011

Confidence

Open Standard Delivery Format

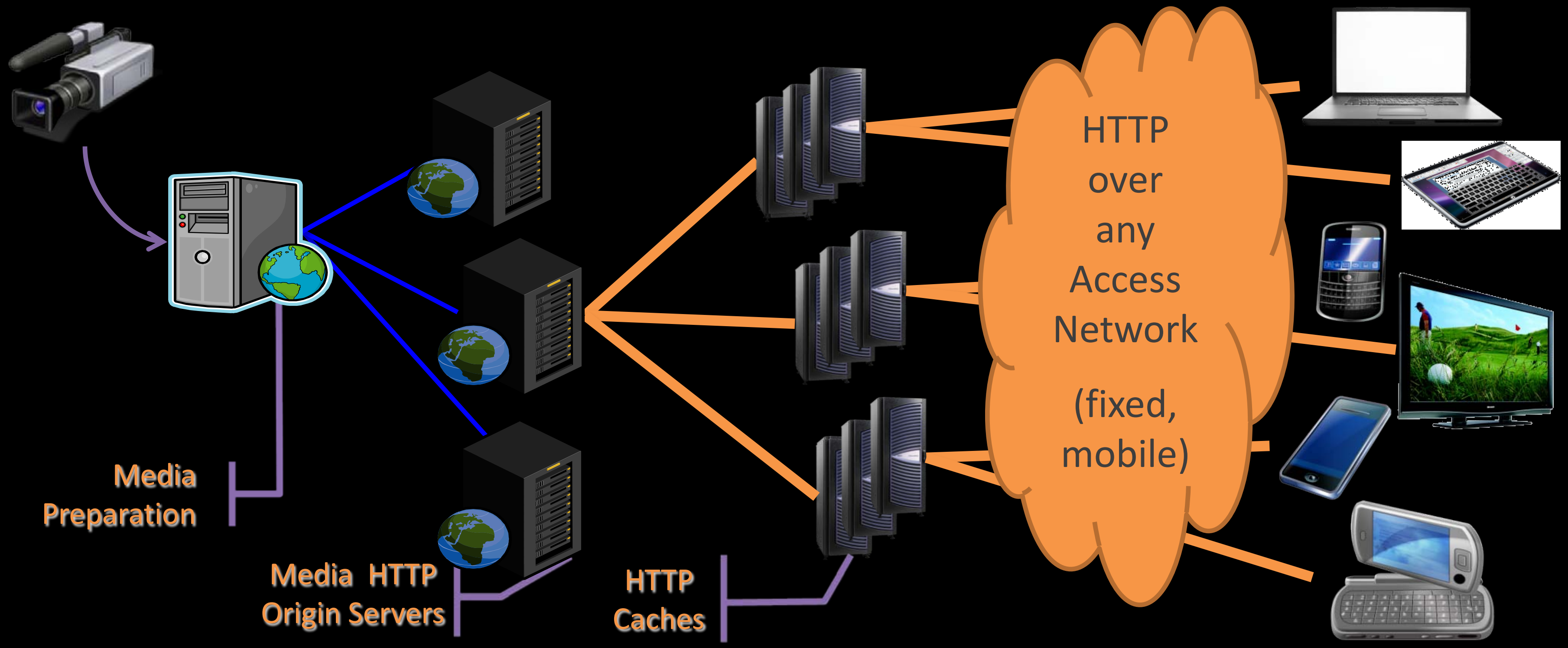
# MPEG DASH ISO/IEC 23009-1

- MPEG DASH ISO/IEC 23009-1 technically frozen in August 2011
- Timeline and Activities
  - ISO/IEC 23009-1 known as MPEG-DASH has been ratified unanimously by positive votes from 26 National bodies in November 2011 pending minor editorial improvements.
  - Editorial updates during MPEG#98 and processing at ITTF such that expected publication of standard in March 2012.
  - Parallel approval process for extensions to
    - ISO base media FF to support DASH 14496-12/AMD 3
    - Common Encryption 23001-7
  - Continuous coordination with 3GPP and other SDOs (DECE, OIPF, etc.)
  - Conformance and Reference Software activities kicked off (see WD 23009-2)
- Good news: Converging standard for adaptive streaming on the way

**Convergence = Confidence**

# DASH in a Nutshell

- **What**: Video streaming solution where small pieces of video streams/files are requested with HTTP and spliced together by the client. Client entirely controls delivery.
- **Why**: reuse widely deployed standard HTTP servers/caches for scalable delivery, e.g. existing Internet CDNs; traverse NAT/Firewalls; simple rate adaptation; fixed-mobile convergence; convergence of services, etc.
- **Use case**: Accessing OTT video streaming services over any access network to any device



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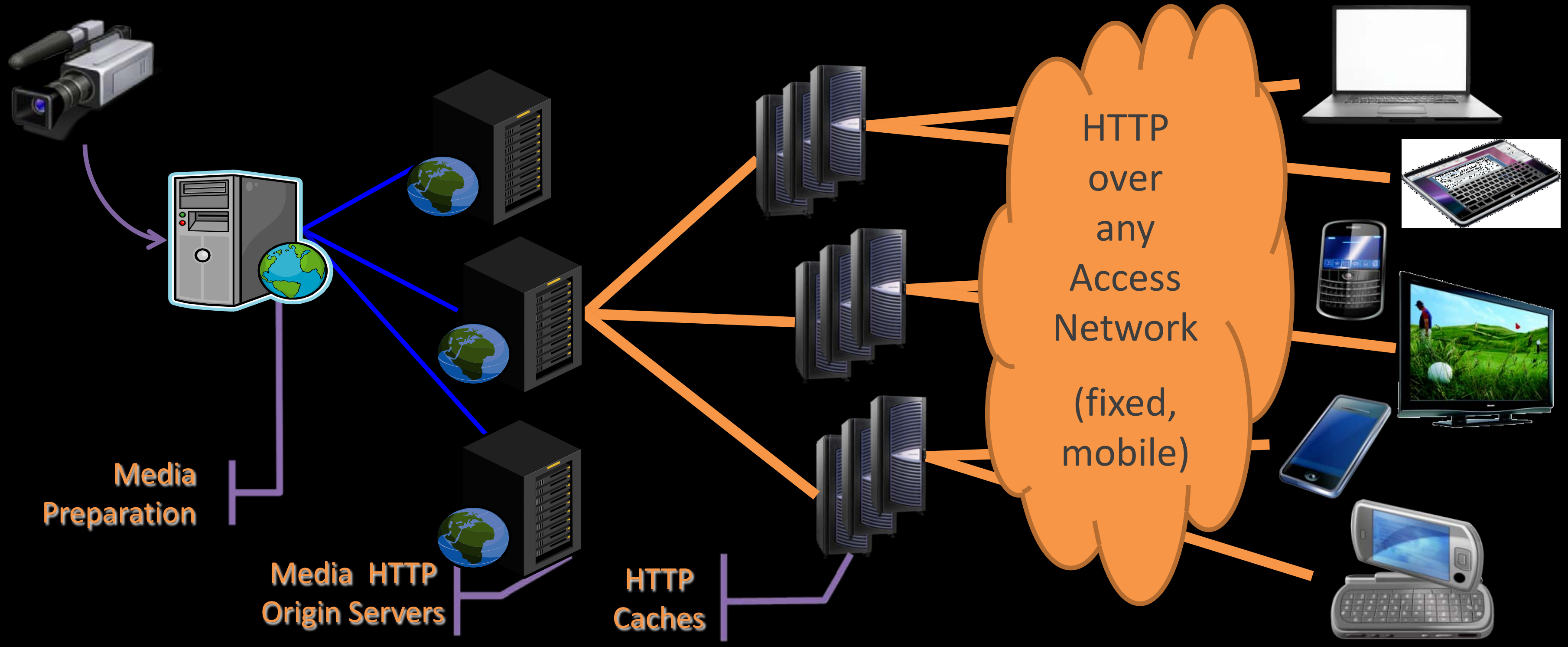
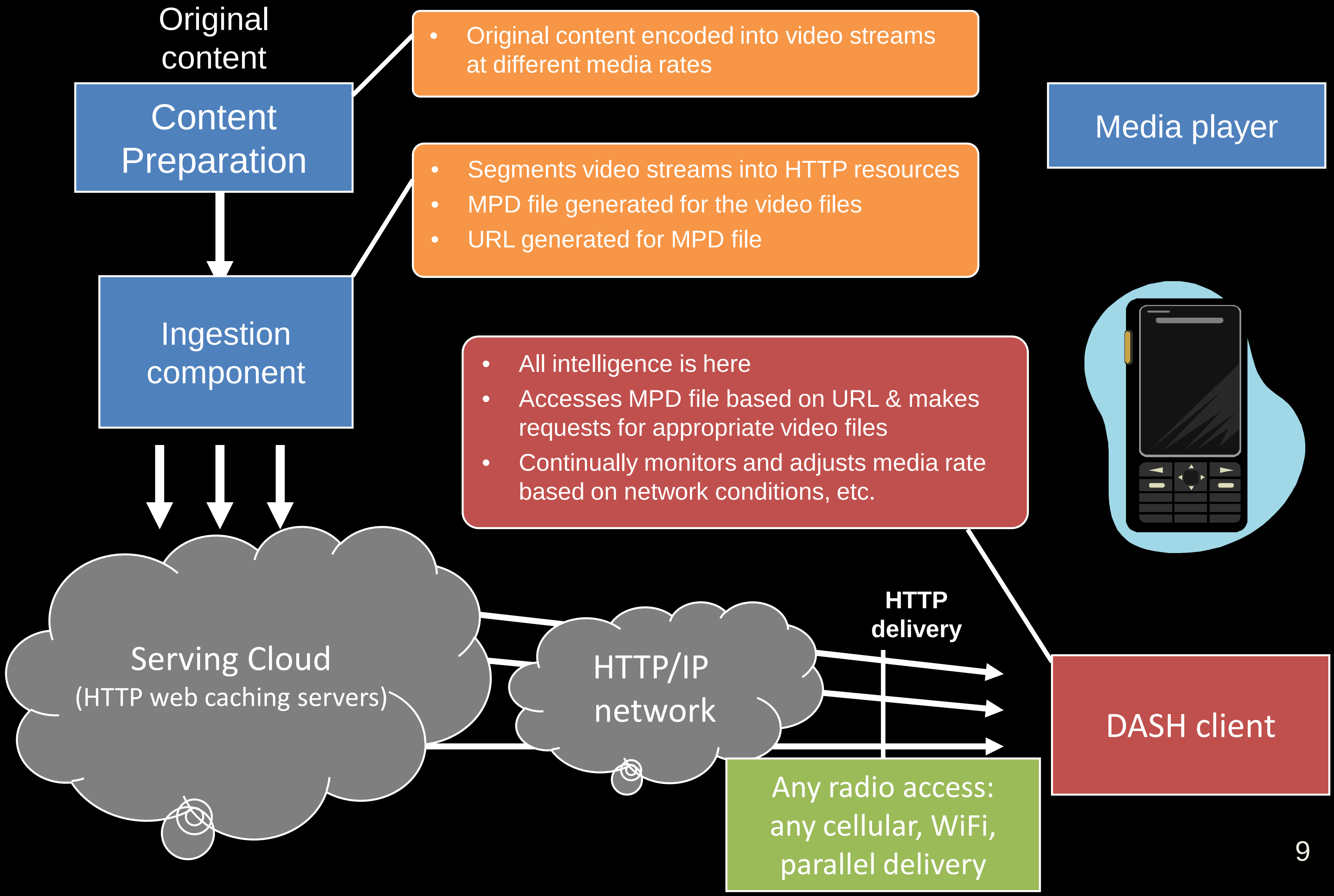


HTTP over any Access Network (fixed, mobile)
Media Preparation
Media HTTP Origin Servers
HTTP Caches

# Example Deployment Architecture



Original content

Content Preparation

- Original content encoded into video streams at different media rates

Ingestion component

- Segments video streams into HTTP resources
- MPD file generated for the video files
- URL generated for MPD file

Media player

- All intelligence is here
- Accesses MPD file based on URL & makes requests for appropriate video files
- Continually monitors and adjusts media rate based on network conditions, etc.

Serving Cloud
(HTTP web caching servers)

HTTP/IP network

HTTP delivery

DASH client

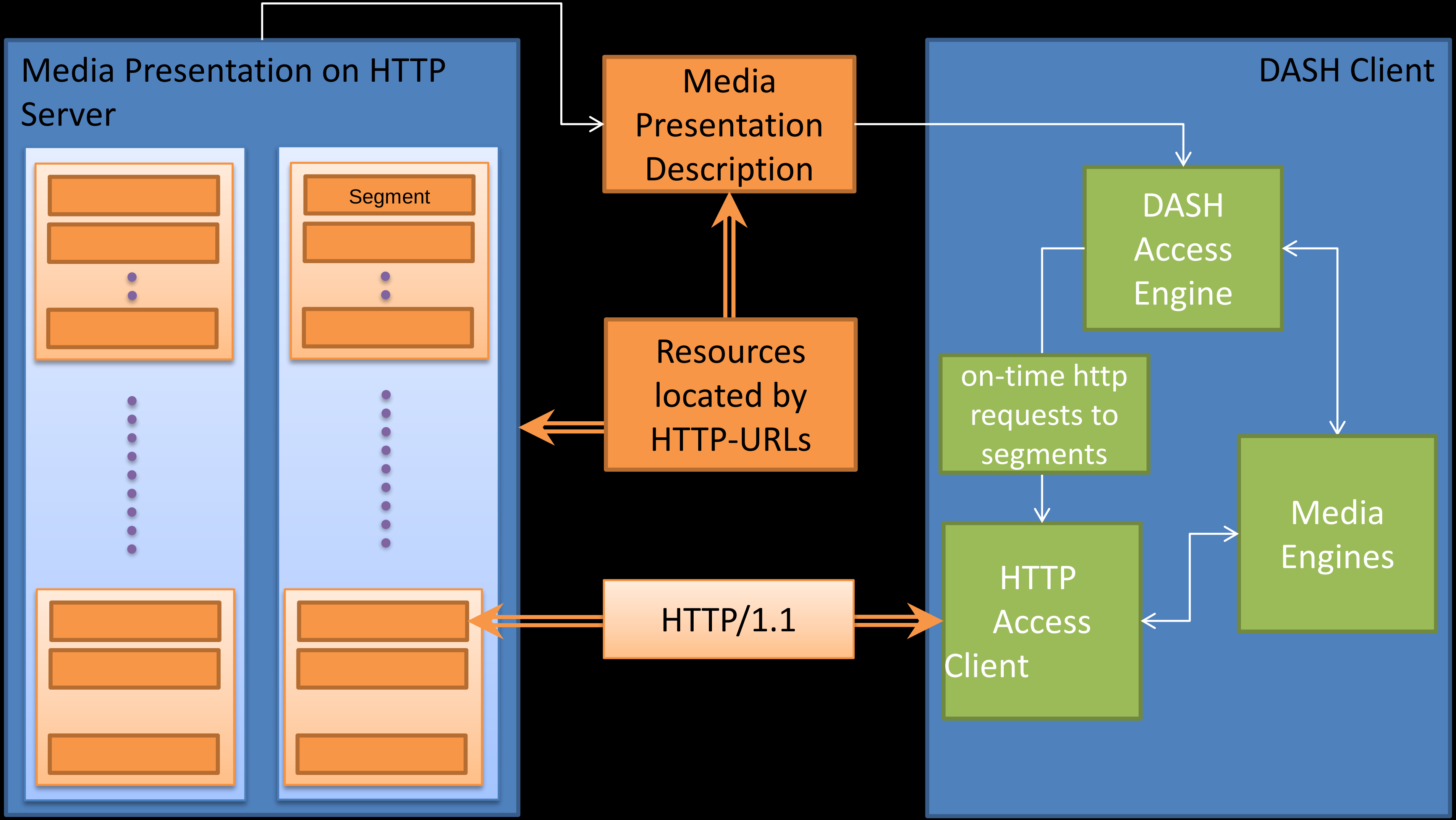
Any radio access: any cellular, WiFi, parallel delivery

# (Some) DASH Design Principles

- DASH is not:
  - system, protocol, presentation, codec, middleware, client specification
- DASH is an enabler
  - provides formats to enable efficient and high-quality delivery of streaming services over the Internet considered as one component in an e2e service
  - System definition left to other organizations (SDOs, Fora, Companies, etc.)
- It attempts to be very good in what is to be addressed by the standard
  - Enables reuse of existing technologies (containers, codecs, DRM etc.)
  - Enables deployment on top of HTTP-CDNs (Web Infrastructures, caching)
  - Enables very high user-experience (low start-up, no rebuffering, trick modes)
  - Enables selection based on network and device capability, user preferences
  - Enables seamless switching
  - Enables live and DVD-kind of experiences
  - addresses global and regulatory deployment issues
  - Moves intelligence from network to client, enables client differentiation
  - Enables deployment flexibility (e.g., live, on-demand, time-shift viewing)
  - Provide simple interoperability points (profiles)
  - provides convergence with existing proprietary technologies in this space

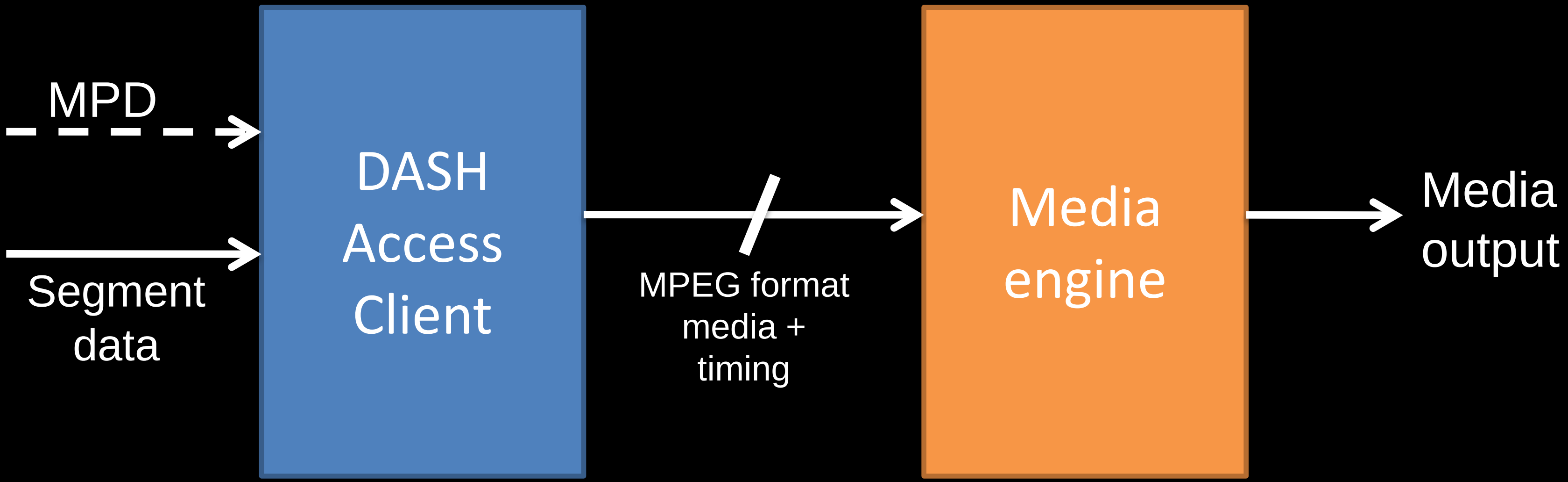
# MPEG DASH SPECIFICATION INSIGHTS

# What is specified – and what is not?


Media Presentation on HTTP Server
Segment
Media Presentation Description
Resources located by HTTP-URLs
HTTP/1.1
DASH Client
DASH Access Engine
on-time http requests to segments
HTTP Access Client
Media Engines

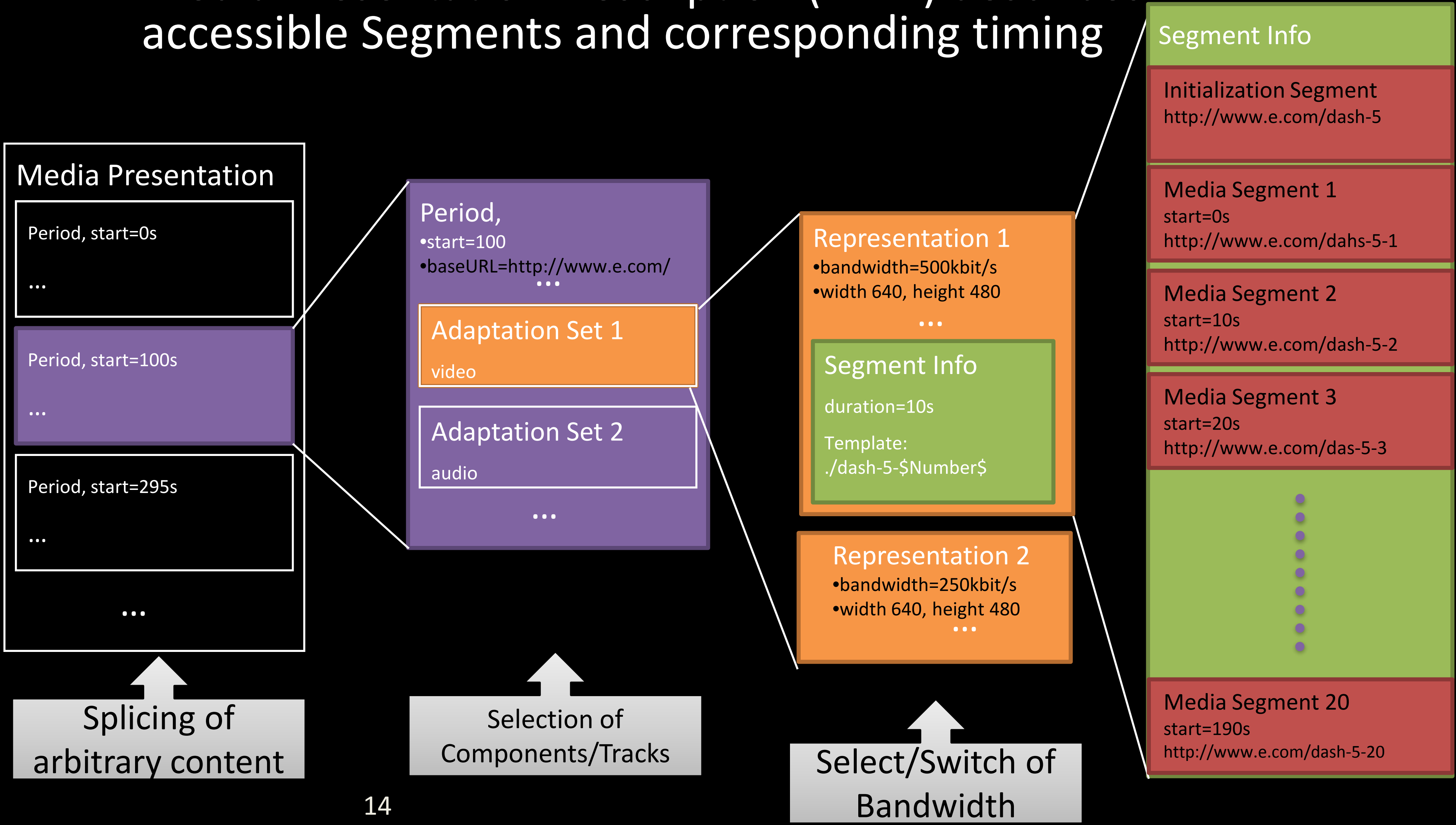
# Information Classification

- MPD and Index Information for DASH Access client
  - Core specification aspects of DASH
- Initilialisation and Media Segments for Media engine
  - Reuse of existing container formats and easy conversion
  - Small adaptations may be necessary for usage in DASH



# Media Presentation Data Model

- Media Presentation Description (MPD) describes accessible Segments and corresponding timing



Media Presentation

Period, start=0s
…

Period, start=100s
…

Period, start=295s
…

…

Period,
•start=100
•baseURL=http://www.e.com/
…

Adaptation Set 1
video

Adaptation Set 2
audio

…

Representation 1
•bandwidth=500kbit/s
•width 640, height 480
…

Segment Info
duration=10s
Template:
./dash-5-$Number$

Representation 2
•bandwidth=250kbit/s
•width 640, height 480
…

Segment Info

Initialization Segment
http://www.e.com/dash-5

Media Segment 1
start=0s
http://www.e.com/dahs-5-1

Media Segment 2
start=10s
http://www.e.com/dash-5-2

Media Segment 3
start=20s
http://www.e.com/das-5-3

Media Segment 20
start=190s
http://www.e.com/dash-5-20

Splicing of arbitrary content

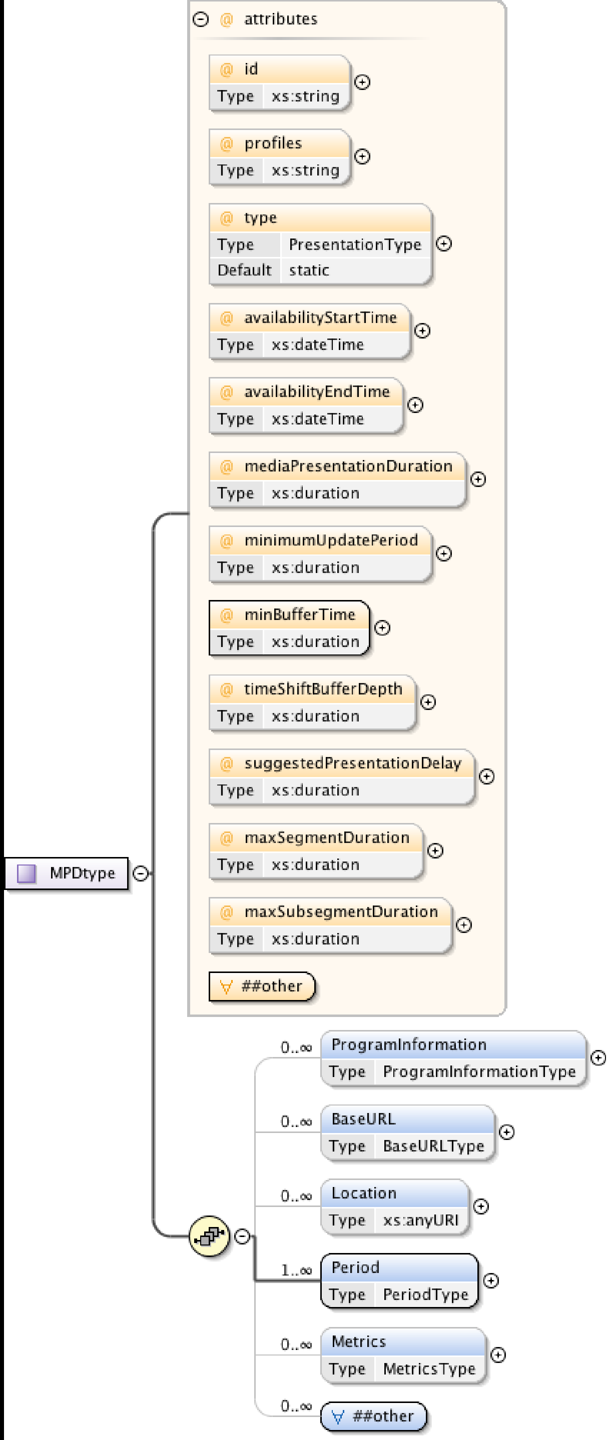
Selection of Components/Tracks

Select/Switch of Bandwidth

# MPD Information

- Redundant information of Media Streams for the purpose to initially select or reject Adaptation Sets/Representations
  - Examples: Role, Codec, DRM, language, resolution, bandwidth
- Access and Timing Information
  - the HTTP-URL(s) and byte range for each accessible Segment
  - the earliest next update of the MPD on the server
  - the segment availability start and end time in wall-clock time
  - the approximated presentation start time and duration of a Media Segment in the media presentation timeline
  - for live service, playout start instructions such that segments will be available in time for fluent playout in the future
- Switching and splicing relationships across Representations
- not much more …

| Element or Attribute Name | Use | Description |
|---|---|---|
| **MPD** | | The root element that carries the Media Presentation Description for a Media Presentation. |
| @id | O | specifies an identifier for the Media Presentation. It is recommended to use an identifier that is unique within the scope in which the Media Presentation is published. |
| @profiles | O | specifies a the list of Media Presentation profiles as described in 8.<br>The contents of this attribute shall conform to either the `pro-simp` or `pro-fancy` productions of RFC6381, Section 4.5, without the enclosing `DQUOTE` characters.<br>As profile identifier the URI defined for the conforming Media Presentation profiles as described in 8 shall be used. |
| @type | OD<br>default: `static` | specifies whether the Media Presentation Description may be updated (`@type="dynamic"`) or not (`@type="static"`).<br>NOTE Static MPDs are typically used for On-Demand services, whereas dynamic MPDs are used for live services. |
| @availabilityStartTime | CM<br>Must be present for `@type='dynamic'` | For `@type='dynamic'` this attribute shall be present. In this case it specifies the anchor for the computation of the earliest availability time (in UTC) for any Segment in the Media Presentation.<br>For `@type="static"` if present, it specifies the Segment availability start time for all Segments referred to in this MPD. If not present, all Segments described in the MPD shall become available at the time the MPD becomes available. |
| @availabilityEndTime | O | specifies the latest Segment availability end time for any Segment in the Media Presentation. When not present, the value is unknown. |
| @mediaPresentationDuration | CM<br>Must be present for `@type='static'` | specifies the duration of the entire Media Presentation. If the attribute is not present, the duration of the Media Presentation is unknown. In this case the attribute **MPD**`@minimumUpdatePeriod` shall be present.<br>This attribute shall be present when the attribute **MPD**`@minimumUpdatePeriod` is not present. |
| @minimumUpdatePeriod | O | If this attribute is present, it specifies the smallest period between potential changes to the MPD. This can be useful to control the frequency at which a client checks for updates.<br>If this attribute is not present it indicates that the MPD does not change.<br>If **MPD**`@type` is `'static'`, `@minimumUpdatePeriod` shall not be present.<br>Details on the use of the value of this attribute are specified in 5.3. |
| @minBufferTime | M | specifies a common duration used in the definition of the Representation data rate (see `@bandwidth` attribute in 5.5.5.2). |
| @timeShiftBufferDepth | O | specifies the duration of the time shifting buffer that is guaranteed to be available for a Media Presentation with |



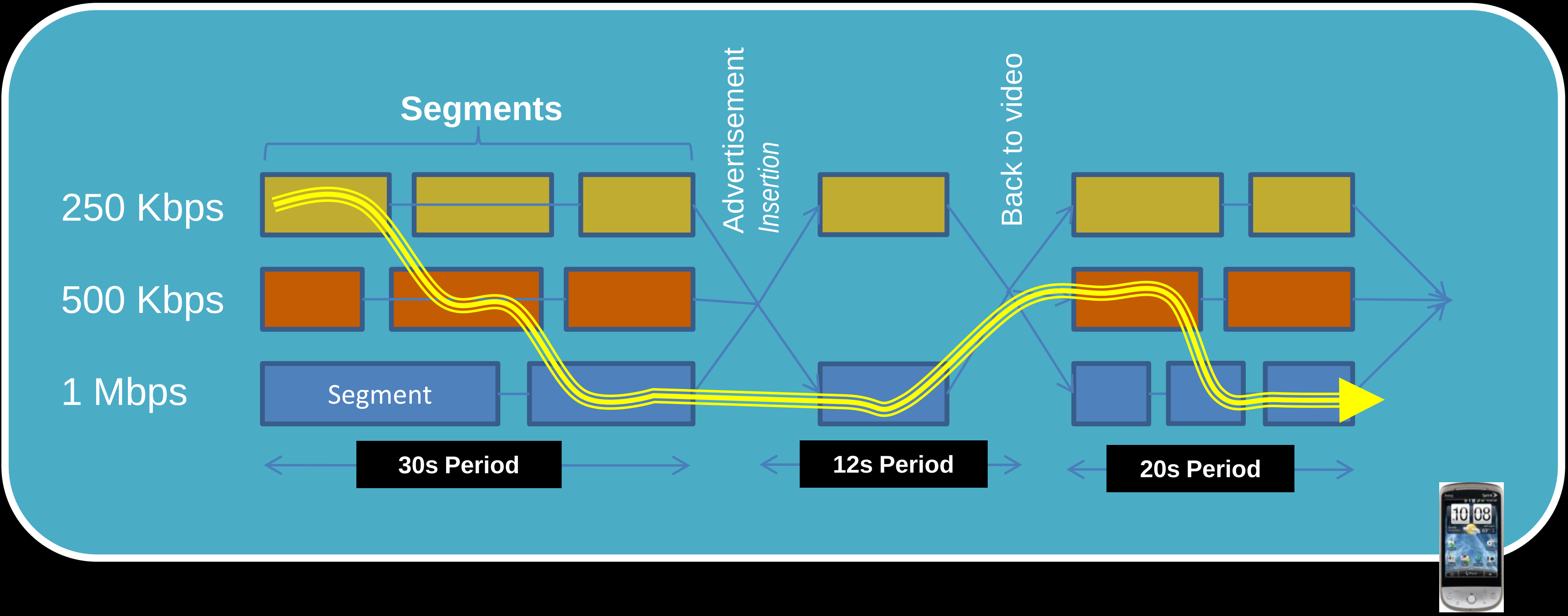
# Key feature – Common Timeline

- Representations in one Period share common presentation timeline
  - presentation time of access unit within the media streams is mapped to the global common presentation timeline
  - enables synchronization of different media components and seamless switching of different coded versions of the same media components
- Other timelines
  - segment availability times (mapped to UTC clock)
  - internal media decode time (not exposed on DASH level)

# Adaptation Sets and Representations

- Each Period consists of one or more Adaptation Sets.
- contains alternate encodings of one or more media content components encapsulated in Representations
- Representations encapsulate media streams that are considered to be perceptually equivalent
- Representations are a *deliverable encoded version*
  - encapsulation in common media formats
  - segmentation possible for delivery optimization
  - concatentation of segments of one Representation complies with media format
- Typically dynamic switching within one Adaptation Set

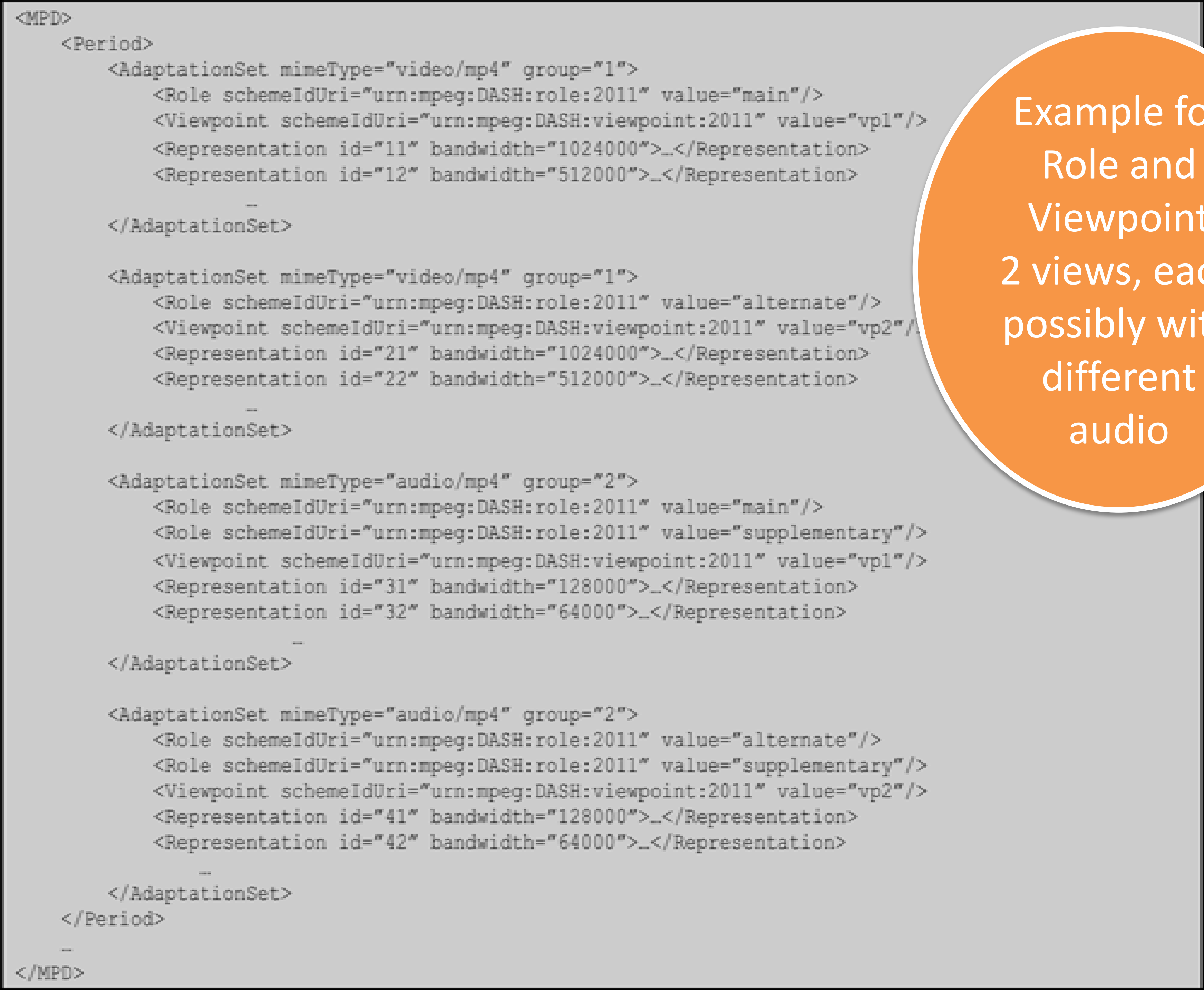
# Client-Side Process



- Process
  - Client downloads the MPD file
  - Client downloads segment by segment based on playout process
  - Bitrate determined by client
- Factors relevant for Representation selection
  - Buffer conditions
  - Network conditions
  - User change in resolution – ex: full screen
  - Device activity and resources

# Descriptors

- Content Protection (2 schemes defined)
- Role (1 scheme defined)
  - caption, subtitle, main, alternate, supplementary, commentary, dub
- Accessibility (Role scheme may be used)
- Rating
- Viewpoint
- Frame Packing (2 schemes defined)
- Audio Channel Configuration (1 scheme defined)



```
<MPD>
    <Period>
        <AdaptationSet mimeType="video/mp4" group="1">
            <Role schemeIdUri="urn:mpeg:DASH:role:2011" value="main"/>
            <Viewpoint schemeIdUri="urn:mpeg:DASH:viewpoint:2011" value="vp1"/>
            <Representation id="11" bandwidth="1024000">…</Representation>
            <Representation id="12" bandwidth="512000">…</Representation>
                        …
        </AdaptationSet>

        <AdaptationSet mimeType="video/mp4" group="1">
            <Role schemeIdUri="urn:mpeg:DASH:role:2011" value="alternate"/>
            <Viewpoint schemeIdUri="urn:mpeg:DASH:viewpoint:2011" value="vp2"/
            <Representation id="21" bandwidth="1024000">…</Representation>
            <Representation id="22" bandwidth="512000">…</Representation>
                        …
        </AdaptationSet>

        <AdaptationSet mimeType="audio/mp4" group="2">
            <Role schemeIdUri="urn:mpeg:DASH:role:2011" value="main"/>
            <Role schemeIdUri="urn:mpeg:DASH:role:2011" value="supplementary"/>
            <Viewpoint schemeIdUri="urn:mpeg:DASH:viewpoint:2011" value="vp1"/>
            <Representation id="31" bandwidth="128000">…</Representation>
            <Representation id="32" bandwidth="64000">…</Representation>
                            …
        </AdaptationSet>

        <AdaptationSet mimeType="audio/mp4" group="2">
            <Role schemeIdUri="urn:mpeg:DASH:role:2011" value="alternate"/>
            <Role schemeIdUri="urn:mpeg:DASH:role:2011" value="supplementary"/>
            <Viewpoint schemeIdUri="urn:mpeg:DASH:viewpoint:2011" value="vp2"/>
            <Representation id="41" bandwidth="128000">…</Representation>
            <Representation id="42" bandwidth="64000">…</Representation>
                   …
        </AdaptationSet>
    </Period>
    …
</MPD>
```

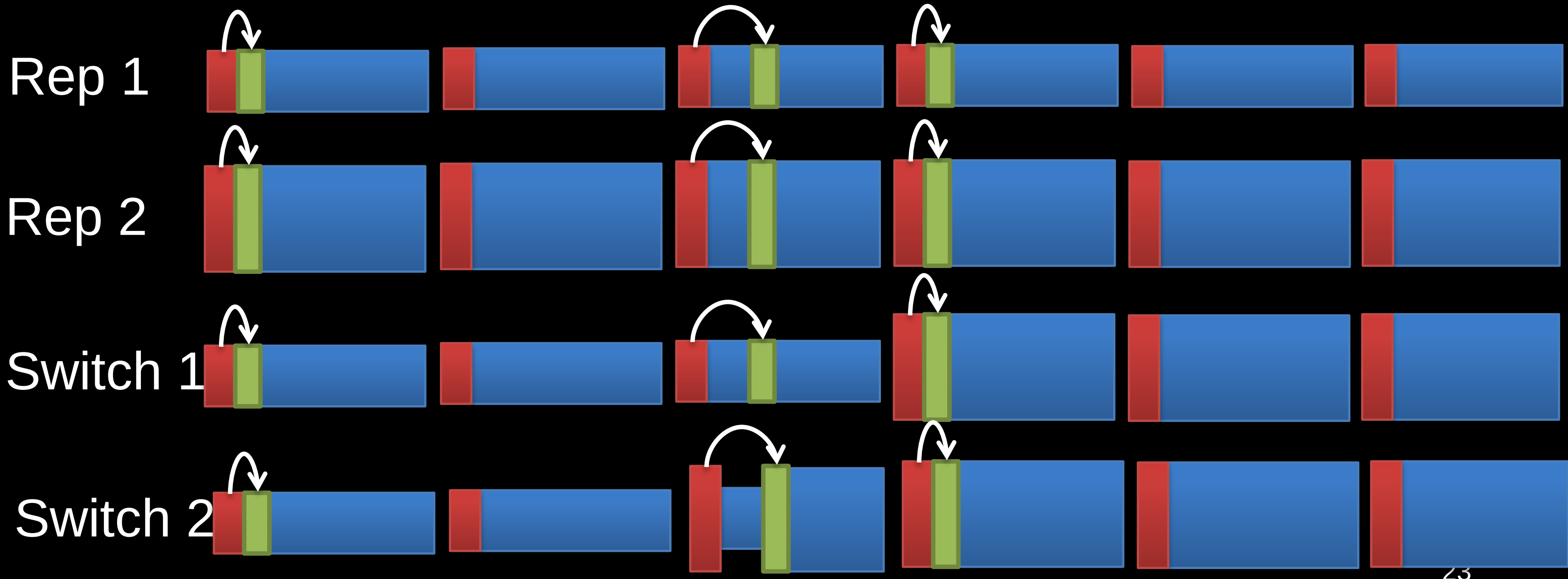
Example for
Role and
Viewpoint
2 views, each
possibly with
different
audio

# Switching Support Features

- Segment Alignment
  - permits non-overlapping decoding and presentation of segments from different Representations
- Stream Access Points (SAPs)
  - presentation time and position in segments at which random access and switching can occur
- Bitstream Switching
  - concatenation of segments from different Representations results in conforming bitstream
- Media Stream Structure Similarity
  - permits switching at Open GOP boundaries
- Alignment and SAPs can also apply for Subsegments

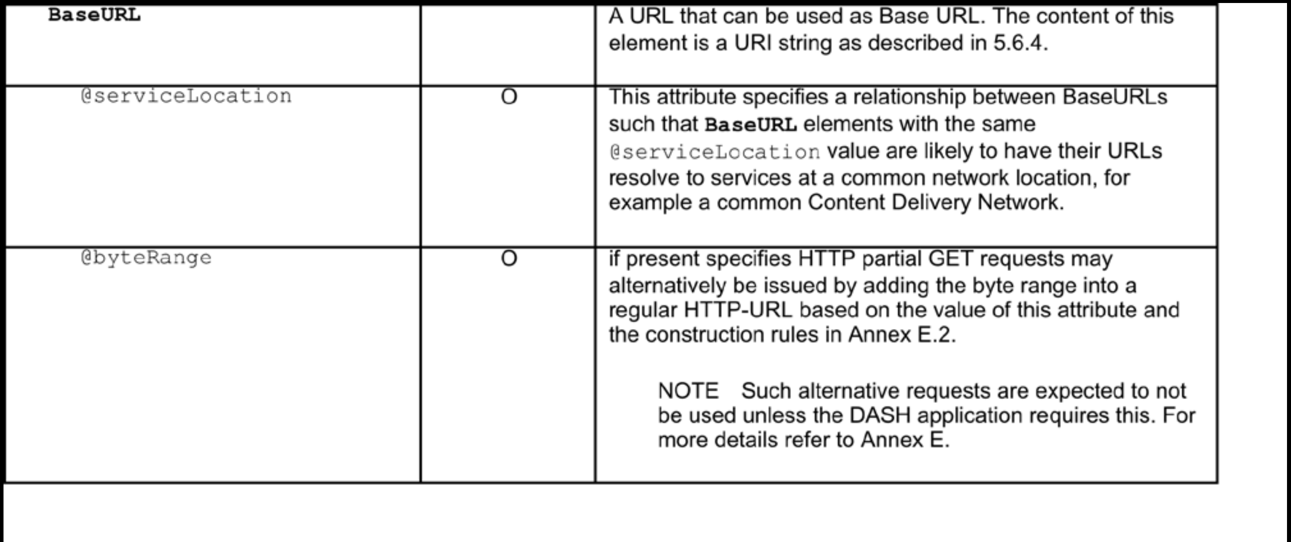
# Preferable Switch Points

- Segment/Subsegment boundaries for which
  - alignment holds across Representations
  - the switch-to Representation starts with a SAP



# Accessing Segments

- Segment information provides URL, time window, type
  - Support of explicit lists and client side template construction rules
- Multiple Base URLs
  - same information can be accessed at multiple locations
  - Redundancy, client-side load balancing, parallel download
- Byte range access with regular GETs
  - mapping to byte ranges needs to be done in CDNs

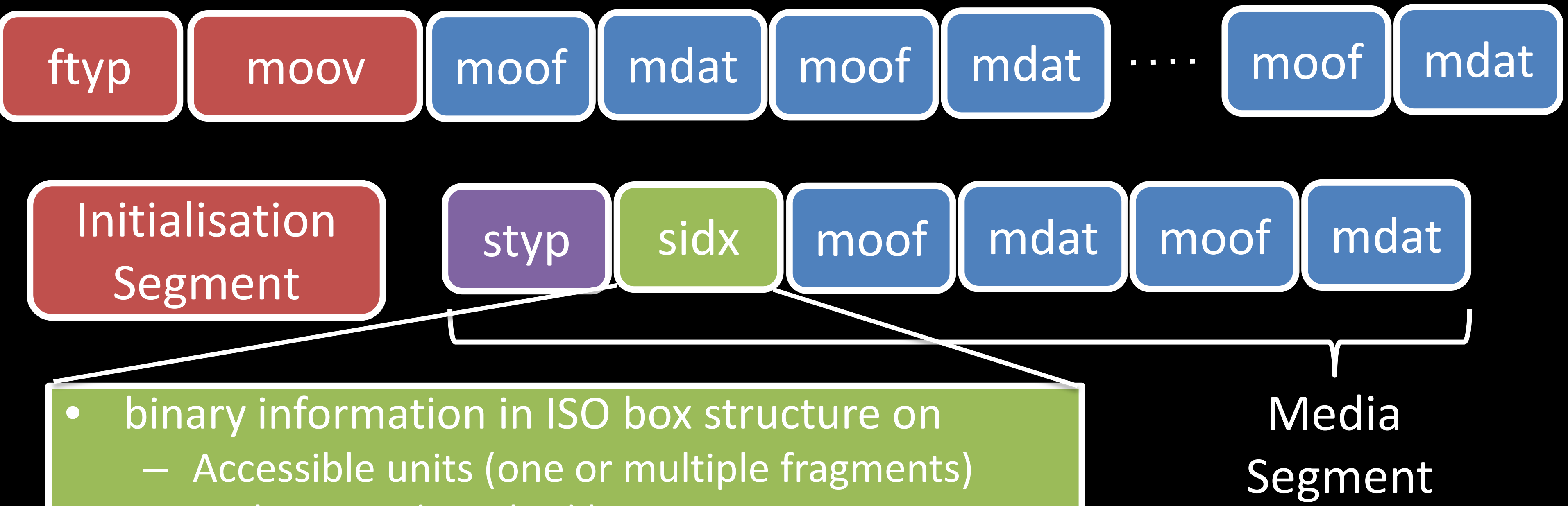


| | | |
|---|---|---|
| **BaseURL** | | A URL that can be used as Base URL. The content of this element is a URI string as described in 5.6.4. |
| @serviceLocation | O | This attribute specifies a relationship between BaseURLs such that **BaseURL** elements with the same @serviceLocation value are likely to have their URLs resolve to services at a common network location, for example a common Content Delivery Network. |
| @byteRange | O | if present specifies HTTP partial GET requests may alternatively be issued by adding the byte range into a regular HTTP-URL based on the value of this attribute and the construction rules in Annex E.2.<br>NOTE Such alternative requests are expected to not be used unless the DASH application requires this. For more details refer to Annex E. |

# Segments

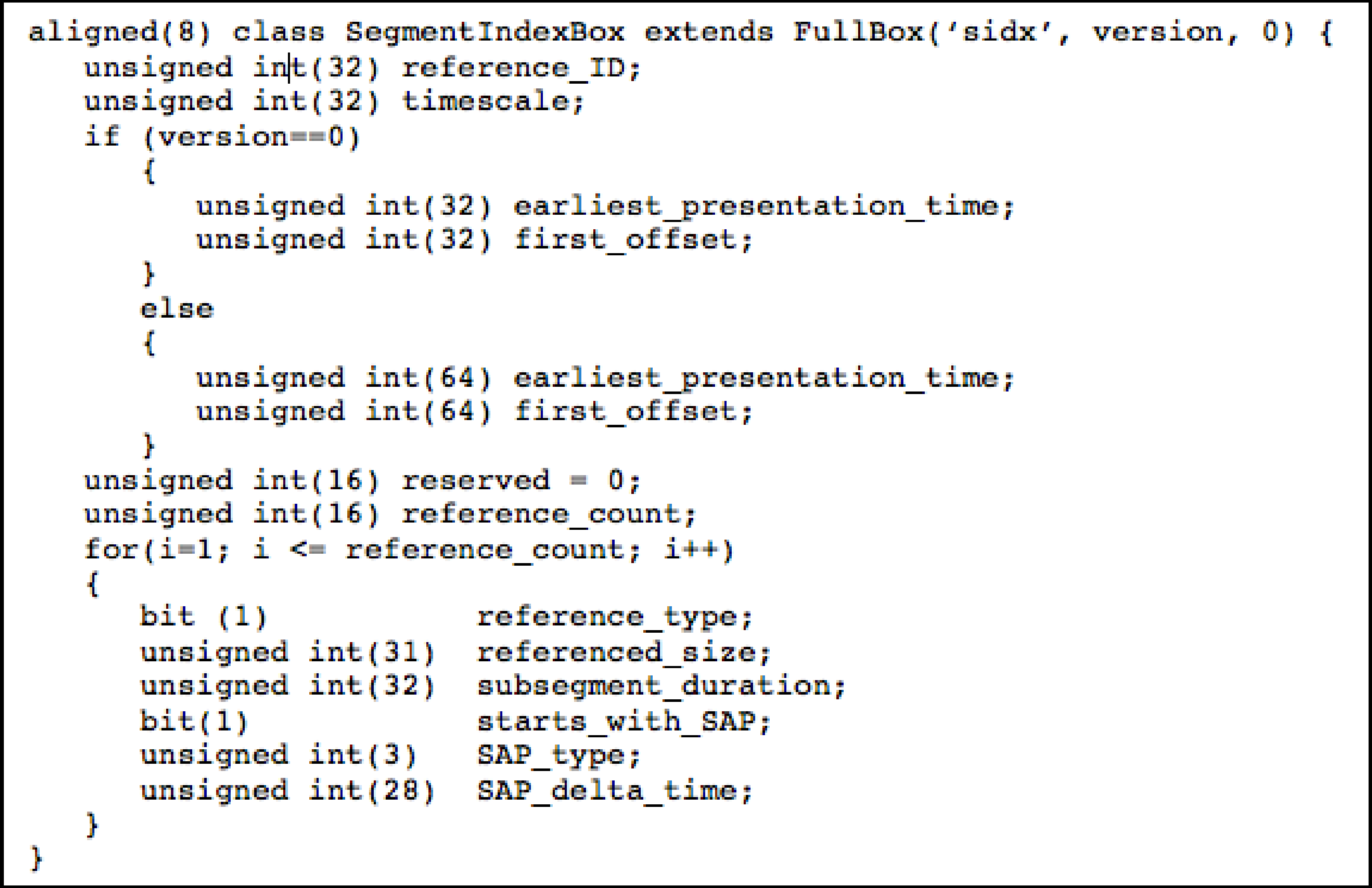
- ISO/IEC 23009 focuses on Segment formats based on MPEG container formats. Specifically,
  - in 6.3, Segment formats are described for use with Media Segments based on the ISO Base Media File Format as defined in ISO/IEC 14496-12;
  - In 6.4, Segment formats are described for use with Media Segments based on the MPEG-2 Transport Stream as defined in the ISO/IEC 13818-2;
- In both cases the Segment formats are defined such that the Media Segment formats comply with the respective container formats.
- Guidelines for adding other Segment formats are provided in Annex F.

# ISO BMFF DASH Segments



- binary information in ISO box structure on
  - Accessible units (one or multiple fragments)
  - Each unit is described by
    - Byte range in the segments
    - Accurate presentation duration (seamless switching)
    - Presence and timing of stream access positions
- Provides a compact bitrate-over-time profile
  - Can be used for intelligent request scheduling

# Segment Index

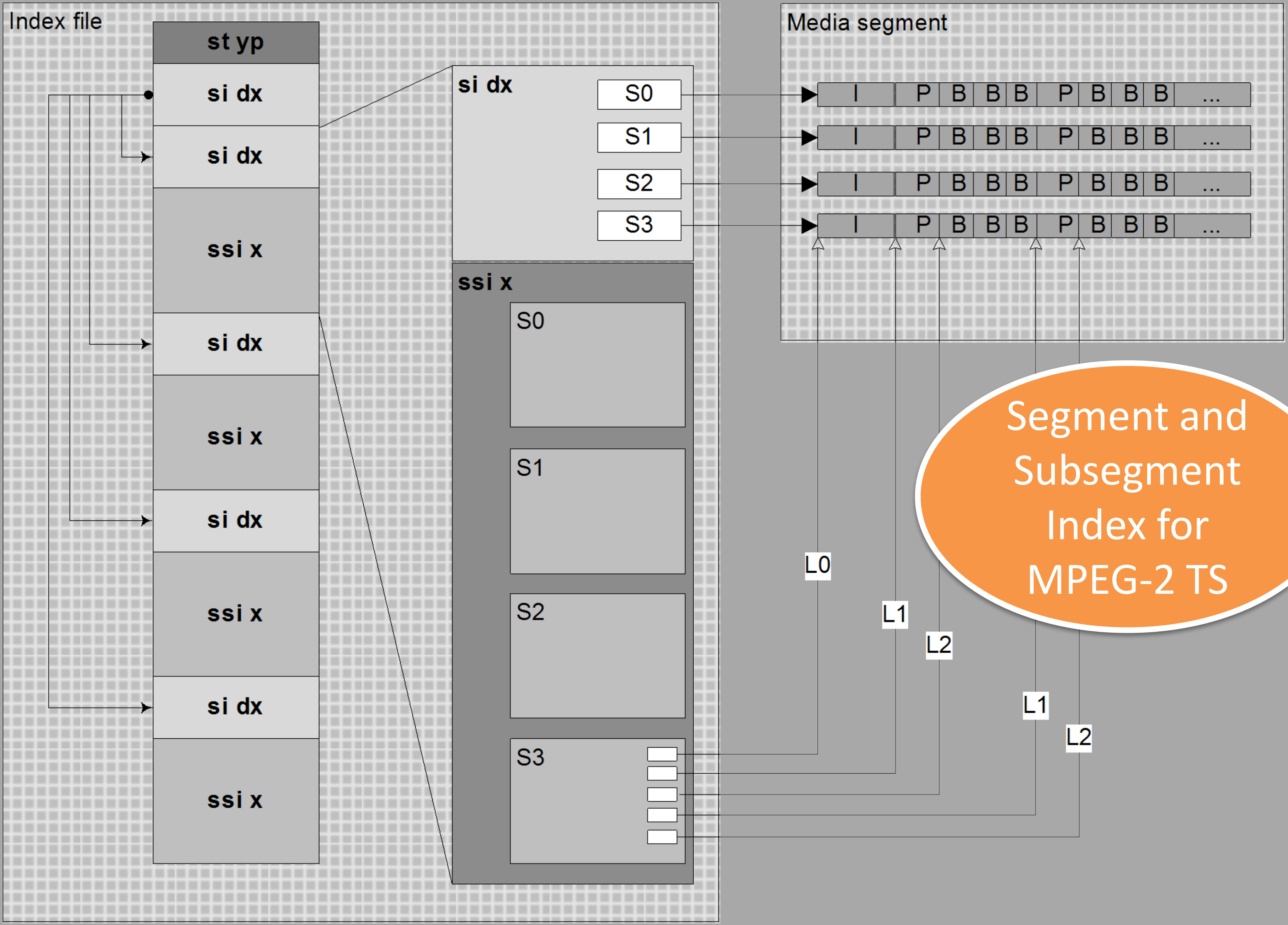


```
aligned(8) class SegmentIndexBox extends FullBox(‘sidx’, version, 0) {
   unsigned int(32) reference_ID;
   unsigned int(32) timescale;
   if (version==0)
      {
         unsigned int(32) earliest_presentation_time;
         unsigned int(32) first_offset;
      }
      else
      {
         unsigned int(64) earliest_presentation_time;
         unsigned int(64) first_offset;
      }
   unsigned int(16) reserved = 0;
   unsigned int(16) reference_count;
   for(i=1; i <= reference_count; i++)
   {
      bit (1)            reference_type;
      unsigned int(31)   referenced_size;
      unsigned int(32)   subsegment_duration;
      bit(1)             starts_with_SAP;
      unsigned int(3)    SAP_type;
      unsigned int(28)   SAP_delta_time;
   }
}
```

# Media Segments

- Contains the actual segmented media streams
- additional information to map segment into media presentation timeline for switching and synchronous presentation with other Representations
- For ISO BMFF, contains one or more movie fragments
- Can be short (≈1-10 sec) and long (≈10sec – 2h)

| Segment duration | Advantages | Disadvantages |
|---|---|---|
| Short | • Suitable for live<br>• for VoD commonality with live<br>• High switching granularity on segment level | • Large number of files<br>• Large number of URLs<br>• Fixed request size<br>• switching granularity on segment level |
| Long | • Small number of files<br>• Small number of URLs<br>• High switching granularity<br>• Flexible request sizes<br>• Improved cache performance | • Need for Segment Index<br>• Difference from Live |

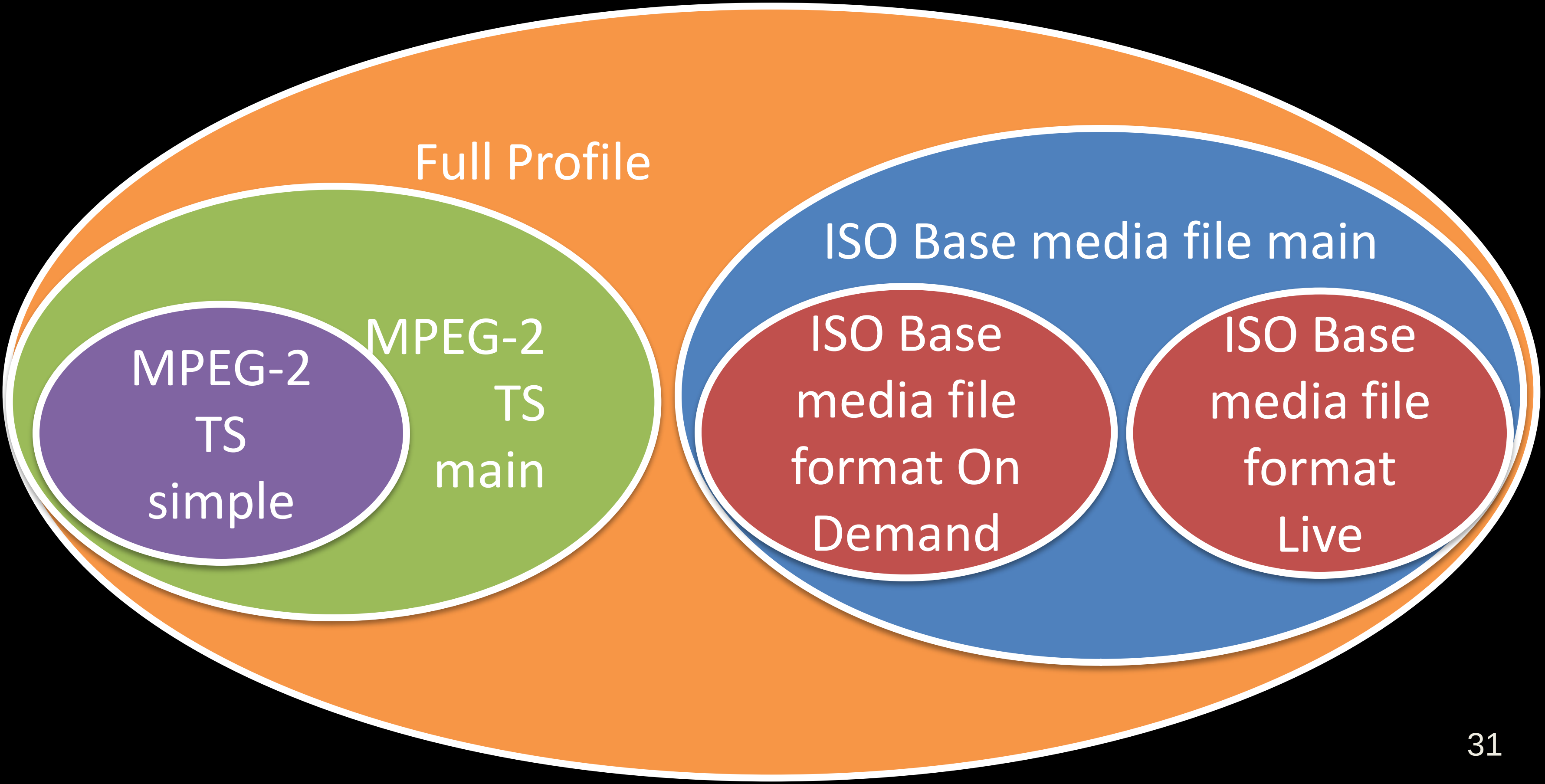


Segment and Subsegment Index for MPEG-2 TS

# PROFILES

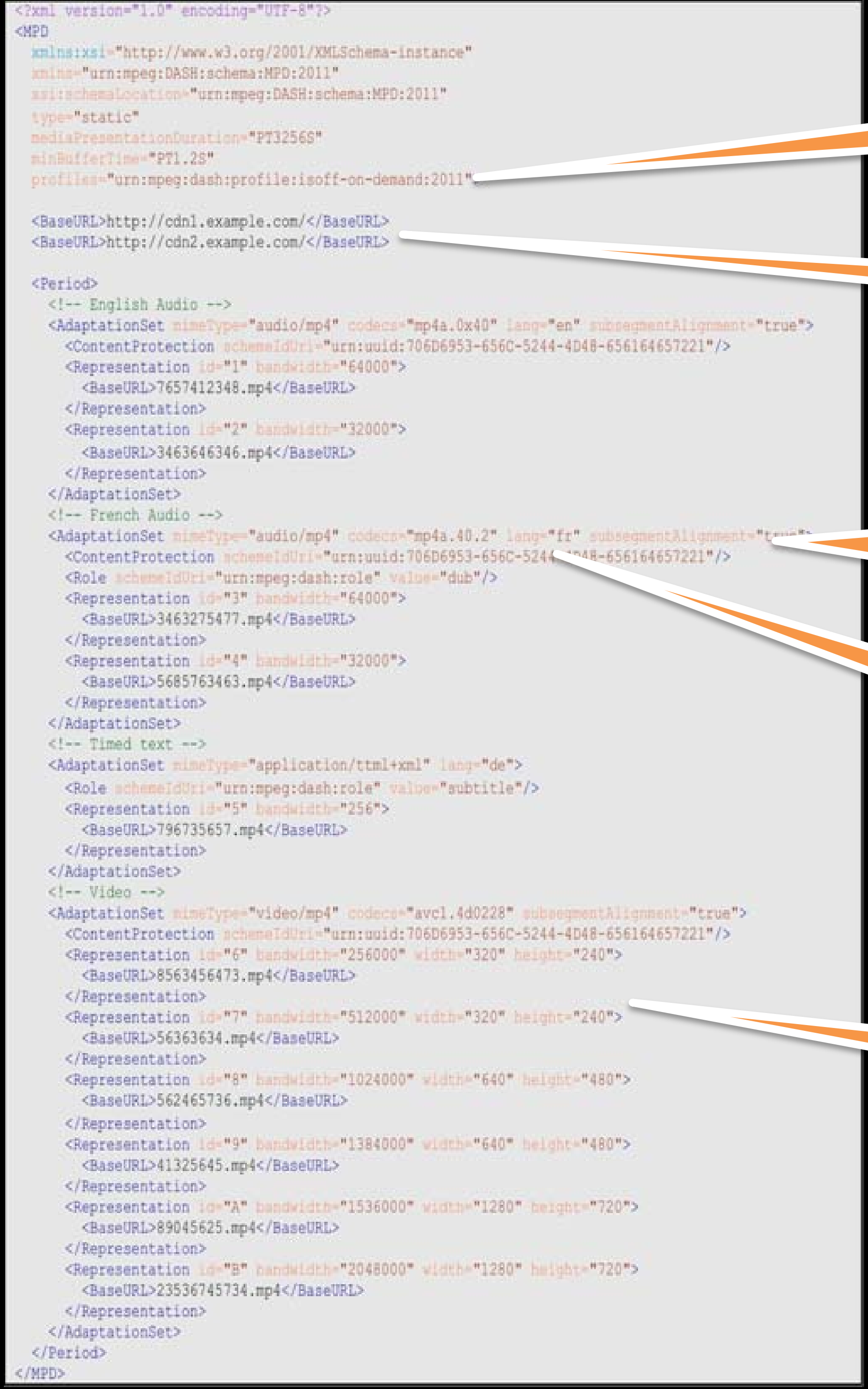
# Profiles

- Set of restrictions on the offered Media Presentation (MPD & Segments)
- can also be understood as permission for DASH clients that only implement the features required by the profile to process the Media Presentation
- Profiles defined in ISO/IEC 23009 (as below). More restrictions may be added


Full Profile
MPEG-2 TS main
MPEG-2 TS simple
ISO Base media file main
ISO Base media file format On Demand
ISO Base media file format Live

# ISO Base media file format
# On Demand

- intended to provide basic support for On-Demand content.
- support for large VoD libraries with minimum amount of content management
- permits scalable and efficient use of HTTP servers and simplifies seamless switching.
- primary constraints imposed by this profile are
  - the requirement that each Representation is provided as a single Segment,
  - Subsegments are aligned across Representations within an Adaptation Set and
  - Subsegments must begin with Stream Access Points.
- Main supporters: Netflix, Qualcomm and few others



```
<?xml version="1.0" encoding="UTF-8"?>
<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"
  type="static"
  mediaPresentationDuration="PT3256S"
  minBufferTime="PT1.2S"
  profiles="urn:mpeg:dash:profile:isoff-on-demand:2011">

  <BaseURL>http://cdn1.example.com/</BaseURL>
  <BaseURL>http://cdn2.example.com/</BaseURL>

  <Period>
    <!-- English Audio -->
    <AdaptationSet mimeType="audio/mp4" codecs="mp4a.0x40" lang="en" subsegmentAlignment="true">
      <ContentProtection schemeIdUri="urn:uuid:706D6953-656C-5244-4D48-656164657221"/>
      <Representation id="1" bandwidth="64000">
        <BaseURL>7657412348.mp4</BaseURL>
      </Representation>
      <Representation id="2" bandwidth="32000">
        <BaseURL>3463646346.mp4</BaseURL>
      </Representation>
    </AdaptationSet>
    <!-- French Audio -->
    <AdaptationSet mimeType="audio/mp4" codecs="mp4a.40.2" lang="fr" subsegmentAlignment="true">
      <ContentProtection schemeIdUri="urn:uuid:706D6953-656C-5244-4D48-656164657221"/>
      <Role schemeIdUri="urn:mpeg:dash:role" value="dub"/>
      <Representation id="3" bandwidth="64000">
        <BaseURL>3463275477.mp4</BaseURL>
      </Representation>
      <Representation id="4" bandwidth="32000">
        <BaseURL>5685763463.mp4</BaseURL>
      </Representation>
    </AdaptationSet>
    <!-- Timed text -->
    <AdaptationSet mimeType="application/ttml+xml" lang="de">
      <Role schemeIdUri="urn:mpeg:dash:role" value="subtitle"/>
      <Representation id="5" bandwidth="256">
        <BaseURL>796735657.mp4</BaseURL>
      </Representation>
    </AdaptationSet>
    <!-- Video -->
    <AdaptationSet mimeType="video/mp4" codecs="avc1.4d0228" subsegmentAlignment="true">
      <ContentProtection schemeIdUri="urn:uuid:706D6953-656C-5244-4D48-656164657221"/>
      <Representation id="6" bandwidth="256000" width="320" height="240">
        <BaseURL>8563456473.mp4</BaseURL>
      </Representation>
      <Representation id="7" bandwidth="512000" width="320" height="240">
        <BaseURL>56363634.mp4</BaseURL>
      </Representation>
      <Representation id="8" bandwidth="1024000" width="640" height="480">
        <BaseURL>562465736.mp4</BaseURL>
      </Representation>
      <Representation id="9" bandwidth="1384000" width="640" height="480">
        <BaseURL>41325645.mp4</BaseURL>
      </Representation>
      <Representation id="A" bandwidth="1536000" width="1280" height="720">
        <BaseURL>89045625.mp4</BaseURL>
      </Representation>
      <Representation id="B" bandwidth="2048000" width="1280" height="720">
        <BaseURL>23536745734.mp4</BaseURL>
      </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

Profile identifier:
ISO BMFF On-demand

Two base URLs

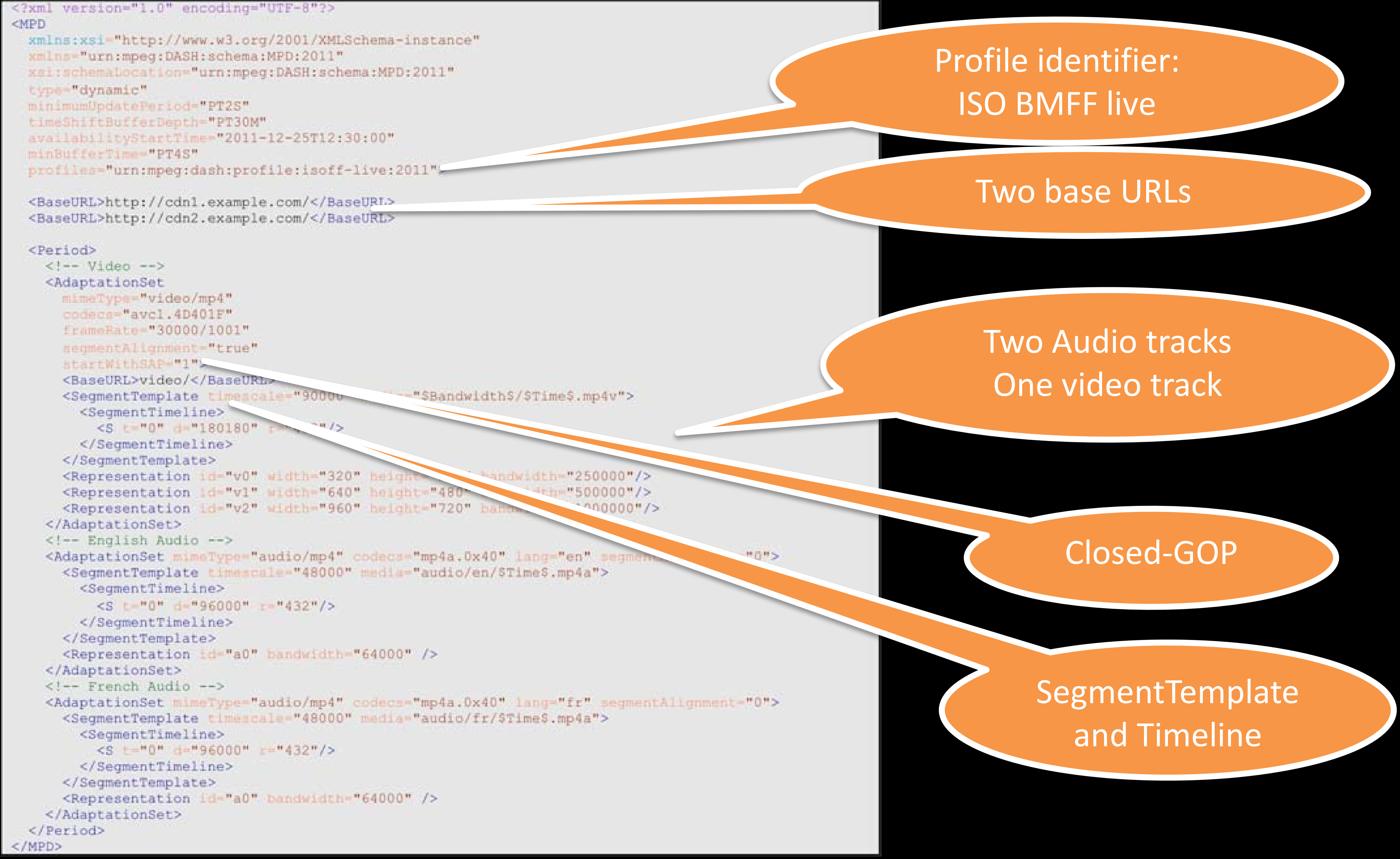
Two Audio tracks
One Subtitle track
One video track

Content Protection

Five video
Representations

# ISO Base media file format Live

- optimized for live encoding and low latency delivery of Segments consisting of a single movie fragment of ISO file format with relatively short duration.
- Each movie fragment may be requested when available using a template generated URL, so it is not normally necessary to request an MPD update prior to each Segment request.
- Segments are constrained so that they may be concatenated on Segment boundaries, and decrypted without gaps or overlaps in the media data, regardless of adaptive switching of Representations in an Adaptation Set.
- Despite the profile is optimized for live services, the MPD@Type attribute may be set to 'static' to distribute non-live content, for example in case a live Media Presentation is terminated, but kept available as On-Demand service.



```
<?xml version="1.0" encoding="UTF-8"?>
<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"
  type="dynamic"
  minimumUpdatePeriod="PT2S"
  timeShiftBufferDepth="PT30M"
  availabilityStartTime="2011-12-25T12:30:00"
  minBufferTime="PT4S"
  profiles="urn:mpeg:dash:profile:isoff-live:2011">

  <BaseURL>http://cdn1.example.com/</BaseURL>
  <BaseURL>http://cdn2.example.com/</BaseURL>

  <Period>
    <!-- Video -->
    <AdaptationSet
      mimeType="video/mp4"
      codecs="avc1.4D401F"
      frameRate="30000/1001"
      segmentAlignment="true"
      startWithSAP="1">
      <BaseURL>video/</BaseURL>
      <SegmentTemplate timescale="90000         ="$Bandwidth$/$Time$.mp4v">
        <SegmentTimeline>
          <S t="0" d="180180" r=     "/>
        </SegmentTimeline>
      </SegmentTemplate>
      <Representation id="v0" width="320" heigh        bandwidth="250000"/>
      <Representation id="v1" width="640" height="480"        dth="500000"/>
      <Representation id="v2" width="960" height="720" ban        000000"/>
    </AdaptationSet>
    <!-- English Audio -->
    <AdaptationSet mimeType="audio/mp4" codecs="mp4a.0x40" lang="en" segmen          "0">
      <SegmentTemplate timescale="48000" media="audio/en/$Time$.mp4a">
        <SegmentTimeline>
          <S t="0" d="96000" r="432"/>
        </SegmentTimeline>
      </SegmentTemplate>
      <Representation id="a0" bandwidth="64000" />
    </AdaptationSet>
    <!-- French Audio -->
    <AdaptationSet mimeType="audio/mp4" codecs="mp4a.0x40" lang="fr" segmentAlignment="0">
      <SegmentTemplate timescale="48000" media="audio/fr/$Time$.mp4a">
        <SegmentTimeline>
          <S t="0" d="96000" r="432"/>
        </SegmentTimeline>
      </SegmentTemplate>
      <Representation id="a0" bandwidth="64000" />
    </AdaptationSet>
  </Period>
</MPD>
```

Profile identifier:
ISO BMFF live

Two base URLs

Two Audio tracks
One video track

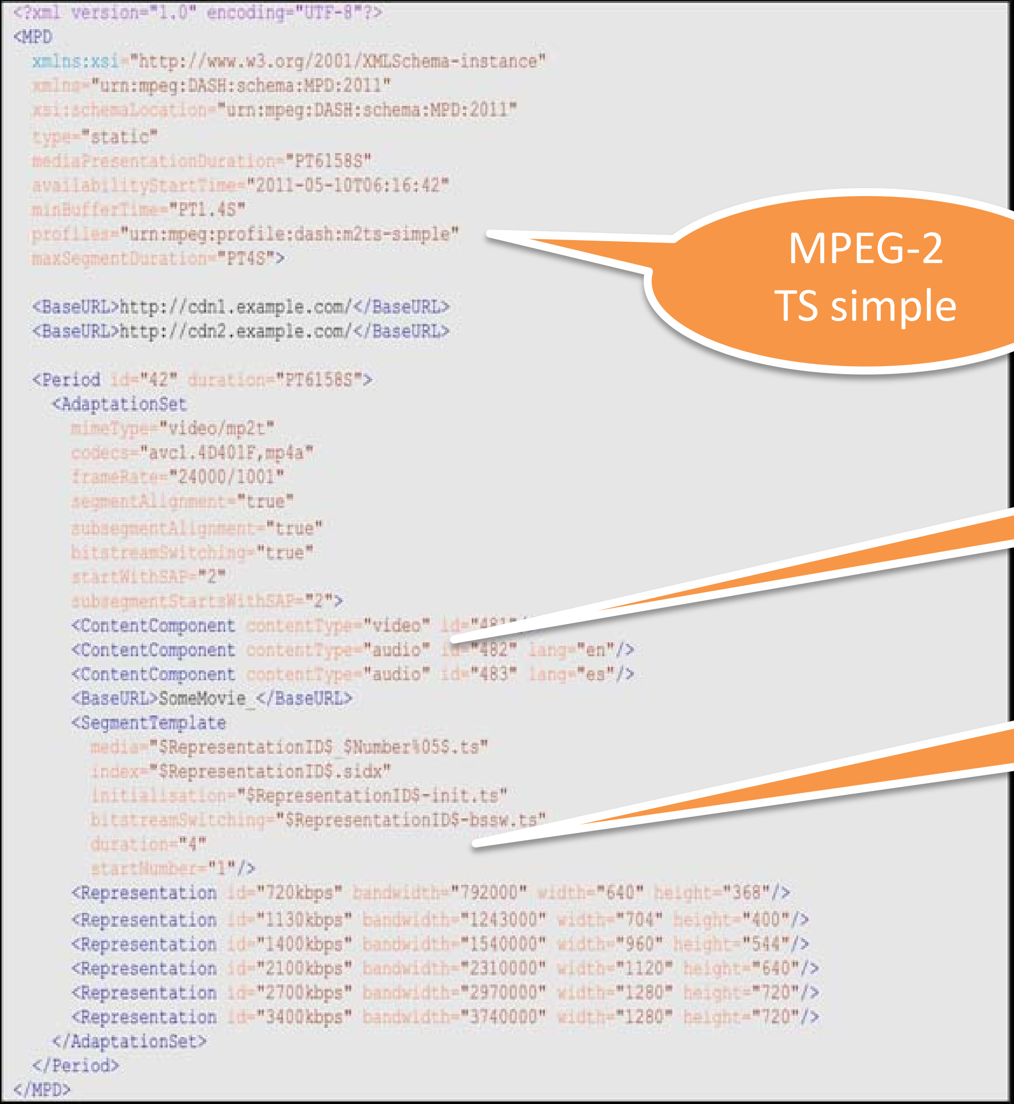
Closed-GOP

SegmentTemplate
and Timeline

```
http://cdn1.example.com/video/500000/0.mp4v
http://cdn1.example.com/video/500000/180180.mp4v
http://cdn1.example.com/video/500000/360360.mp4v
http://cdn1.example.com/video/500000/540540.mp4v
http://cdn1.example.com/video/500000/720720.mp4v
...
```

# MPEG-2 TS Profiles

- Main:
  - imposes little constraint on the Media Segment format for MPEG-2 Transport Stream content.
    - multiplexed Representations (no late binding required)
    - segment formats are chopped at MPEG-2 TS packet boundaries
  - HLS content can be integrated with this profile
  - Indexing and segment alignment is recommended
- Simple:
  - a subset of MPEG-2 TS main profile.
  - poses more restrictions on content encoding and multiplexing in order to allow simple implementation of seamless switching.
  - achieved by guaranteeing that *a* media engine conforming to ISO/IEC 13818-1 can play any bitstream generated by concatenation of consecutive segments from any Representation within the same Adaptation Set.



```xml
<?xml version="1.0" encoding="UTF-8"?>
<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"
  type="static"
  mediaPresentationDuration="PT6158S"
  availabilityStartTime="2011-05-10T06:16:42"
  minBufferTime="PT1.4S"
  profiles="urn:mpeg:profile:dash:m2ts-simple"
  maxSegmentDuration="PT4S">

  <BaseURL>http://cdn1.example.com/</BaseURL>
  <BaseURL>http://cdn2.example.com/</BaseURL>

  <Period id="42" duration="PT6158S">
    <AdaptationSet
      mimeType="video/mp2t"
      codecs="avc1.4D401F,mp4a"
      frameRate="24000/1001"
      segmentAlignment="true"
      subsegmentAlignment="true"
      bitstreamSwitching="true"
      startWithSAP="2"
      subsegmentStartsWithSAP="2">
      <ContentComponent contentType="video" id="481"
      <ContentComponent contentType="audio" id="482" lang="en"/>
      <ContentComponent contentType="audio" id="483" lang="es"/>
      <BaseURL>SomeMovie_</BaseURL>
      <SegmentTemplate
        media="$RepresentationID$_$Number%05$.ts"
        index="$RepresentationID$.sidx"
        initialisation="$RepresentationID$-init.ts"
        bitstreamSwitching="$RepresentationID$-bssw.ts"
        duration="4"
        startNumber="1"/>
      <Representation id="720kbps" bandwidth="792000" width="640" height="368"/>
      <Representation id="1130kbps" bandwidth="1243000" width="704" height="400"/>
      <Representation id="1400kbps" bandwidth="1540000" width="960" height="544"/>
      <Representation id="2100kbps" bandwidth="2310000" width="1120" height="640"/>
      <Representation id="2700kbps" bandwidth="2970000" width="1280" height="720"/>
      <Representation id="3400kbps" bandwidth="3740000" width="1280" height="720"/>
    </AdaptationSet>
  </Period>
</MPD>
```

MPEG-2 TS simple

Component Description

Template for different segments

```
http://cdn1.example.com/SomeMovie_1400kbps_00001.ts
http://cdn1.example.com/SomeMovie_1400kbps_00002.ts
http://cdn1.example.com/SomeMovie_1400kbps_00003.ts
http://cdn1.example.com/SomeMovie_1400kbps_00004.ts
http://cdn1.example.com/SomeMovie_1400kbps_00005.ts
...
```

# Summary: DASH Selected Feature List

- Live, On-Demand and Time-shift services
- Independency of request size and segment size (byte range requests)
- Segment formats
  - ISO base media FF and MPEG-2 TS
  - guidelines for integrating any other format
  - Are codec independent
- Support for server and client-side component synchronization (e.g., separate and multiplexed audio and video)
- Support for efficient trick mode
- Simple splicing and (targeted) ad insertion
- Multiple base URLs for the same content
- Clock drift control for live sessions
- DASH metrics for reporting the session experience
- Profile: restriction of DASH and system features (claim & permission)
- Content Descriptors for Protection,  Accessibility, Rating, etc.
  - Enables common encryption, but different DRM (DECE-like)

23009-2

# TEST VECTORS AND CONFORMANCE SOFTWARE

# Reference Software

- MPEG requires reference/conformance software
- Very little is done until now
- Objective is:
  - provide a significant set of good test vectors for positive and negative tests, especially for different profiles
  - provide conformance software that permits to check compliance of provided Media Presentations
- Significant work is necessary between now and the meeting in Geneva end of November

# RELATIONSHIP TO 3GPP TS26.247

# History

- Completed Release-9 TS26.234 AHS basis for MPEG DASH
  - Initially MPEG-DASH attempted to be backward-compatible to Release-9 AHS, but deemed infeasible
- 3GPP initiated Rel-10 Work Item on DASH
  - 3GPP DASH is available in TS26.247
  - Close collaboration between MPEG and 3GPP,
  - always one group was used to define the next step
- TS26.247 is more and less
  - More:
    - It also defines codecs, protocols metric reporting, etc.
    - It does have some small additional features (MPD delta)
  - Less:
    - it does not use all MPEG DASH features
    - it does not define profiles or basically is a single profile.

# Remaining Work for 3GPP

- Rel-9 AHS is kept incompatible with Rel-10 on the MPD level.
  - Requires some thoughts on how exactly to separate
  - Segment formats for Rel-9 and Rel-10 can be used jointly
- TS26.247 is currently not compatible to MPEG DASH
  - purely historical and procedural and timing reasons
  - Work about to completed to ensure compatibility (this week)
  - feature and name-space separation
  - definition as a profile
- Rel-11 discussion on integration into 3GPP architecture
  - support for QoS for DASH users
  - Using eMBMS to distribute DASH content efficiently
  - study item to be launched to make DASH even more carrier-friendly

# DEPLOYMENT CONSIDERATIONS

# Typical Uses Cases

- MPEG-DASH supports simple and advanced use cases:
  - On-Demand, Live and time-shift (nPVR) streaming
  - Dynamic ad-insertion
  - Dynamic update of program
  - Delivery of  same content on three screens
  - Delivery of any multimedia content (2D, 3D, animation, graphics, multiview, subtitles, text, etc.), not just AV
  - Support of multiple languages and different audio configuration
  - etc.
- Simple use cases can be gradually extended to more complex and advanced ones

# Migration Scenarios

- Most generated content/production equipment for legacy Adaptive Bitrate Streaming systems can be used for MPEG-DASH:
  - generic encoders can be reused, DASH adds descriptive metadata for better client operations
  - Apple HLS Content suitable for DASH M2TS Main profile.
  - Smooth Streaming Content suitable for DASH ISOBMFF Live profile.
- Manifest files can be easily converted to MPD format
  - XML conversion from m3u8 and Smooth Streaming manifests.
  - Deployment of two manifest files (legacy and DASH MPD) in parallel (low overhead)
- Documentation in preparation …
- It’s should not be a competition

# DASH Promoters Group

- Informal collaboration of companies that have committed or at least significant interest to deploy an open standard for HTTP-based streaming based on DASH.
- Effort may include recommending profiles, codecs, DRM
- Just started to create PR information, white papers, licensing, attend conferences, demos, interoperability efforts and so on
- Current Members: Microsoft, Qualcomm, Netflix, Samsung, Ericsson, Akamai, AEG, Harmonics, Digital Rapids
- Significant interest from content providers (globally), operators, device manufacturers, etc.
- Interested companies are invited to listen in and/or join
- http://dashpg.org

# Draft DASH264 Profile

- MPEG DASH:
  - ISO base media FF On-Demand and Live profile
  - potentially addition of efficient low latency profile
- Video: H.264/AVC CBP and High Profile
- Audio: MPEG AAC, enhanced AAC
- Text and Subtitles: tbd
- DRM: Common Encryption based on 23001-7
- Other interop points are tbd

# HTML-5 and DASH

- Continuous discussions in W3C how to integrate Adaptive Streaming into HTML-5
- Possible Architectures under consideration:
  - programmable approach: Javascript based download of segments that are fed into video tag
  - add MPD to video tag
  - add MPD as URL into the browser (like Apple HLS)
- Multiple solution may be deployed

# Next steps

- Complete standardization work
  - Completion and publication of all specifications
  - Conformance, interoperability and reference software
- Towards deployments
  - Generate end-to-end system specs based on DASH including codecs, DRM, profiles, etc. (OIPF, 3GPP, HbbTV, HD Forum, etc.)
  - Generate guidelines, white papers, test content and software
  - Promotional efforts: Licensing, interoperability, plug-fests, etc.
  - Combine it with browsers, the web and HTML-5
- Everyone is invited to contribute

# Some Research Challenges

- Client side implementation
  - Rate-adaptation for efficiency, high user experience, robustness
  - seamless switching experience
  - Usage and optimization of HTTP, TCP and lower layers
  - Efficient cloud-based trick modes
- Content generation:
  - Switch points vs. efficiency (how frequent and how)
  - how many and which bit rates to offer
  - low-latency optimized content provisioning
  - caching optimized content generation
- Media coding , e.g. efficient switch points
- Cloud-support
  - caching (predictive caching, content management)
- Transport and delivery (QoS, multicast, etc.)

# More Information

- Draft Specifications
  - 14496-12:2008/FDAM-3: http://www.3gpp.org/ftp/Inbox/LSs_from_external_bodies/ISO_IEC_JTC1_SG29_WG11/29n12310.zip
  - 23001-7: http://www.3gpp.org/ftp/Inbox/LSs_from_external_bodies/ISO_IEC_JTC1_SG29_WG11/29n12313.zip
  - 23009-1: http://www.3gpp.org/ftp/Inbox/LSs_from_external_bodies/ISO_IEC_JTC1_SG29_WG11/29n12316.zip
- More information from Qualcomm including Qualcomm‘s licensing position
  - http://www.qualcomm.com/blog/2011/08/16/dash-toward-better-mobile-video-user-experience
- Several other companies have declared or expressed willingness to declare favorable licensing conditions

# Your Questions

- Why is the live profile most popular even for on demand deliver?
- How does subtitling work (outside or inside container)?
- Is there language support available?
- What trick modes are supported in live and on demand profiles?
- What are the minimal common features supported for different clients (interoperability between Silverlight, Flash, IOS, etc.)?
- Are extra server side components needed for the live or on demand profile?
- Is there an impact analysis available from encoding to distribution?
- What are the best practices around segmentation?
- What are the implications of MPEG TS or ISO base media file format?
- What is the preferred profile to distribute both live an on demand (presuming broadcasters want one infrastructure meaning one file base and on streaming platform).
- Are there show cases and test streams available?
- How much is work is it to support more/all profiles?
- What is the latency?
- What is the target of the bandwidth, are there limitations to take into account?
- Scalability is the same for MPEG DASH (cashing and so on) compared to HLS streaming?
- What are the security / encryption possibilities? Probably common encryption format is supported?
- If there is no encryption is available, how easy is it to copy/download files?

Comments – Questions - Feedback

# THANK YOU