Dynamic Adaptive Streaming over HTTP – Design Principles and Standards

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Frustration!
User Frustration in Internet Video

- Video not accessible
  - Behind a firewall
  - Plugin not available
  - Bandwidth not sufficient
  - Wrong/non-trusted device
  - Wrong format
- Fragmentation
  - Devices
  - Content Formats
  - DRMs
- Low quality of experience
  - Long start-up delay
  - Frequent Rebuffering
  - Low playback quality
  - No lip-sync
  - No DVD quality (language, subtitle)
- Expensive
  - Sucks my bandwidth
  - Need a dedicated device
  - Other costs …
One way to build confidence - Open Standards
DASH: Standardization History and Status

- HTTP Live Streaming
- IIS Smooth Streaming
- Mobile Companies
Why in 3GPP?
The Mobile Video Streaming Challenge

- **The mobile video landscape**
  - Mobile Internet use is dramatically expanding
  - Video traffic is growing exponentially & is a large fraction of the usage

- **The challenges**
  - Mobile users expect high quality video experience
  - Network operators need to offer quality experience affordably

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**Figure 1.** Cisco Forecasts 3.6 Exabytes per Month of Mobile Data Traffic by 2014

**Figure 2.** Video Will Account for 66 Percent of Global Mobile Data Traffic by 2014

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39 times growth of mobile data

66% mobile video by 2014

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TB per Month

<table>
<thead>
<tr>
<th>Year</th>
<th>Mobile VoIP</th>
<th>Mobile Gaming</th>
<th>Mobile P2P</th>
<th>Mobile Web/Data</th>
<th>Mobile Video</th>
<th>Total</th>
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<td>0%</td>
<td>4%</td>
<td>4%</td>
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</tbody>
</table>

108% CAGR 2009-2014

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Figure 2
Standardization History and Status

- **Sept 2010**: Dynamic Adaptive Streaming over HTTP (DASH)
- **March 2010**: Adaptive HTTP Streaming (AHS)

- **Mobile Companies**
  - 3GPP
  - A GLOBAL INITIATIVE

- **CE Vendors**
  - IIS Smooth Streaming

- **HTTP Adaptive Streaming (HAS)** (Sept 2010)
  - Liaison relationship

- **HTTP Live Streaming**

- **Publish**

- **Contribution & Liaison** relationship

- **MPEG - ISO/IEC JTC1/SC29 WG11**

- **14496-12 ISO Base Media File Format**
  - Draft Amendment - February 2011
MPEG DASH ISO/IEC 23001-6

- MPEG DASH ISO/IEC 23001-6 is now the master specification
- Provides a superset for system specifications
  - 3GPP Release-9 AHS
  - Open IPTV Forum HTTP Adaptive Streaming
  - 3GPP Release-10 DASH (completion target July 2011)
  - System specifications may define more: codecs, DRM, etc.

- Timeline and Activities
  - Draft International Standard (DIS) 23001-6 available publicly
  - 5 months balloting period until July 2011
  - Parallel approval process for extensions to ISO base media FF to support DASH
  - Continuous coordination with 3GPP and other organizations (DECE, OIPF, etc.)
  - Conformance and Reference Software activities kicked off (see WD 23001-7)

- The good news: Converging standard for adaptive streaming on the way

Convergence = Confidence
DASH Design Principles
(Some) DASH Design Principles

- **DASH is not:**
  - system, protocol, presentation, codec, interactivity, client specification
- **DASH is an enabler**
  - It provides formats to enable efficient and high-quality delivery of streaming services over the Internet
  - It is 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**
  - Enable reuse of existing technologies (containers, codecs, DRM etc.)
  - Enable deployment on top of HTTP-CDNs (Web Infrastructures, caching)
  - Enable very high user-experience (low start-up, no rebuffering, trick modes)
  - Enable selection based on network and device capability, user preferences
  - Enable seamless switching
  - Enable live and DVD-kind of experiences
  - Move intelligence from network to client, enable client differentiation
  - Enable deployment flexibility (e.g., live, on-demand, time-shift viewing)
  - Provide simple interoperability points (profiles)
DASH Specification Insights
What is specified – and what is not?

Media Presentation on HTTP Server

- Segment
- Resources located by HTTP-URLs

HTTP/1.1

DASH Client

- DASH Control 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
- Initialisation 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.
MPD Information

- Redundant information of Media Streams for the purpose to initially select or reject Groups or Representations
  - Examples: 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 media start time and duration of a Media Segment in the media presentation timeline
  - for live service, instructions on starting playout such that media segments will be available in time for fluent playout in the future

- Switching and splicing relationships across Representations
- Relatively little other information
Segment Indexing

- Provides binary information in ISO box structure on
  - Accessible units of data in a media segment
  - Each unit is described by
    - Byte range in the segments (easy access through HTTP partial GET)
    - Accurate presentation duration (seamless switching)
    - Presence of representation access positions, e.g. IDR frames
- Provides a compact bitrate-over-time profile to client
  - Can be used for intelligent request scheduling
- Generic Data Structure usable for any media segment format, e.g. ISO BMFF, MPEG-2 TS, etc.
- Hierarchical structuring for efficient access
- May be combined with media segment or may be separate
Media Segment with Segment Index

- Simple
  - S1
  - F1
  - F2
  - F3
  - F4
  - F5
  - F6

- Hierarchical
  - S1
  - S2
  - F1
  - F2
  - S3
  - F3
  - F4
  - S4
  - F5
  - F6

- Daisy-Chain
  - S1
  - F1
  - F2
  - S3
  - F3
  - F4
  - S5
  - F5
  - F6
Media Segments

- Contain 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)

<table>
<thead>
<tr>
<th>Segment duration</th>
<th>Advantages</th>
<th>Disadvantages</th>
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</table>
| Short            | • Commonality with Live  
                  • High switching granularity on segment level | • Large number of files  
                  • Large number of URLs  
                  • Fixed request size  
                  • switching granularity on segment level |
| Long             | • Small number of files  
                  • Small number of URLs  
                  • High switching granularity  
                  • Flexible request sizes  
                  • Improved cache performance | • Need for Segment Index  
                  • Difference from Live |
DASH Selected Features
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
- Definition of quality metrics
- Profile: restriction of DASH and system features (claim & permission)
- Content Descriptors for Protection, Accessibility, Rating, etc.
  - Enables common encryption, but different DRM (DECE-like)
Forward looking

- Do the homework
  - Specification completion in the next few months
  - Conformance, interoperability and reference software
- DASH is rich and simple at the same time
  - Understand more detailed market needs
  - Create profiles as considered necessary
  - Collaborate with system creators on how to integrate DASH
- Integrate it into the web – what is necessary?
- Get it deployed
- Everyone is invited - get involved in and excited about DASH
Confident?

Or more Chocolate?
Thank you

Comments – Questions - Feedback