ADAPTIVE STREAMING OVER ICN
DRAFT-VIDEO-STREAMING-OVER-ICN-00.txt

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Video Predominant on the Internet

- Real-time video is more than 50% of the traffic at peak periods
- Mobile traffic is growing exponentially, all delivered over the top (OTT)

... BUT

THERE ARE PROBLEMS!

- Wrong format
- Wrong protocol
- Plugin required
- DRM issues
- Long start-up delay
- Low quality
- Frequent stalls
- Bitrate intense
- No DVD/PVR experience
- ....
... AND HETEROGENEOUS DEVICES

Desktop/Laptop

Mobile

Living Room

Desktop/Laptop: QuickTime, Apple, Silverlight
Mobile: HTML5, Android, iOS
Living Room: IPTV, aonTV, HbbTV, SMART TV, LG Smart TV, Google TV
Dynamic Adaptive Streaming over HTTP (DASH)

Proprietary Solutions
- Apple HTTP Live Streaming
- Adobe HTTP Dynamic Streaming
- Microsoft Smooth Streaming
- Netflix
- Akamai
- Movestreaming
- Amazon
- ...
Dynamic Adaptive Streaming over HTTP

- Dynamic adaption to the network conditions
- Usage of existing and cheap Internet (HTTP) Infrastructure
- Streaming-Logic is located at the Client
- Flexible and scalable
MPEG-DASH STANDARD

- Dynamic Adaptive Streaming over HTTP (DASH)
ICN and MPEG-DASH have several elements in common:

- Client-initiated pull approach
- Content being dealt with in pieces (or chunks)
- Support of efficient replication and distribution of content pieces within the network
- Session-free nature of the exchange between the client and the server at the streaming layer: the client is free to request any chunk from any location
- Support for potentially multiple sources
DASH and ICN: Open Issues

- Different naming schemes in DASH and ICN
  - DASH MPD: http://www.example.com/movie.mpd
  - Segment: http://www.example.com/rep1seg1.m4s
  - http://www.example.com/rep1/seg1.m4s
  - etc.

- How a combined naming scheme could look like?

- Establish an MPD profile for DASH over ICN
  - URIs instead of HTTP-URLs

- ICN transport mechanisms have to be compliant
  - Rate at which interests are issued should be such that the chunks received to ensure the playback
**DASH and ICN: Open Issues**

- **Bandwidth estimation in ICN environments**
  - Content may be cached or come from different origin nodes
  - Bandwidth measurements may vary from segment to segment

- **Caching efficiency**
  - Cache Hit:
    Same Segment, Format/Codec, Bitrate, Resolution, etc.
  - How efficient will the caching will be?

- **Caching may cause oscillations**
  - E.g.: Lower representations may be cached, higher quality representations not → Oscillation
  - Causes poor Quality of Experience (QoE)
DASH and ICN: Open Issues

- Usage of multiple network interfaces is possible in ICN
  - Enabling a seamless handover between them
  - Intelligent strategy which should focus on traffic load balancing between the available links may be necessary
  - Potential to leverage the combined available bandwidth of all links

- Publishing concerns regarding access control and accounting
  - Owner of the video stream may access these data chunks need to be accounted/billed/monitored
DASH & CCN = DASC

- Located at different protocol layers
  - DASH at the application layer and CCN at the network layer
  - Can be combined very efficiently: substitute HTTP by CCN

- Potential benefits
  - Segments can be cached efficiently by CCN network nodes
  - Data can be requested and transmitted via multiple links/sources, etc.

- Various Implementations at [http://dash.itec.aau.at](http://dash.itec.aau.at)
  - Patches for the DASH VLC plugin
  - DASH Dataset CCNx Repository
  - Patches for libdash, available soon
WORK DONE YET

- DASH over CCN Experiments/Evaluations
  - Protocol Overhead
  - Streaming Performance
  - Evaluation Multilink Transmission
  - Investigation of possible improvements and research areas
- DASH over CCN Experiments/Evaluations in Mobile Networks
  - Evaluation using mobile bandwidth traces
  - Comparison to our previous evaluations (Apple HLS, Microsoft SS, etc.)
  - Evaluation using multiple links and mobile bandwidth traces
- Dissemination
  - CCNxConn 2012, ICC 2013, ICME 2013, ICC 2013 IIMCFI Workshop, etc.
Leverage the intrinsic versioning and segmentation support of CCN

Move representation selection from the client to the network
Questions, Comments?

DASH @ Alpen-Adria-Universität Klagenfurt
Join this activity, everyone is invited – get involved in and exited about DASH!

http://dash.itec.aau.at
REFERENCES


BACKUP
OVERHEAD ANALYSIS

CCN:
Higher but constant overhead due to signing and routing information

HTTP:
Relatively low overhead, dependent on chosen representation
CCN
High delay sensitivity and prototype implementation

Identified improvement possibilities regarding:
- Segment Pipelining
- Interest Pipelining
- Interest and Stream Management
# DASH over CCN in Mobile Networks

![Map of mobile network tracks](image)

![Graph showing bandwidth and media bitrate](image)

<table>
<thead>
<tr>
<th>Name</th>
<th>Average Bitrate [kbps]</th>
<th>Average Switches [Number of Switches]</th>
<th>Average Unsmoothness [Seconds]</th>
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<td><strong>160</strong></td>
<td><strong>0</strong></td>
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</table>
CCN Strategy Layer
Chooses the fastest link automatically

Identified Improvement Possibilities
More intelligent interest dispatching over the available links
→ Combining available bandwidths
DASH OVER CCN IN MOBILE NETWORKS USING MULTIPLE LINKS

Using our adjusted mobile bandwidth traces

~29% and ~15% higher average media bitrate than using Interface 1 and 2 separately