ADAPTIVE STREAMING OVER ICN

DRAFT-VIDEO-STREAMING-OVER-ICN-00.TXT

http://users.soe.ucsc.edu/~cedric/papers/draft-video-streaming-over-ICN-00.txt

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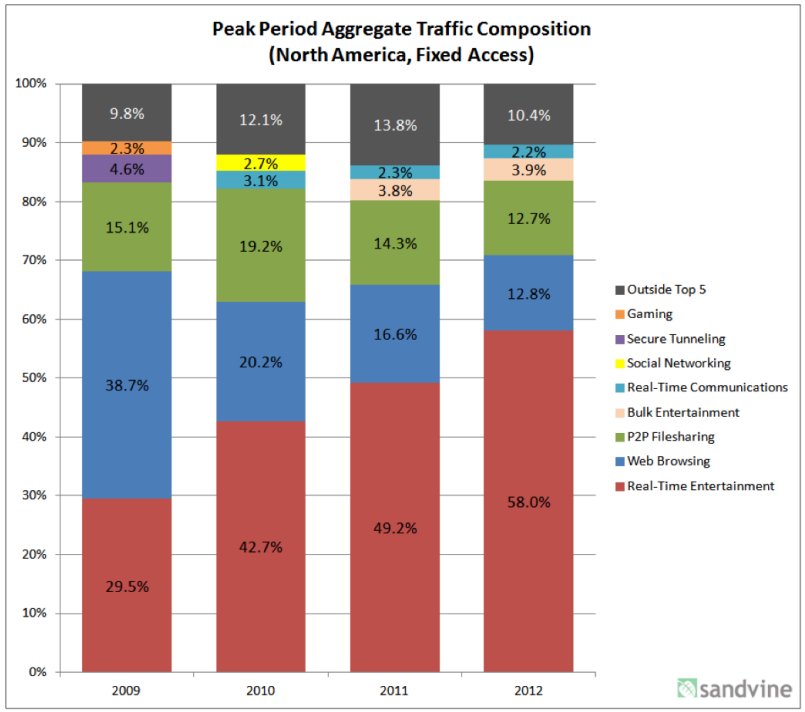
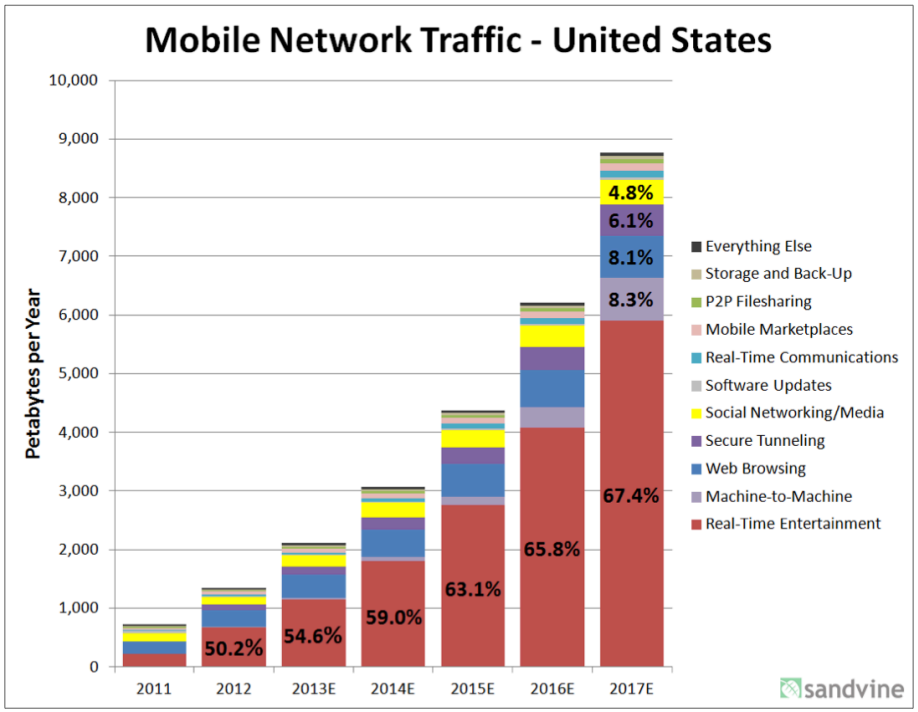
VIDEO PREDOMINANT ON THE INTERNET

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



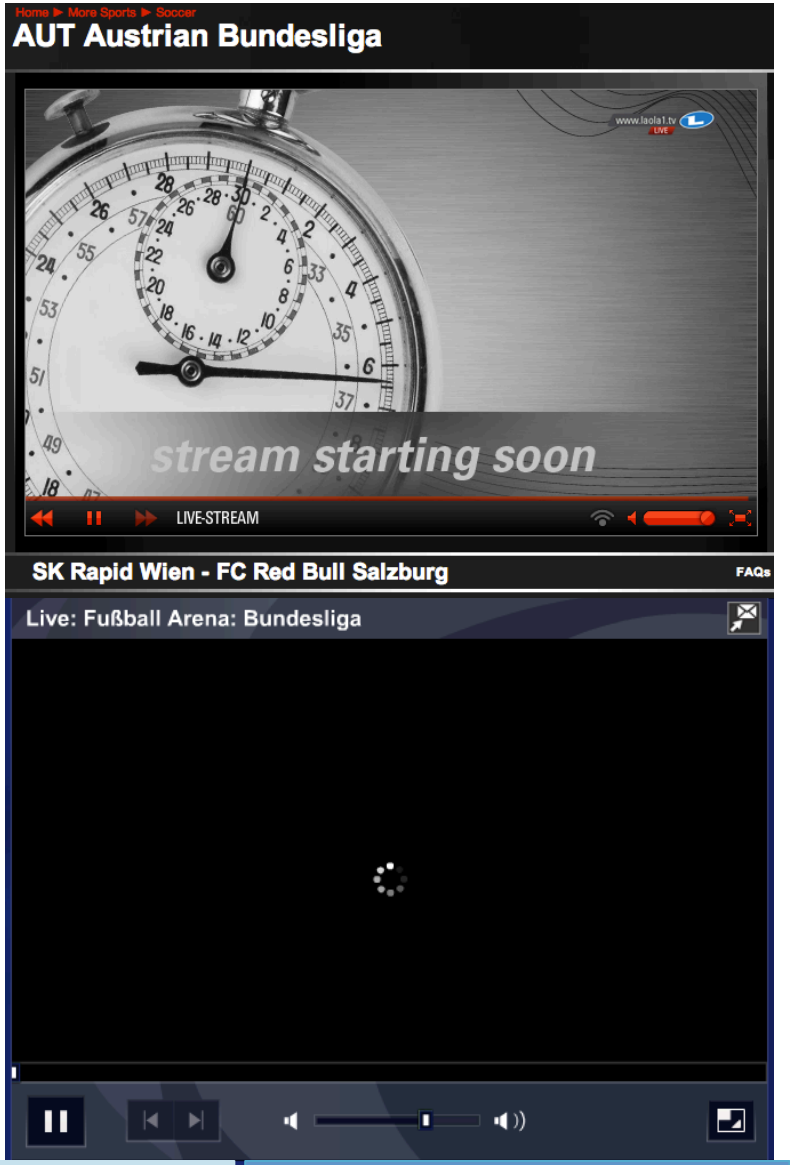


Source: http://www.sandvine.com/downloads/documents/Phenomena_1H_2012/Sandvine_Global_Internet_Phenomena_Report_1H_2012.pdf

… 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
- ….



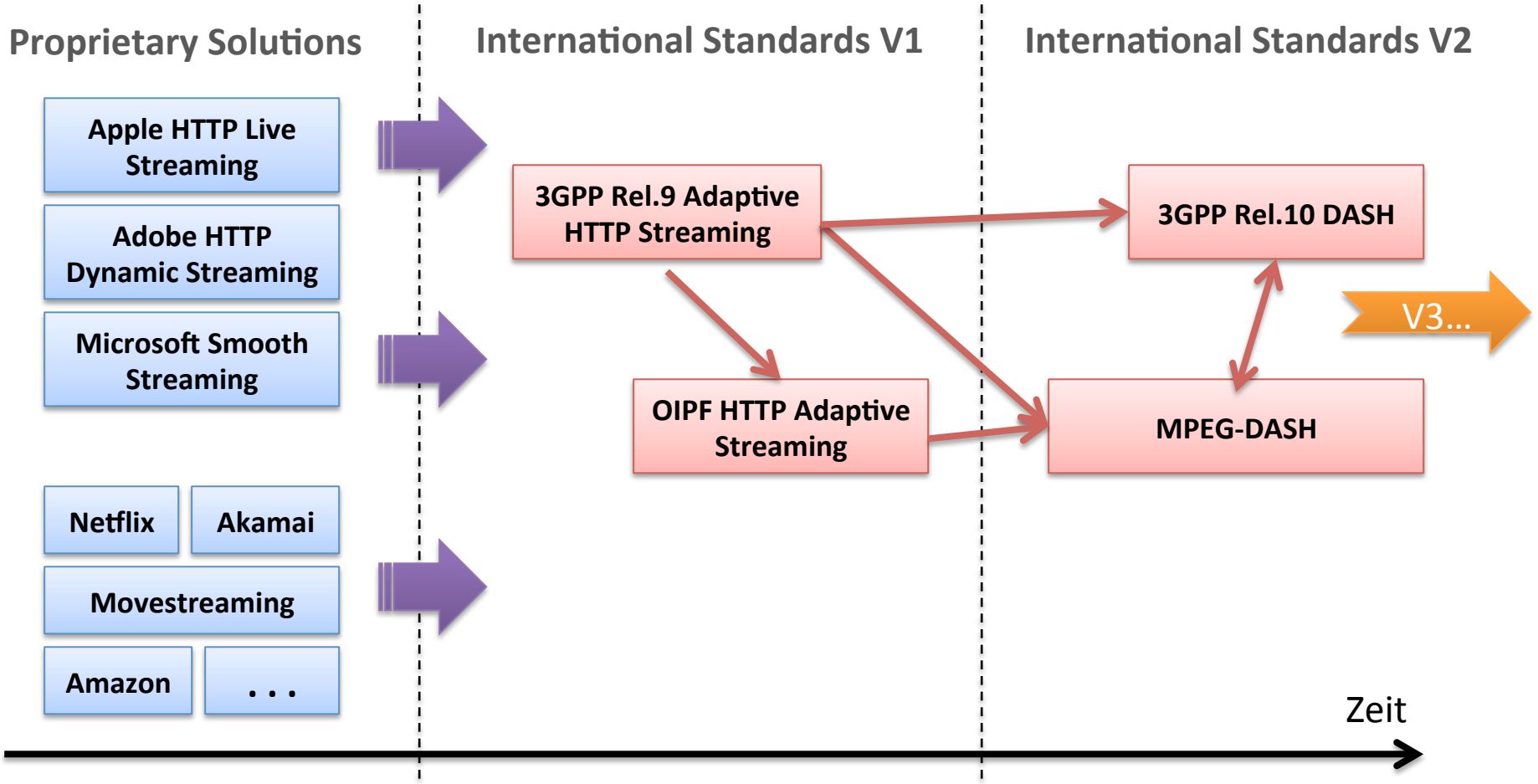
… AND HETEROGENEOUS DEVICES

Desktop/Laptop

Mobile

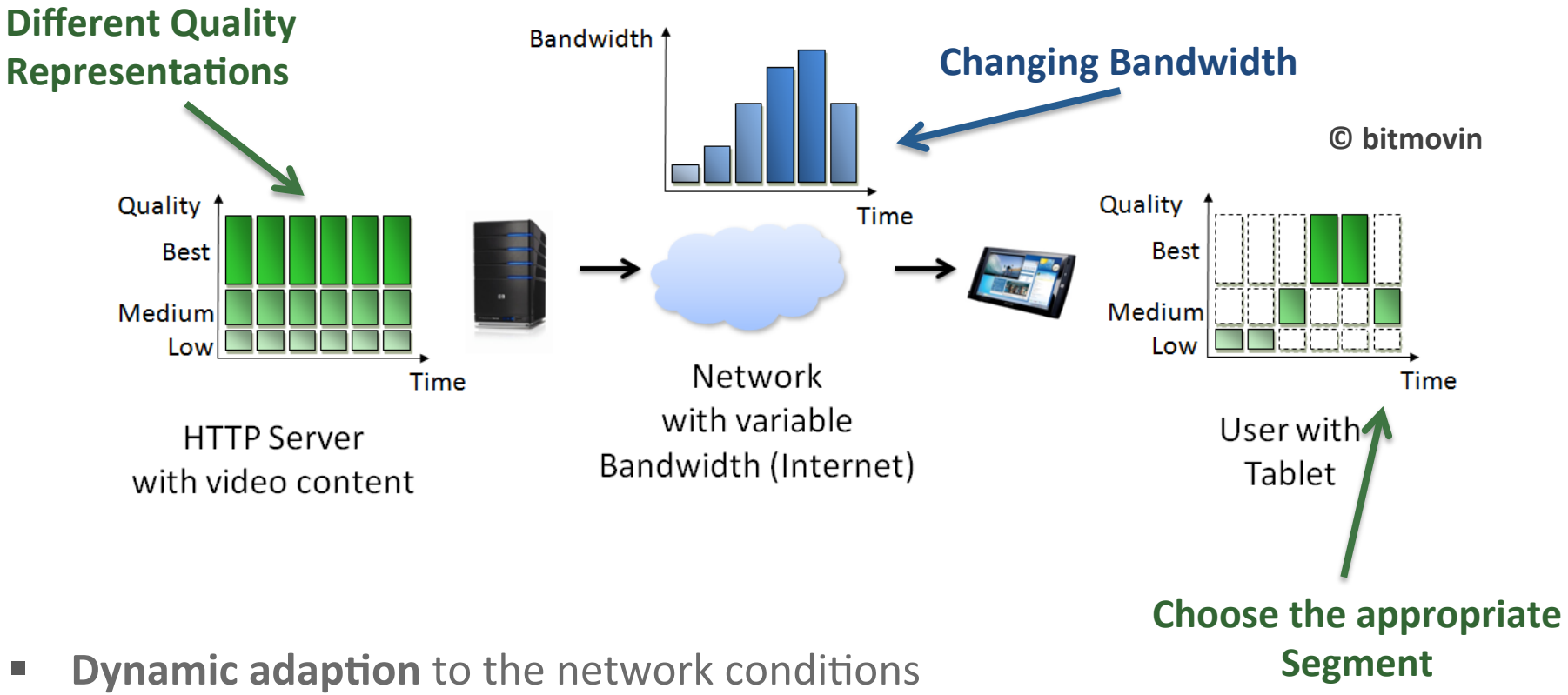
Living Room

DYNAMIC ADAPTIVE STREAMING OVER HTTP (DASH)



http://multimediacommunication.blogspot.com/2010/05/http-streaming-of-mpeg-media.html

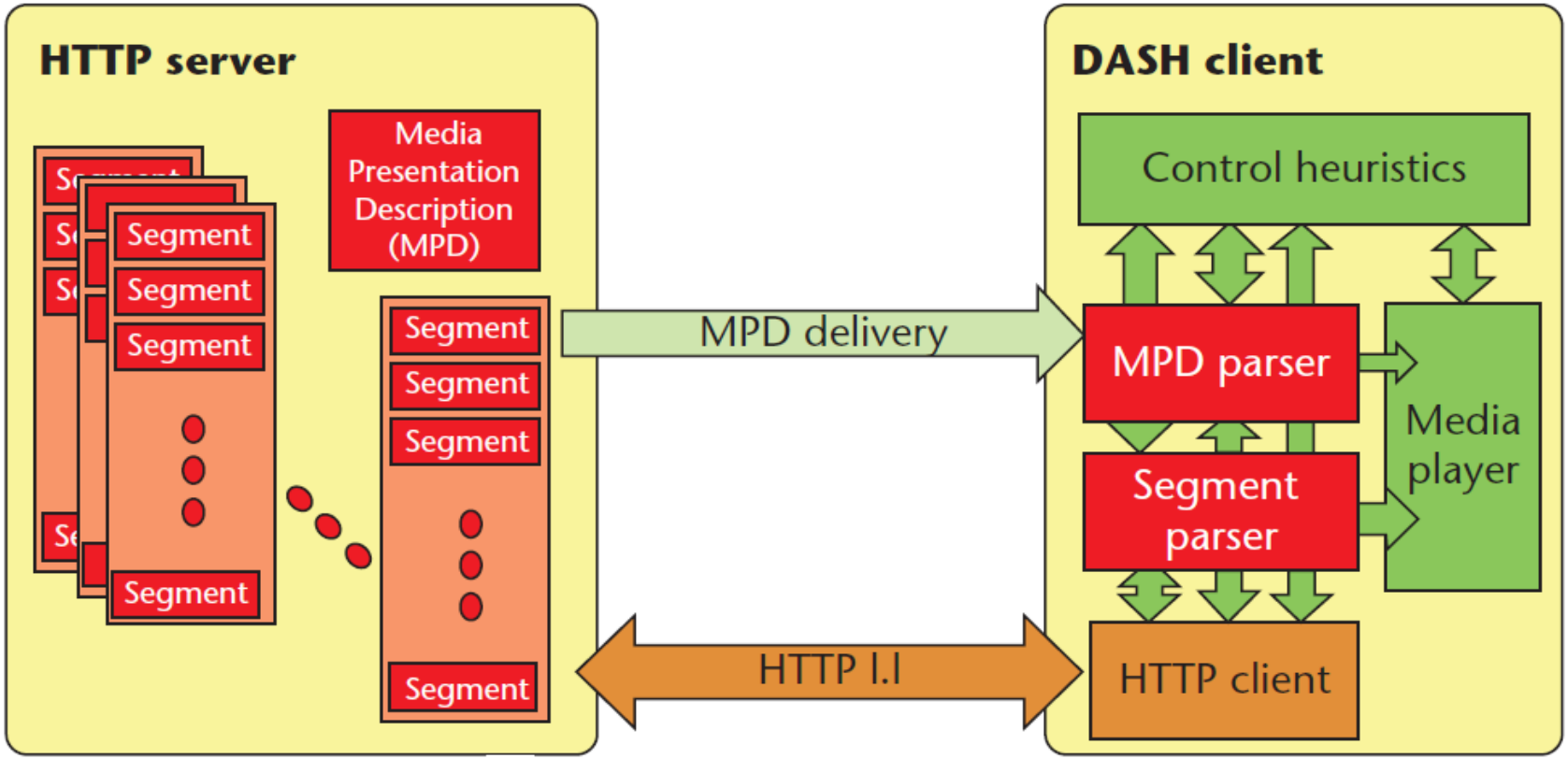
Dynamic Adaptive Streaming over HTTP



- **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

- **D**ynamic **A**daptive **S**treaming over **H**TTP **(DASH)**



DASH AND ICN

- **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**
  - **Patches for the DASH VLC plugin**
  - **DASH Dataset CCNx Repository**
  - **Patches for libdash, available soon**

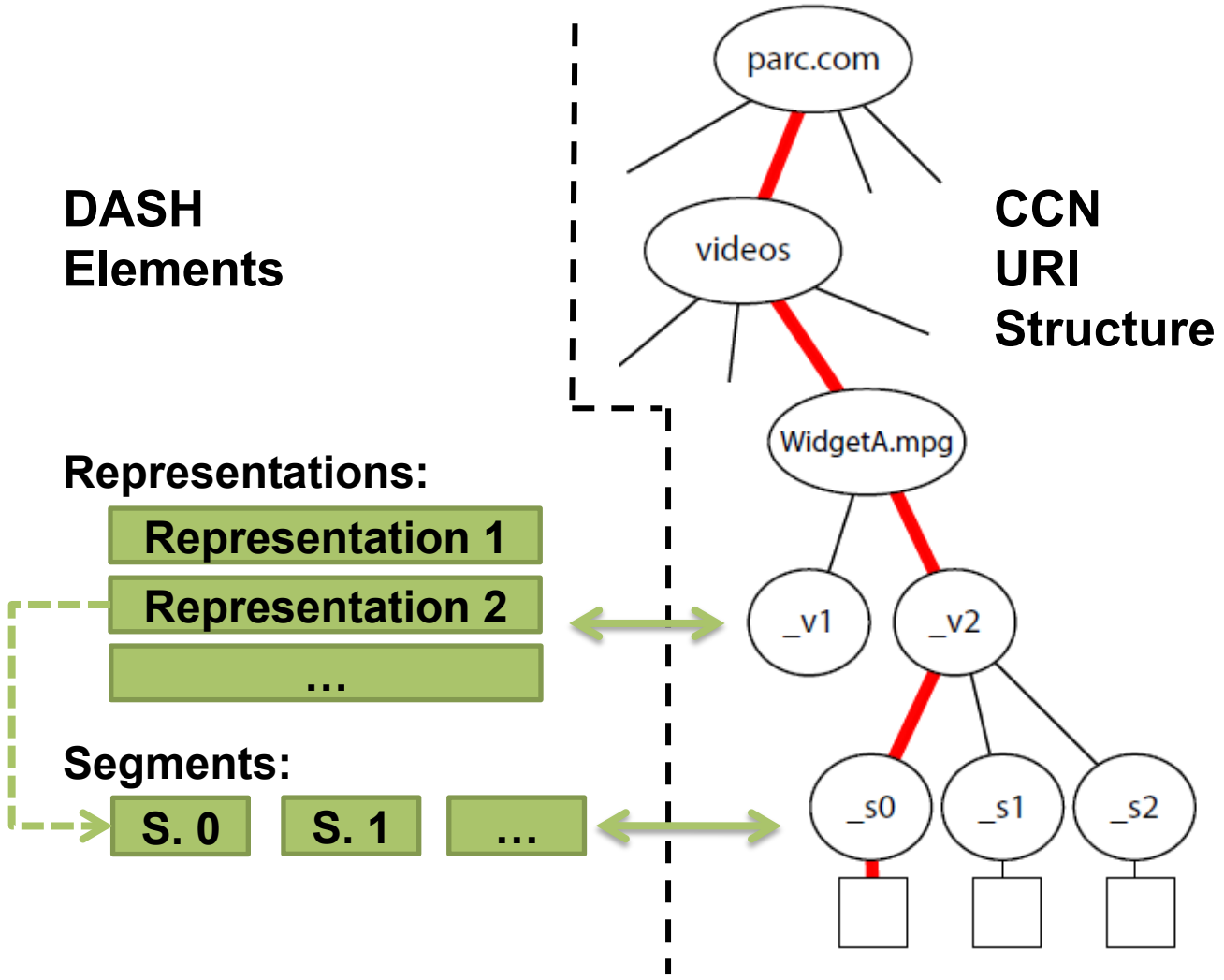
Work Done Yet

- **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.

DASH OVER CCN: FURTHER INTEGRATION

Leverage the intrinsic versioning and segmentation support of CCN

Move representation selection from the client to the network



DASH @ Alpen-Adria-Universität Klagenfurt

Join this activity, everyone is invited – get involved in and exited about DASH!

http://dash.itec.aau.at

Questions, Comments?

REFERENCES

[1] ISO/IEC DIS 23009-1.2, Information technology — Dynamic adaptive streaming over HTTP (DASH) — Part 1: Media presentation description and segment formats

[2] Lederer, S., Müller, C., Rainer, B., Timmerer, C., Hellwagner, H., "An Experimental Analysis of Dynamic Adaptive Streaming over HTTP in Content Centric Networks", in Proceedings of the IEEE International Conference on Multimedia and Expo 2013, San Jose, USA, July, 2013

[3] Liu, Y., Geurts, J., Point, J., Lederer, S., Rainer, B., Mueller, C., Timmerer, C., Hellwagner, H., "Dynamic Adaptive Streaming over CCN: A Caching and Overhead Analysis", in Proceedings of the IEEE international Conference on Communication (ICC) 2013 – Next-Generation Networking Symposium, Budapest, Hungary, June, 2013

[4] Grandl, R., Su, K., Westphal, C., "On the Interaction of Adaptive Video Streaming with Content-Centric Networks", eprint arXiv:1307.0794, July 2013.

[5] S. Lederer, C. Müller, B. Rainer, C. Timmerer, and H. Hellwagner, "Adaptive Streaming over Content Centric Networks in Mobile Networks using Multiple Links", in Proceedings of the IEEE International Workshop on Immersive & Interactive Multimedia Communications over the Future Internet, Budapest, Hungary, June, 2013

[6] V. Jacobson, D. Smetters, J. Thornton, M. Plass, N. Briggs and R. Braynard, "Networking named content", *in Proc. of the 5th int. Conf. on Emerging Networking Experiments and Technologies* (CoNEXT '09). ACM, New York, NY, USA, 2009, pp. 1-12.

[7] A. Detti, M. Pomposini, N. Blefari-Melazzi, S. Salsano and A. Bragagnini, "Offloading cellular networks with Information-Centric Networking: The case of video streaming", In *Proc. of the Int. Symp. on a World of Wireless, Mobile and Multimedia Networks* (WoWMoM '12), IEEE, San Francisco, CA, USA, 1-3, 2012.

[8] A.Detti, B. Ricci, N. Blefari-Melazzi, "Supporting mobile applications with Information Centric Networking: the case of P2P live adaptive video streaming", ACM SIGCOMM 2013, ICN workshop,Hong Kong, China, 12 August 2013

BACKUP

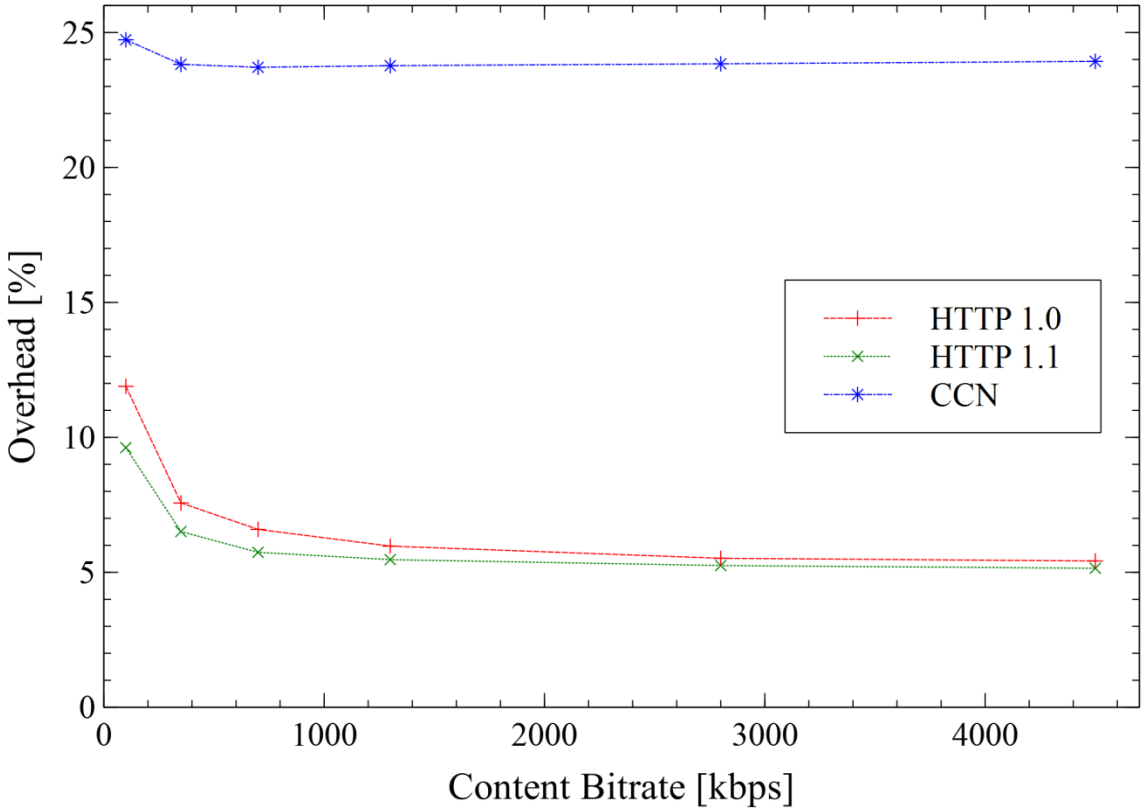
Overhead Analysis

CCN:

Higher but constant overhead due to signing and routing information

HTTP:

Relatively low overhead, dependent on chosen representation



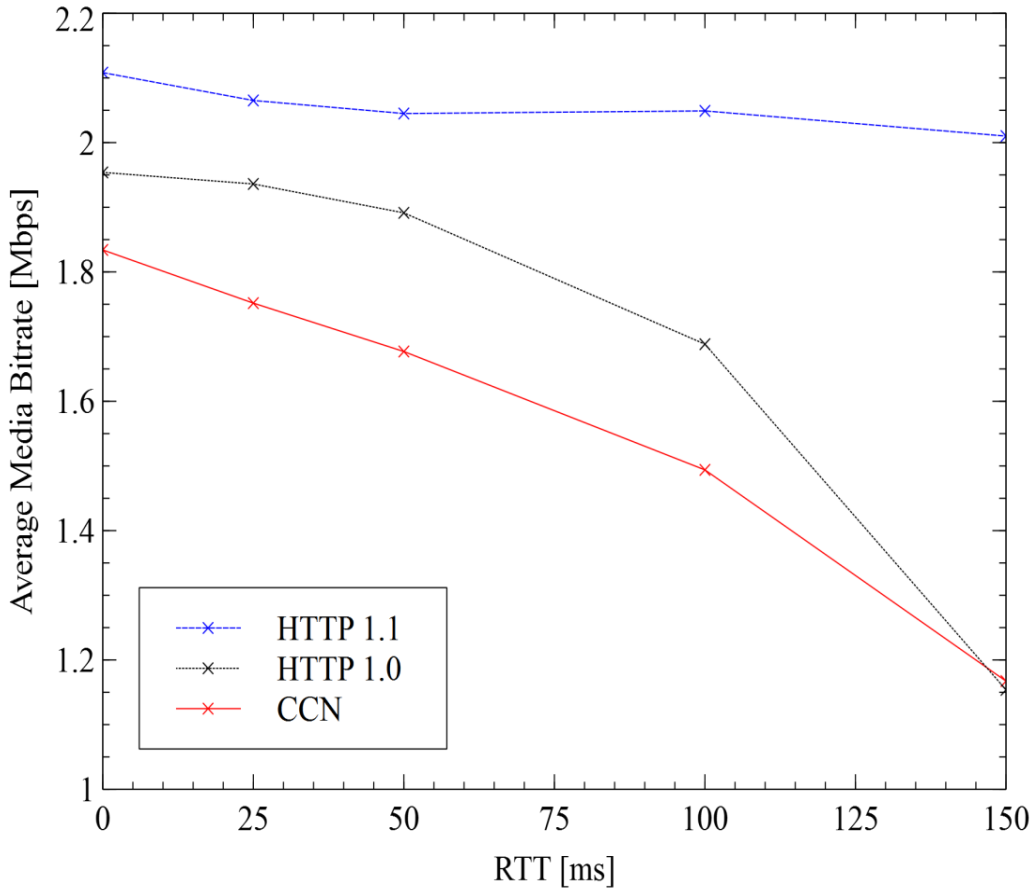
Performance Analysis

CCN

High delay sensitivity and prototype implementation

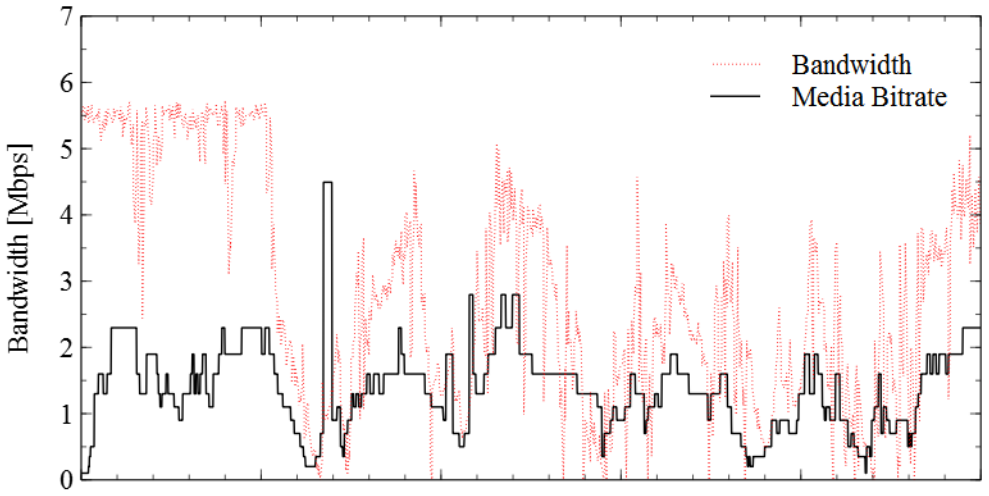
Identified improvement possibilities regarding:

- Segment Pipelining
- Interest Pipelining
- Interest and Stream Management



DASH over CCN in Mobile Networks

Name	Average Bitrate [kpbs]	Average Switches [Number of Switches]	Average Unsmoothness [Seconds]
Microsoft [11]	1522	51	0
Adobe [11]	1239	97	64
Apple [11]	1162	7	0
DASH AVC [11]	1464	166	0
Improved DASH AVC [12]	2341	81	0
DASH SVC [12]	2738	101	0
DASH over CCN	**1326**	**160**	**0**



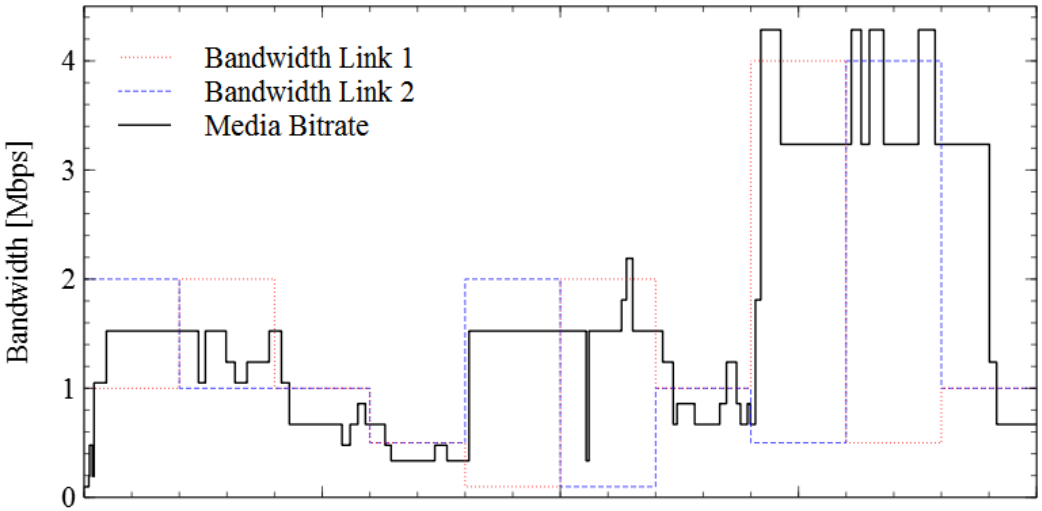
MULTILINK PERFORMANCE

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