Towards SVC-based adaptive streaming in information centric networks

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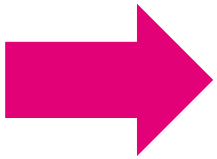
Internet services have drastically changed

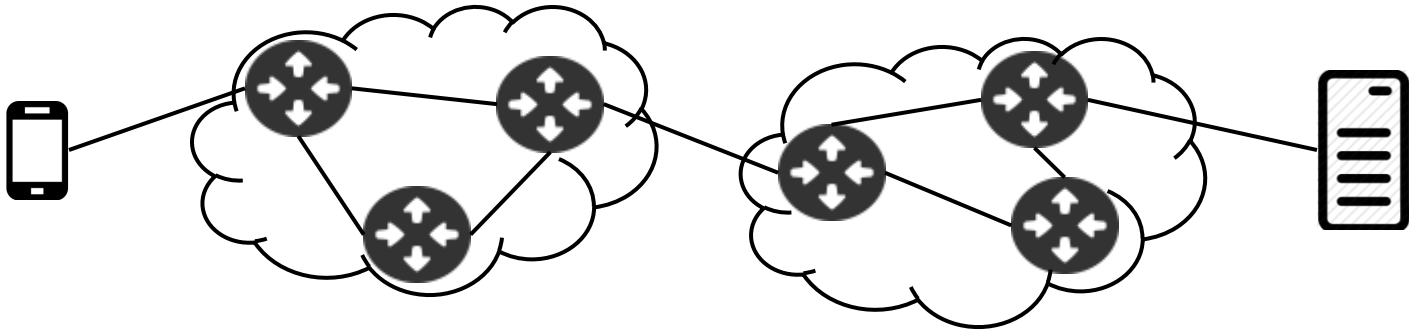


- Low complexity
- Performance easy to measure

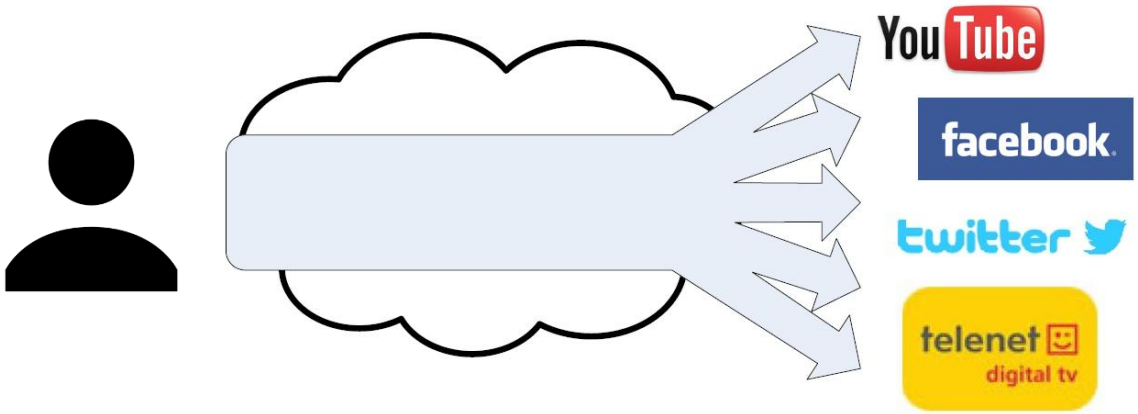
- Real-time and bandwidth consuming
- Performance *difficult* to measure

Information-Centric Networking (ICN)

Node-centric



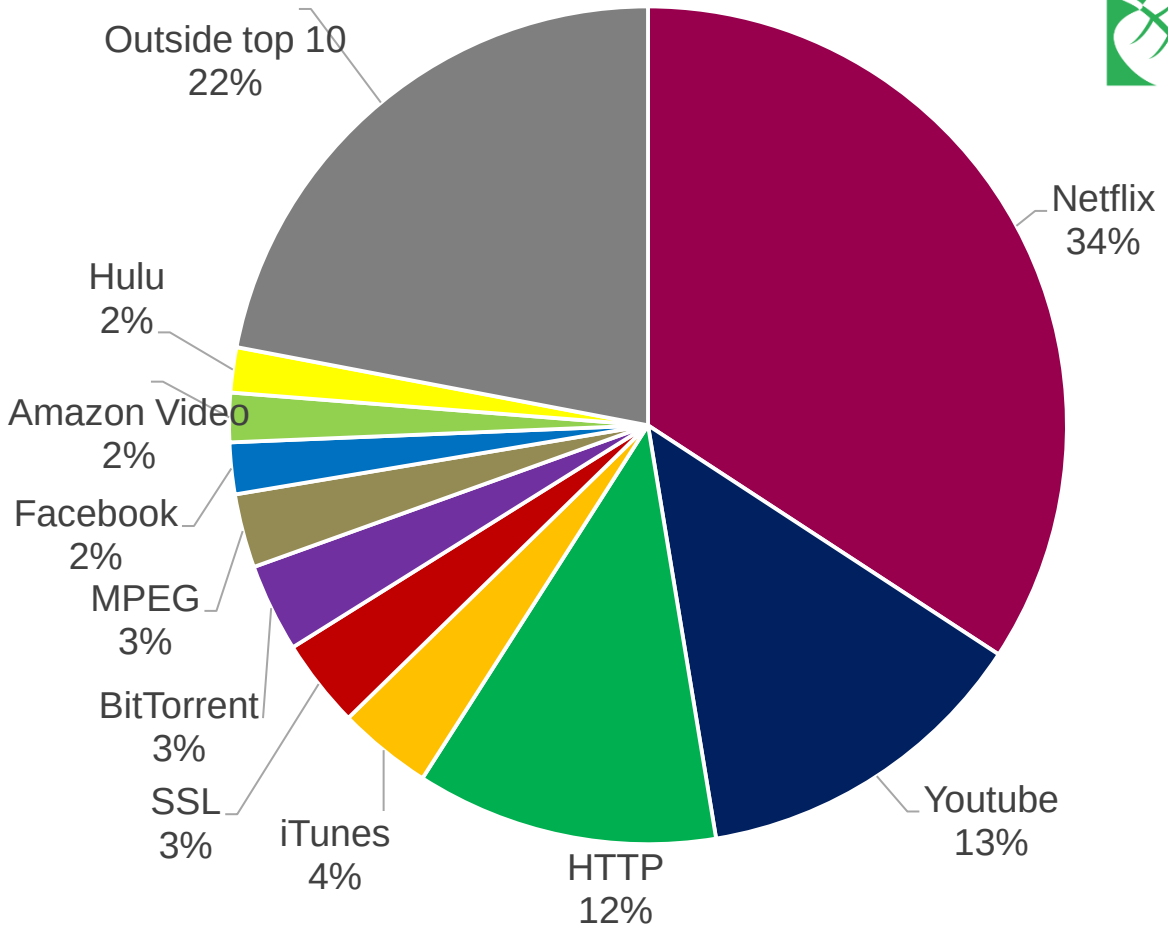
Information-centric



Advantages of ICN

- Inherent support for in-network caching and multicast
  - Content distributed in an efficient and scalable way
- Seamless use of all network interfaces of a device
  - Mobility and multi-access are enabled by default

Video streaming in today's Internet

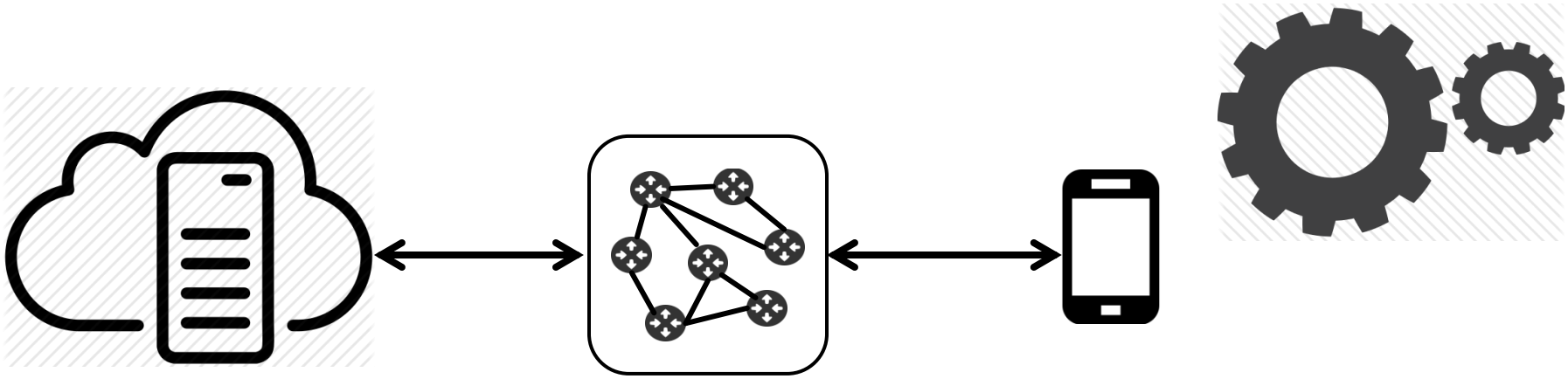


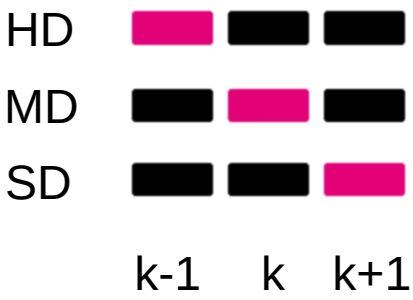
sandvine

Internet video streaming accounts for ≈50% of the downstream traffic on north American fixed network

HTTP Adaptive Streaming

HTTP Adaptive Streaming (HAS)





Local estimated bandwidth

Video player buffer level

HTTP Adaptive Streaming (HAS)

Avoid re-buffering events

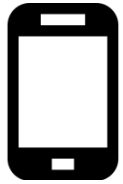
+

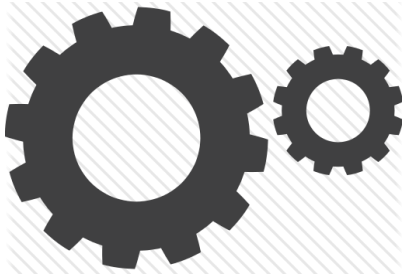
Maximize video quality

+

Minimize quality oscillations

Quality of Experience (QoE)



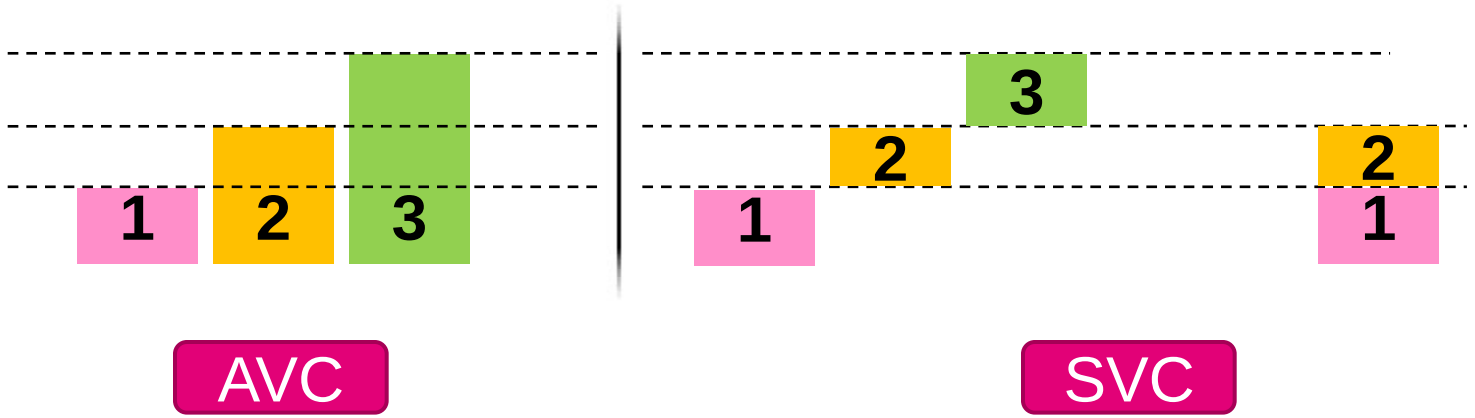


Inefficiencies of AVC over ICN

- Bandwidth unpredictability of ICN environments
- Not suitable to seamless use of multiple network interfaces at the same time

Scalable Video Coding (SVC) adaptive streaming

SVC-based adaptive streaming

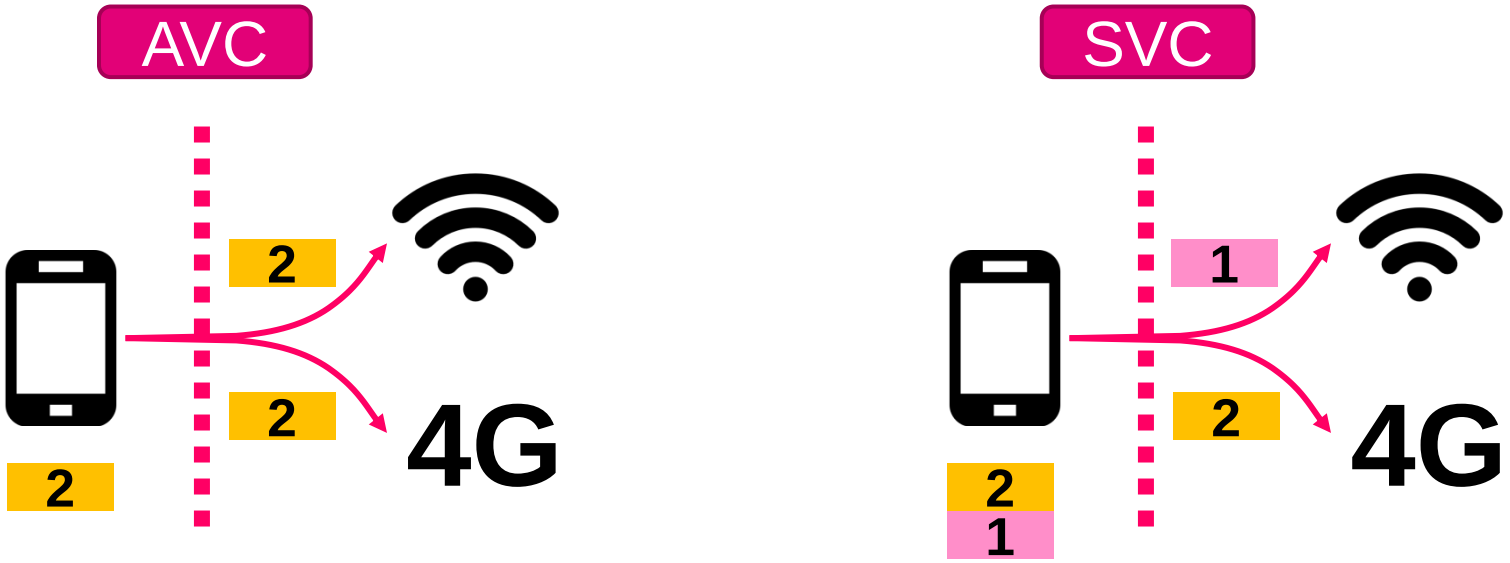


- ✚ Reduced redundancy in quality representations
- ✚ Robust behavior when BW fluctuates
- ✚ Client can incrementally increase quality
- ➖ Encoding overhead (around 10% per layer)

SVC over ICN: Opportunity and Challenges

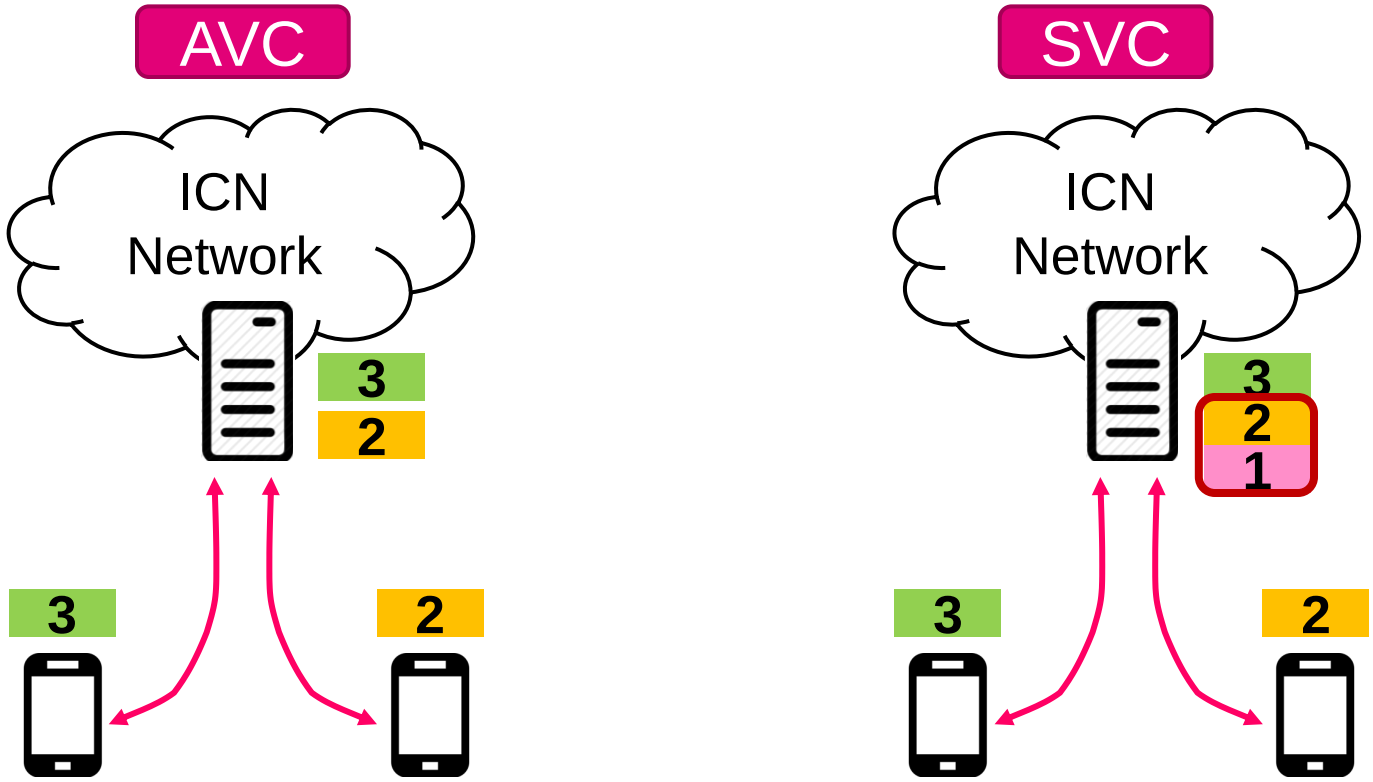
Multiple interface utilization

SVC can seamlessly use all the available network interfaces of a device to forward an interest

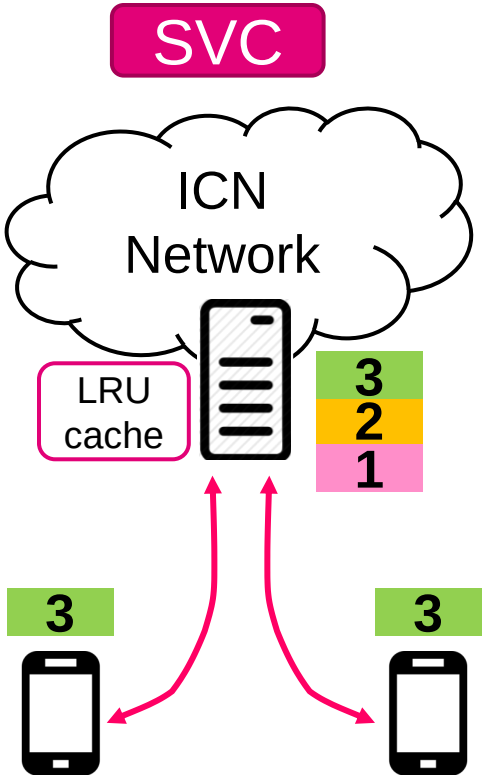


Impact on caching efficiency

SVC allows to increase caching efficiency and lower bandwidth usage in ICN



Mitigating cache misses for lower layers

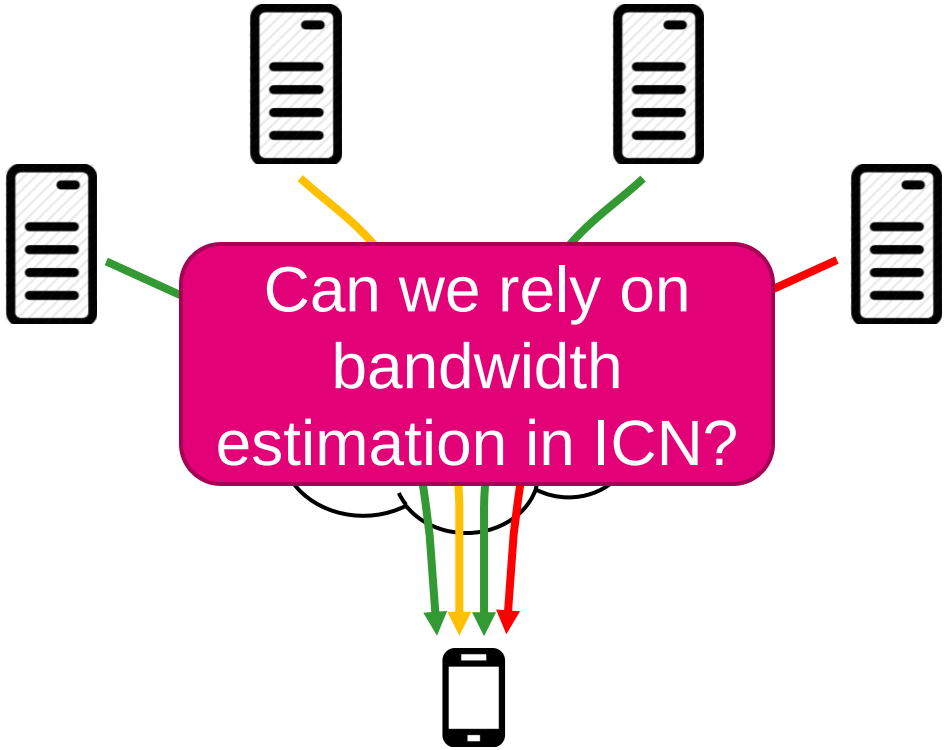


1. Cache aware of the inter-dependency between the layers

2. Quality layer removed if higher layers are not cached

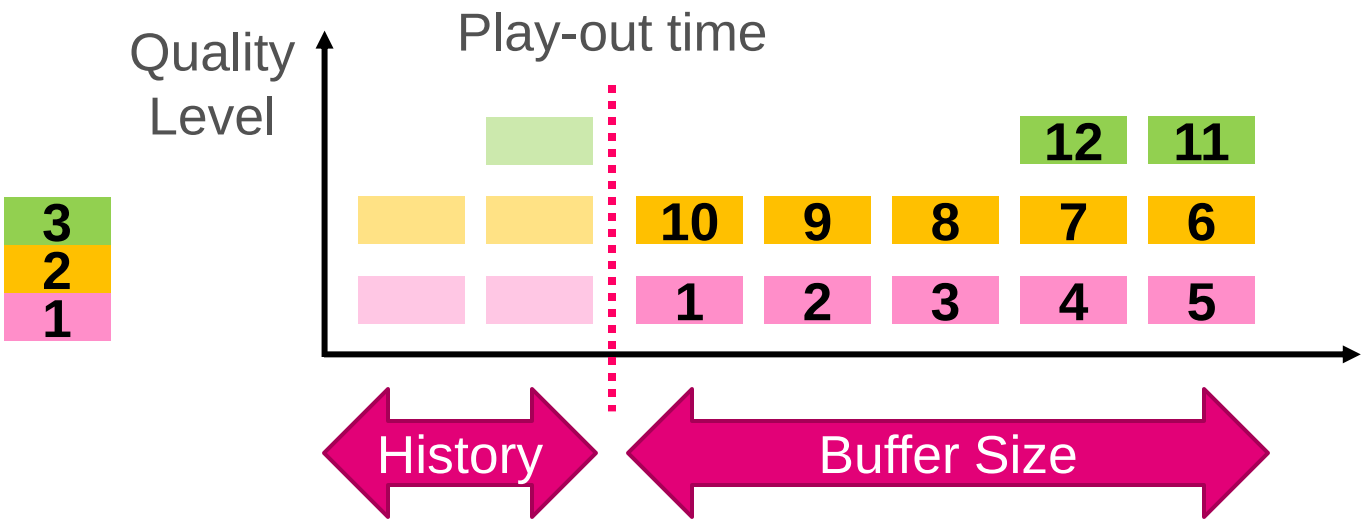
Mitigating bandwidth unpredictability

Bandwidth unpredictability makes rate adaptation challenging



Mitigating bandwidth unpredictability

Purely buffer-based heuristics can reduce this issue

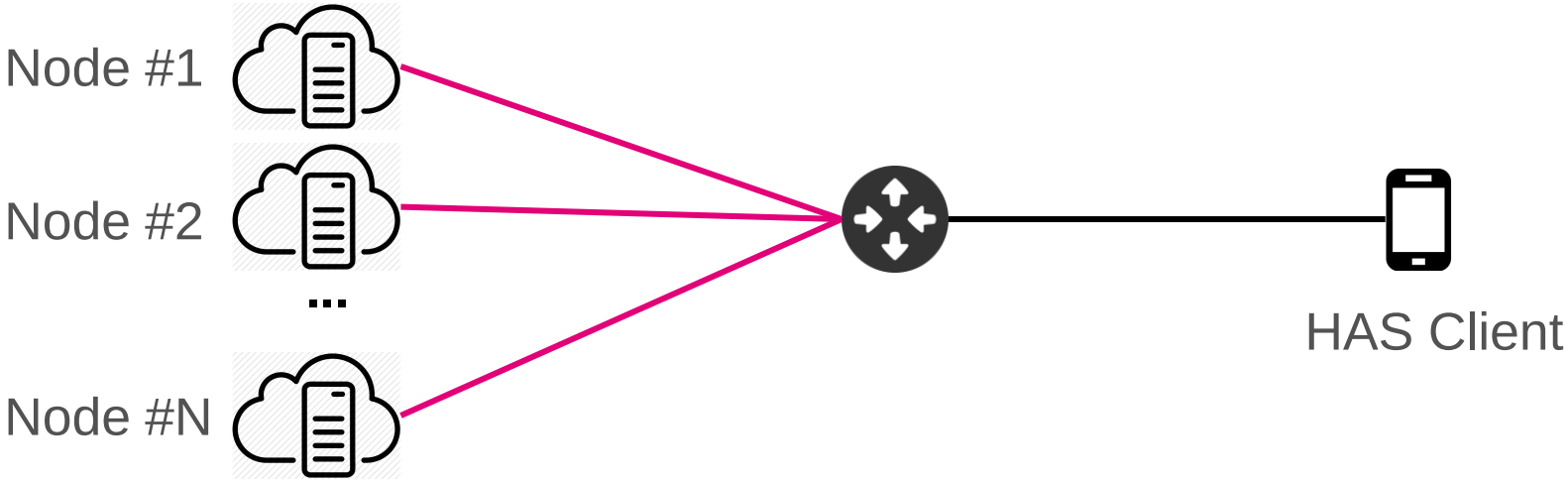


Experimental Setup and Results

Experimental setup on NS-3

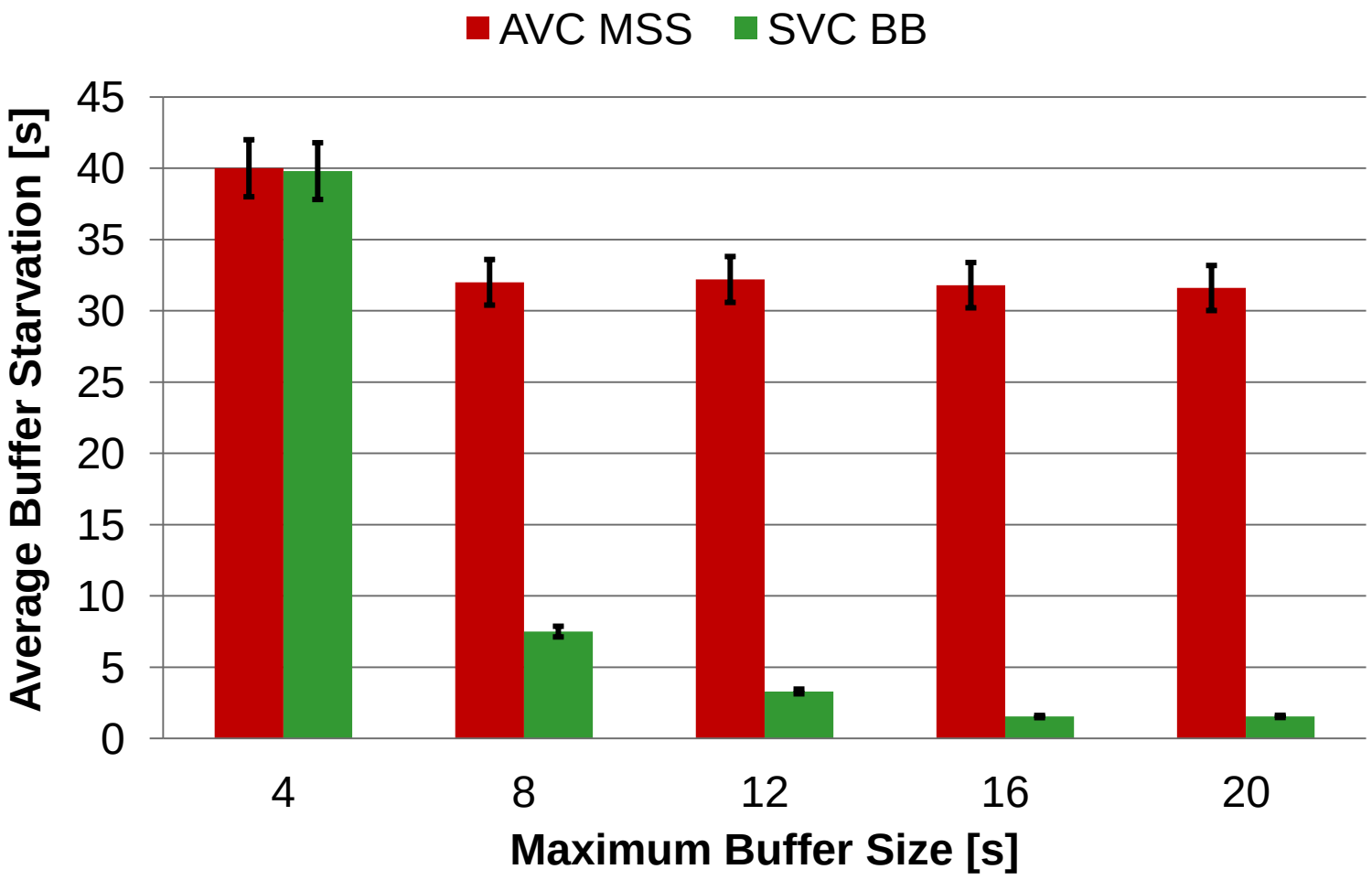
- An NS-3 based simulator was used
- We focus primarily on the problem of bandwidth (un)predictability
  - Multiple interface utilization and caching strategies is left as future work

Experimental setup on NS-3

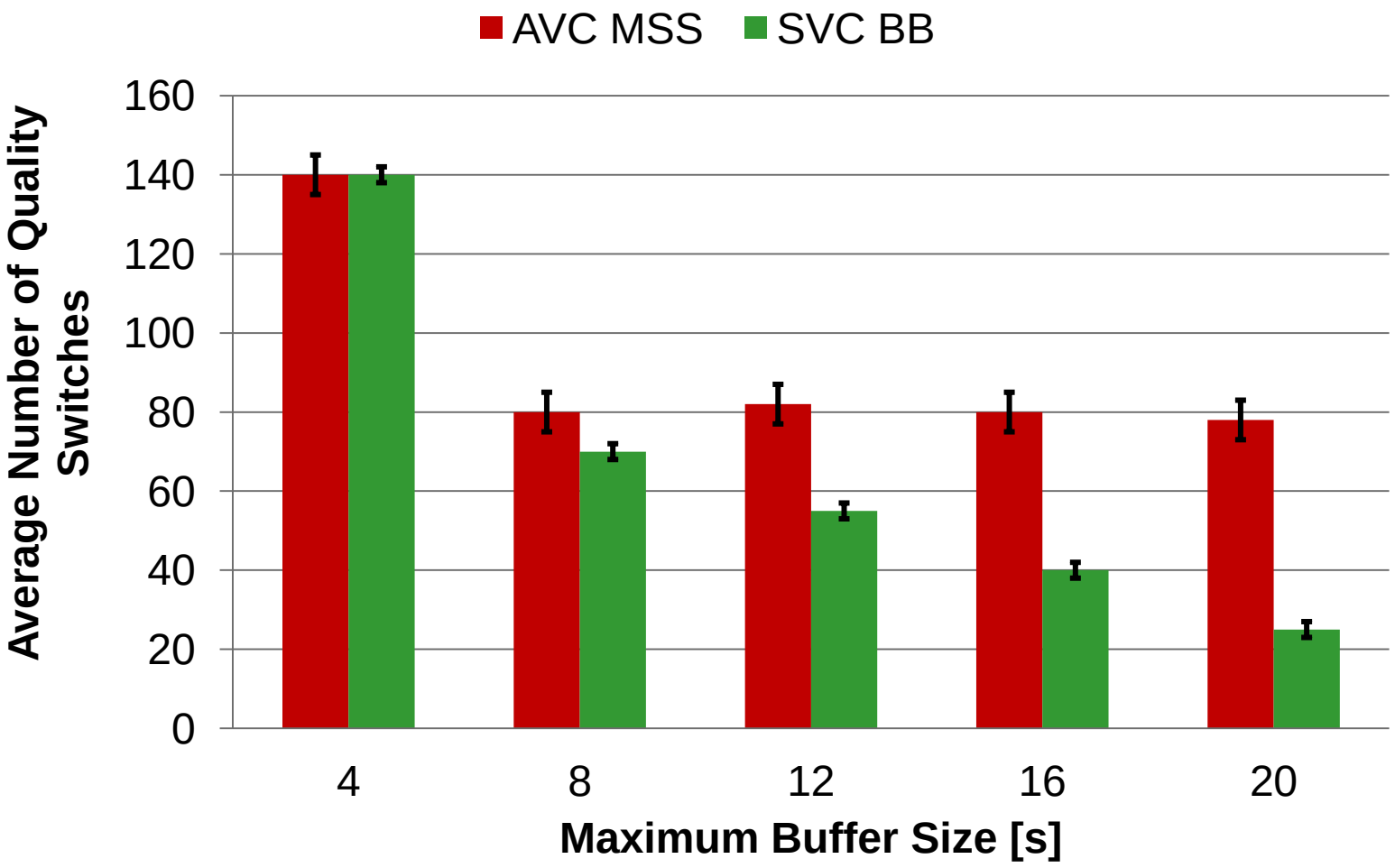


- Benchmarking with:
  - AVC Microsoft Smooth Streaming (AVC MSS)
  - SVC buffer based (SVC BB)
- Video with 3 quality levels and 2 seconds segments

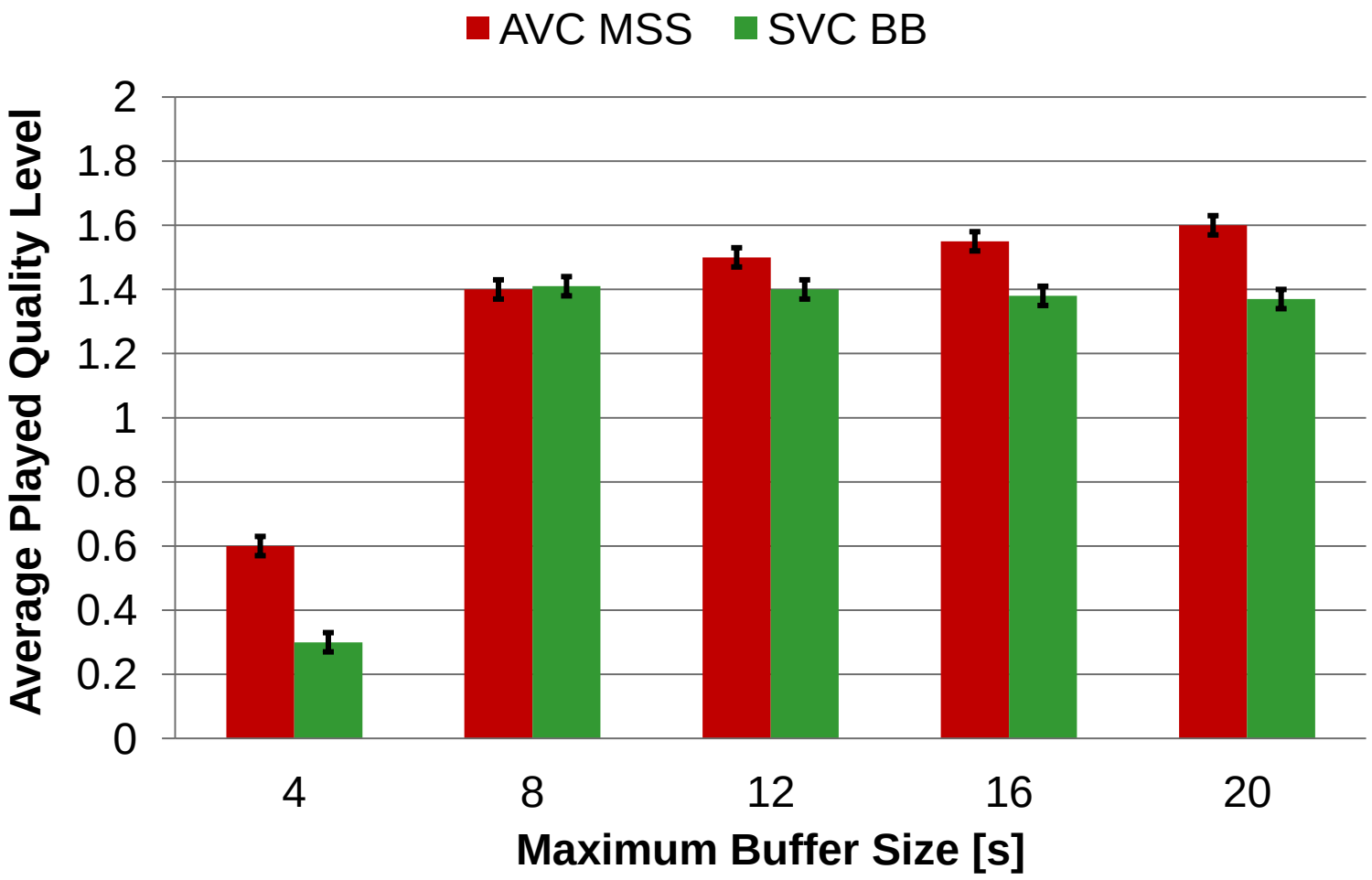
Average buffer starvation



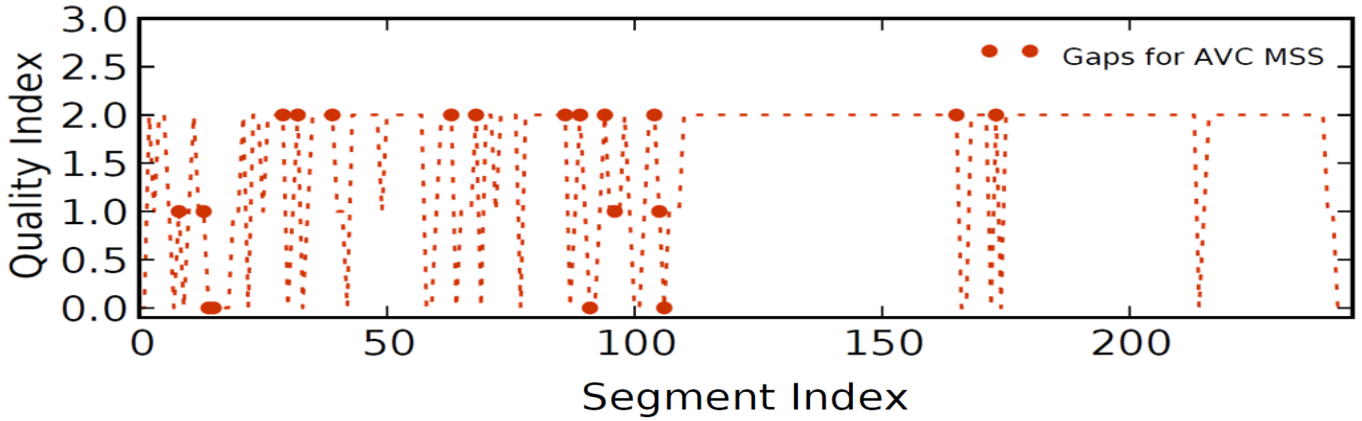
Average number of quality switches

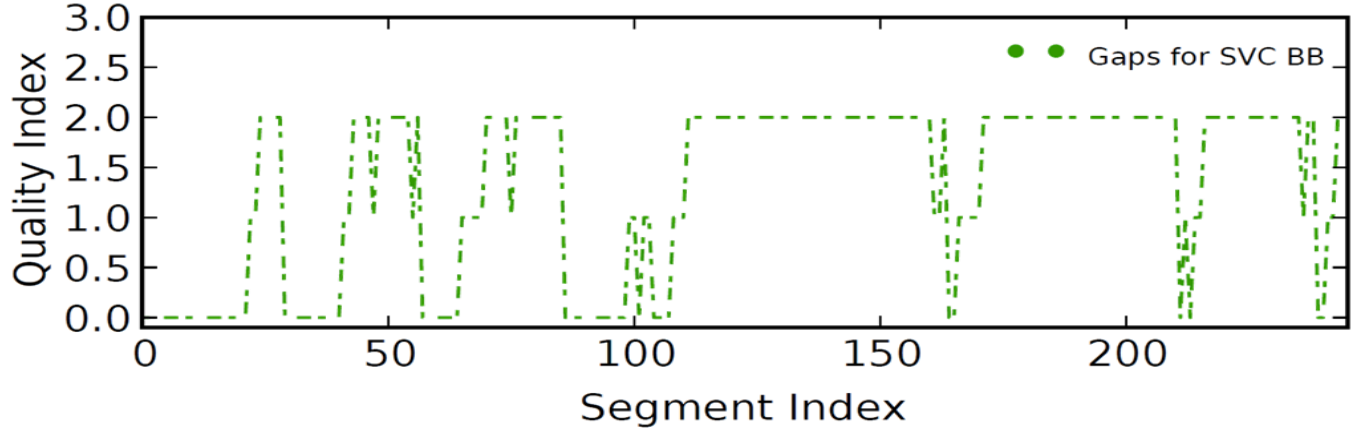


Average played quality



Quality adaptation for a 12s buffer size





Conclusions and Future Work

Conclusions

- Overview of opportunities and challenges of SVC in ICN environments
  - Leveraging multiple interface utilization
  - Impact on caching and resource utilization
  - Bandwidth unpredictability of ICN environments

- Results show that a buffer-based heuristic can consistently mitigate bandwidth unpredictability

Future work

- Investigate the use of more ICN-oriented simulation tool (ndnSIM)
- Evaluation of advanced caching strategies and multiple interface utilization
- Network-assisted delivery over ICN

Questions?

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