Fraunhofer
Heinrich Hertz Institute

Title: Scalable Video Coding based DASH for efficient usage of network resources

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Orange-FT, Yannick Le Louédec

Outline

- Motivation
- Dynamic Adaptive Streaming over HTTP (DASH)
- Scalable Video Coding (SVC)
- DASH using SVC
- Benefits of SVC-based DASH
- Conclusion

Motivation

- HTTP Streaming allows providing an Internet TV service at low cost
- No complex server requirements: servers are simple web servers
- HTTP caches can be re-used: load at servers reduced
- Complexity moved to the client: clients decide what to download
- Ease of deployment: no traversal issues with Firewalls and NATs as for RTP/UDP

⇒HTTP Streaming and in particular DASH has raised interest of researchers and market

Dynamic Adaptive Streaming over HTTP (DASH) – Part I

- Standardized in MPEG
- Multiple versions of the same content are offered
- DASH defines: XML Document MPD and Segment formats

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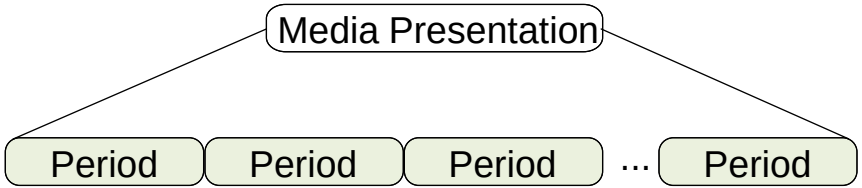

Structure and Description of the Media Presentation on DASH

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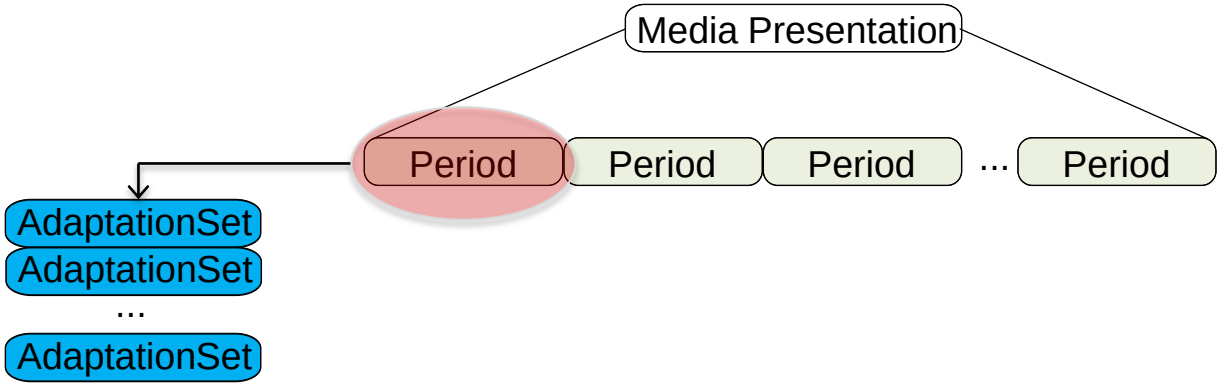

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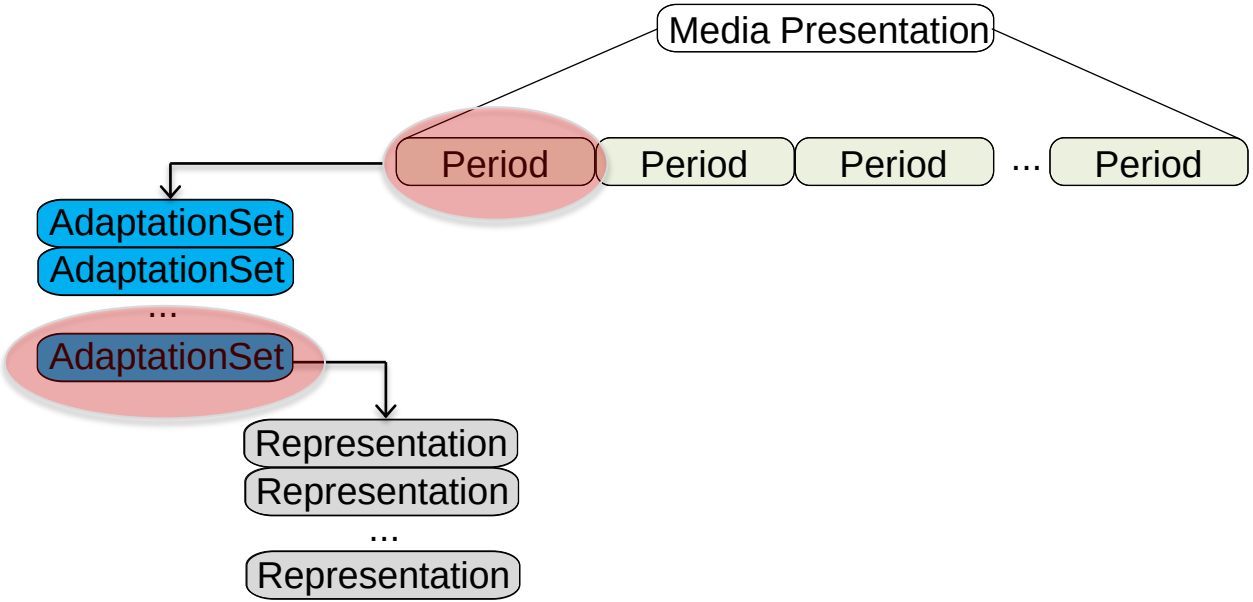

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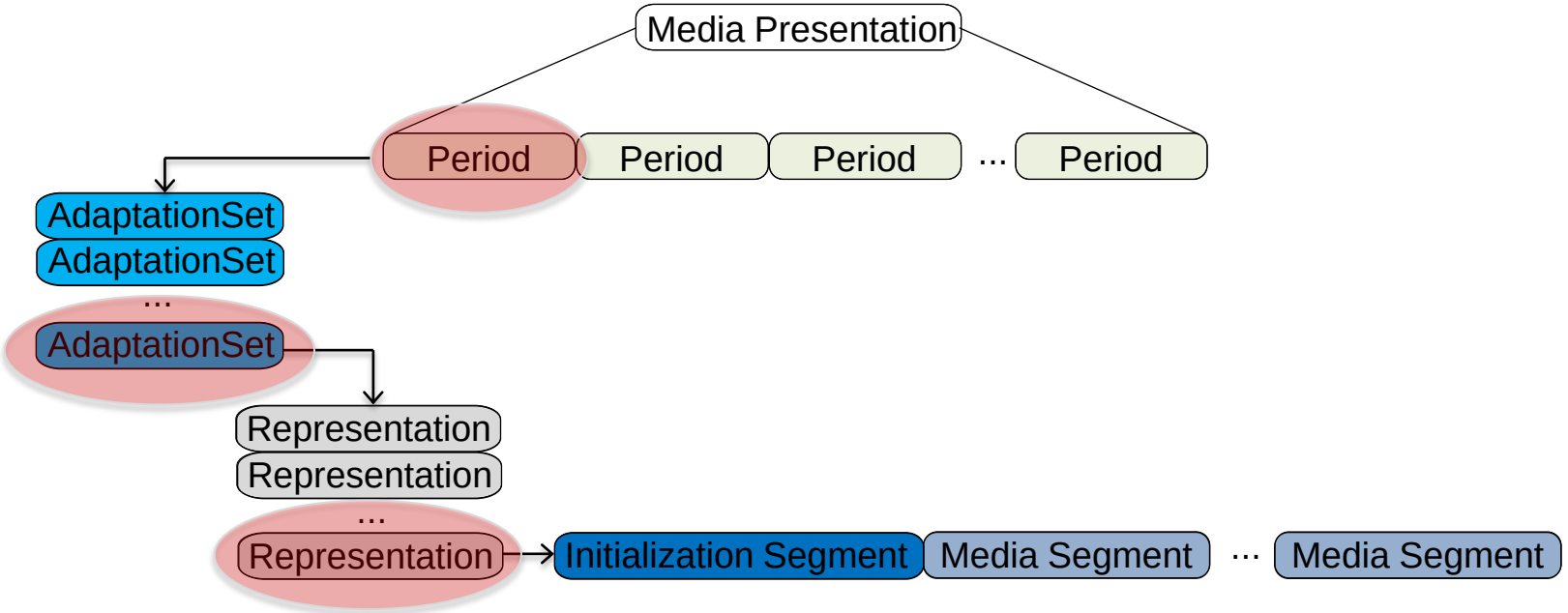

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Dynamic Adaptive Streaming over HTTP (DASH) – Part II

- Description of the available media: Media Presentation Description (MPD)
- Segment Formats:
  - ISO base media File Format
  - MPEG2-TS
  - But it can be used with other formats: there is a guideline in DASH

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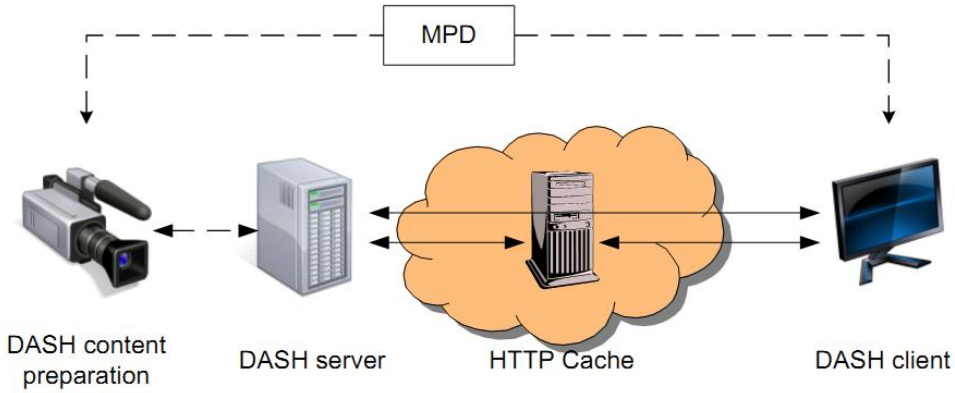


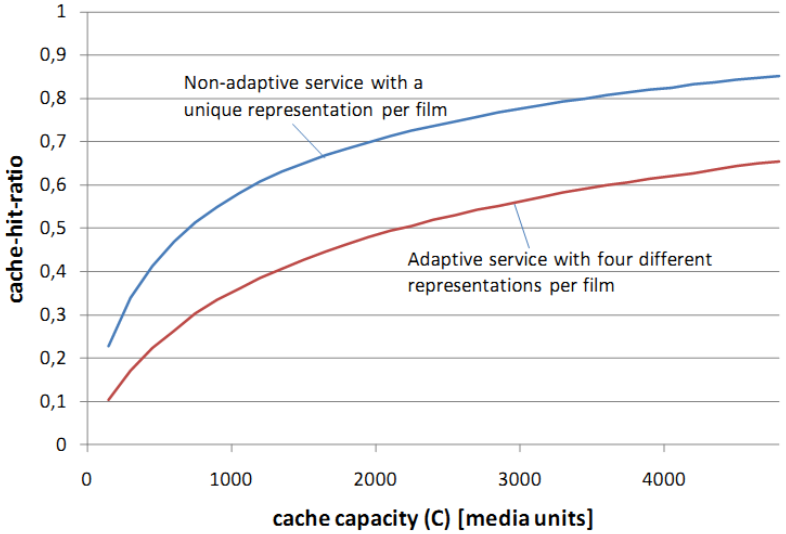
Example of DASH architecture

Problem description

- Heterogeneous clients or variable access link characteristics
- Different media components: languages, subtitles…

⇒Traffic diversification: efficiency decrease in cache-performance and network traffic increase

Media units = size of a film of 90 minutes @ 500Kbps



Results obtained from European project OCEAN: http://www.ict-ocean.eu/

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- Heterogeneous clients or variable access link characteristics
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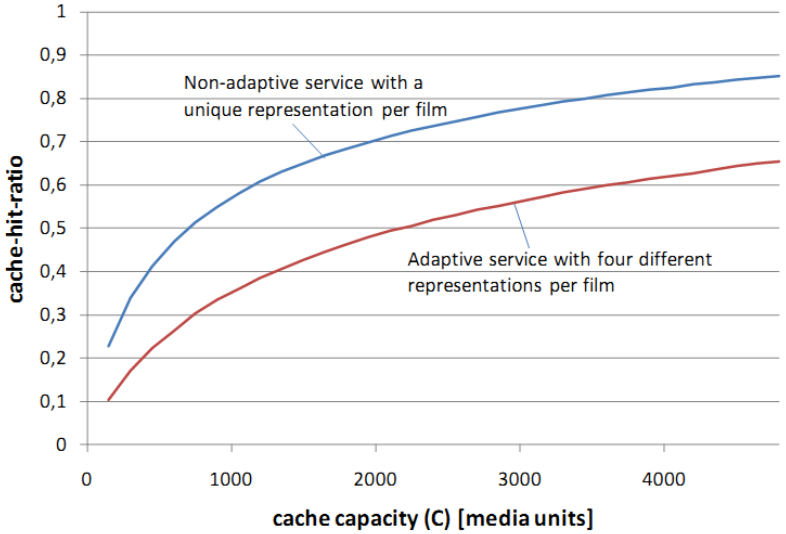
Solution

- Usage of SVC

Media units = size of a film of 90 minutes @ 500Kbps



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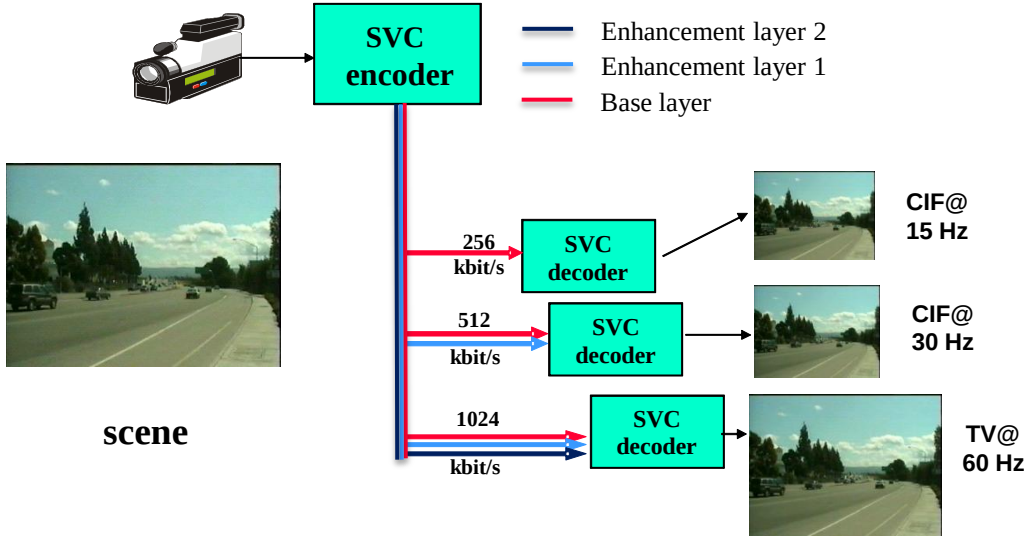
Scalable Video Coding

- Different qualities (temporal, spatial or fidelity) representations in a stream
- Additive/incremental substreams or layers
  - i.e., subset of layers can be selected for different quality representations



Principle of Scalable Video Coding

Introduction to DASH using SVC – Part I

- Efficient support of SVC within DASH is fulfilled
- Layers of SVC are mapped to representations
- Dependencies between representations indicated in MPD

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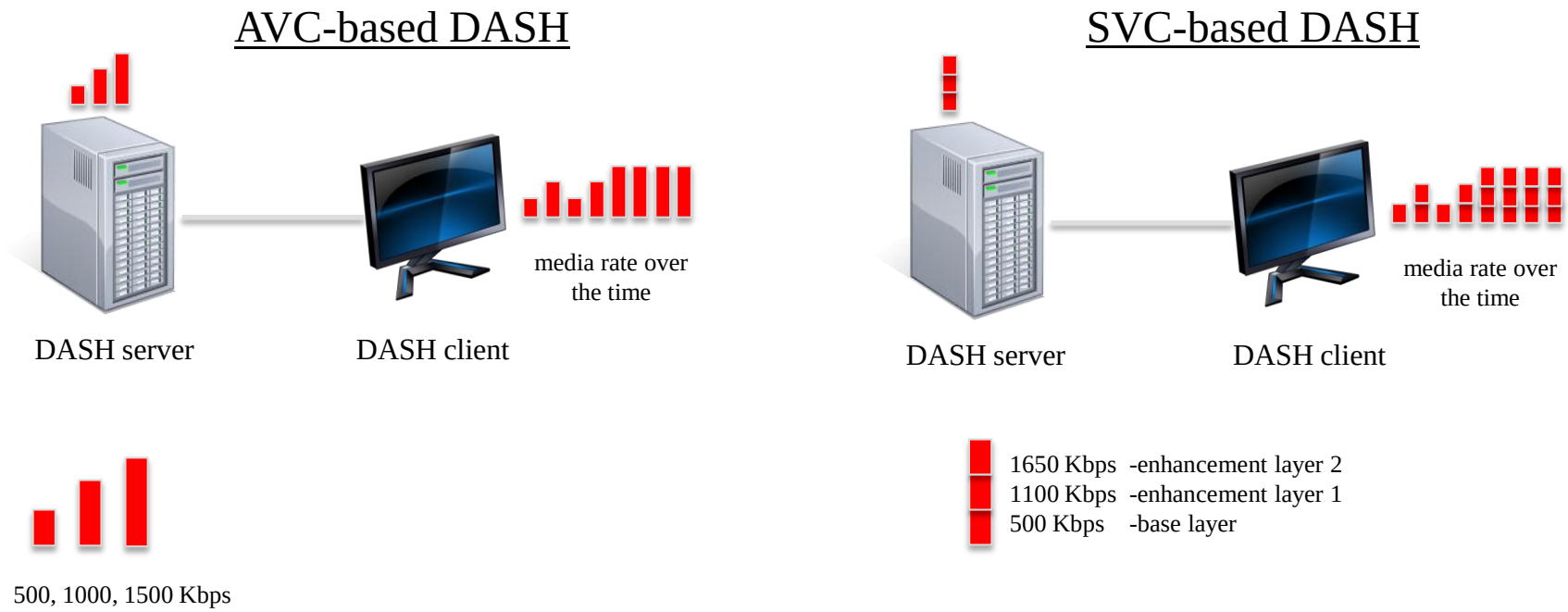


Introduction to DASH using SVC – Part II

- Efficient support of SVC within DASH is fulfilled
- Layers of SVC are mapped to representations
- Dependencies between representations indicated in MPD

AVC-based DASH

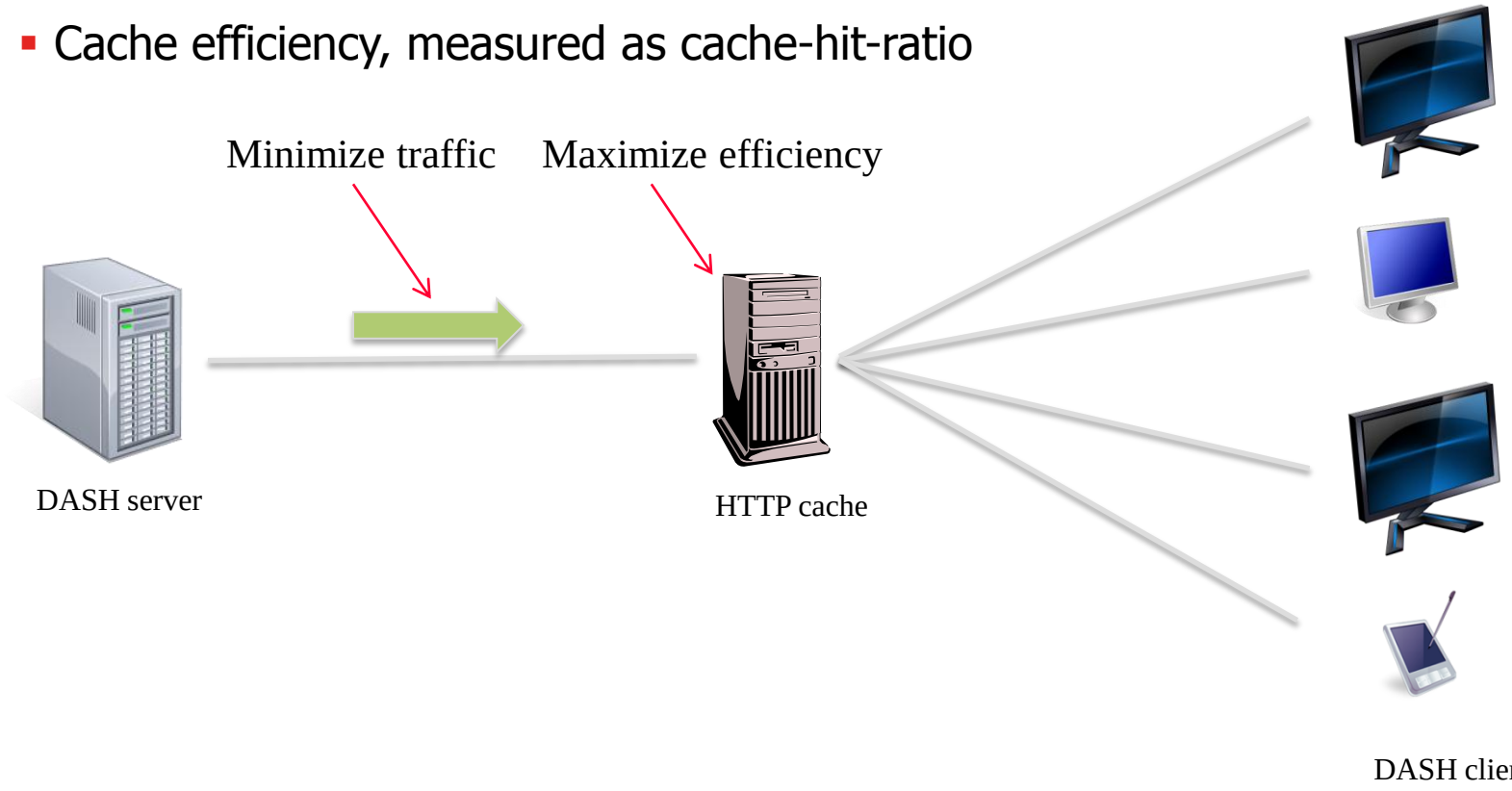
```
<?xml version="1.0" encoding="UTF-8"?>
<MPD …>
  …
  <Period>
    <AdaptationSet …>
      <Representation id="tag5" …>
        <BaseURL>video-500k.mp4</BaseURL>
      </Representation>
      <Representation id="tag6" …>
        <BaseURL>video-1000k.mp4</BaseURL>
      </Representation>
      <Representation id="tag7" …>
        <BaseURL>video-1500k.mp4</BaseURL>
      </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

SVC-based DASH

```
<?xml version="1.0" encoding="UTF-8"?>
<MPD …>
  …
  <Period>
    <AdaptationSet …>
      <Representation id="tag5" …>
        <BaseURL>video-500k.mp4</BaseURL>
      </Representation>
      <Representation id="tag6" dependencyId="tag5" …>
        <BaseURL>video-1100k.mp4</BaseURL>
      </Representation>
      <Representation id="tag7" dependencyId="tag5 tag6" …>
        <BaseURL>video-1650k.mp4</BaseURL>
      </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

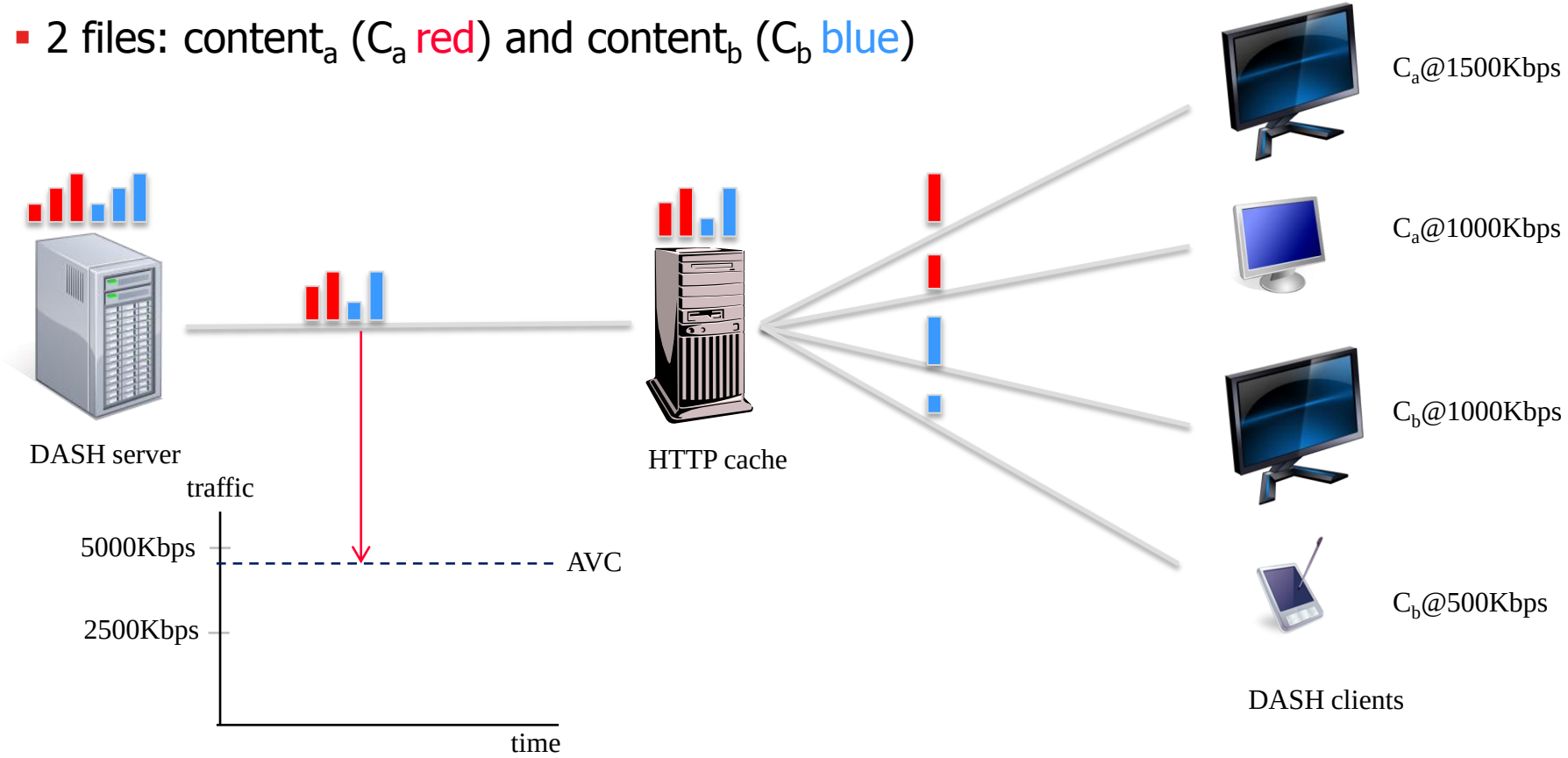
Usage of network resources - Part I

- Outbound traffic at DASH server
- Cache efficiency, measured as cache-hit-ratio



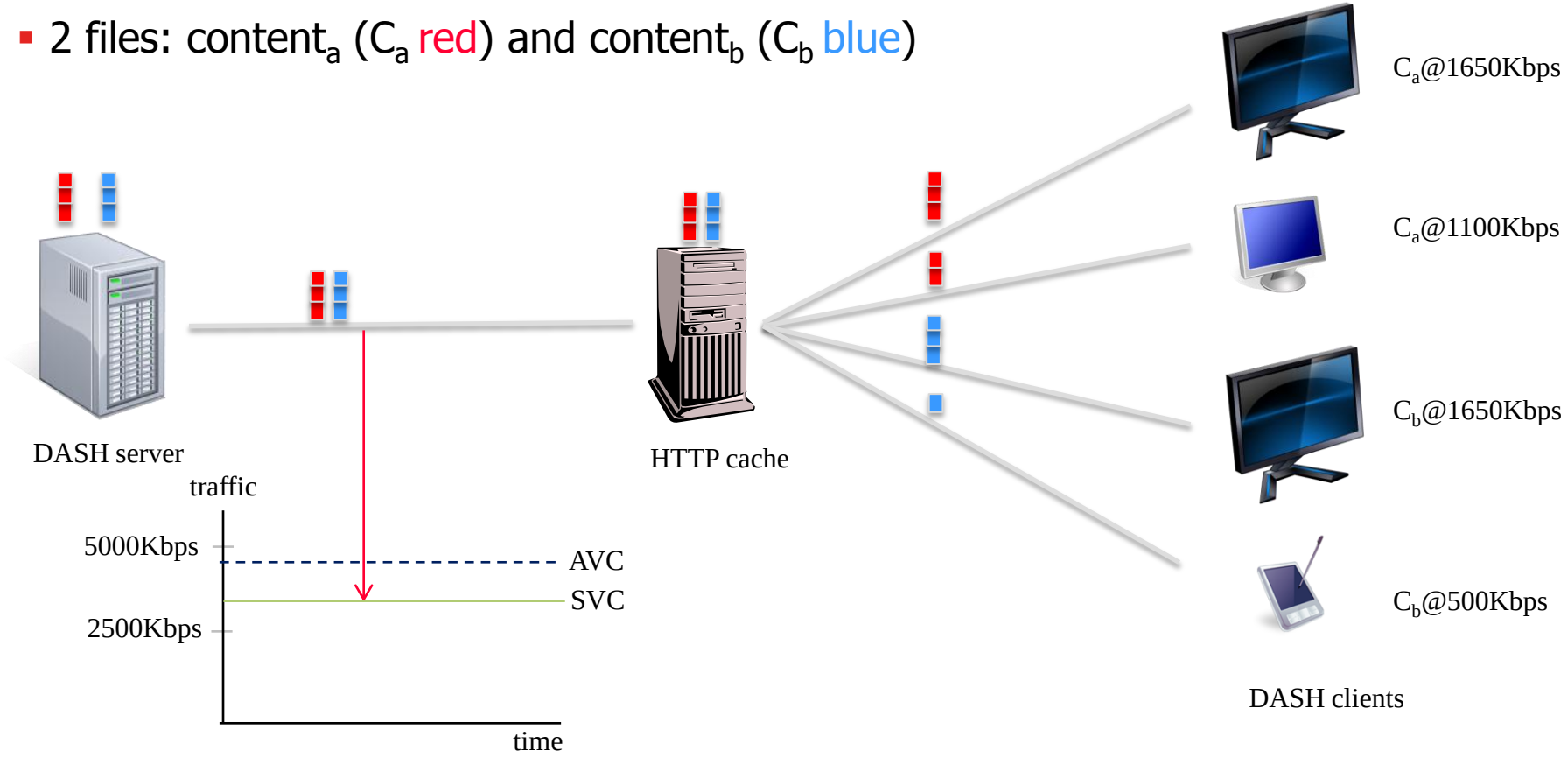
Usage of network resources - Part II (AVC based DASH)

- 3 versions for each content
- 2 files: content$_a$ (C_a red) and content$_b$ (C_b blue)



Usage of network resources - Part III (SVC based DASH)

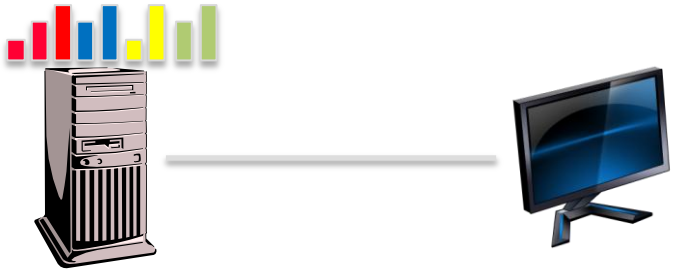
- 3 versions for each content
- 2 files: content$_a$ (C_a red) and content$_b$ (C_b blue)



Usage of network resources - Part IV (Comparison of cache usage)

- Same limited cache storage capacity for AVC and SVC

AVC based DASH



HTTP cache DASH client

SVC based DASH

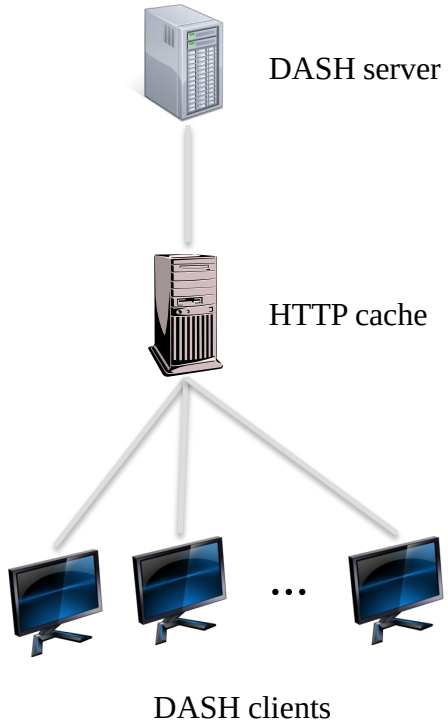
HTTP cache DASH clients

- In the example, different content versions
  - 20 for SVC
  - 9 for AVC single-layer
- Expected higher cache-hit-ratio for SVC-based DASH
- The transit-link traffic is further reduced by enhanced cache performance

Simulation Set up

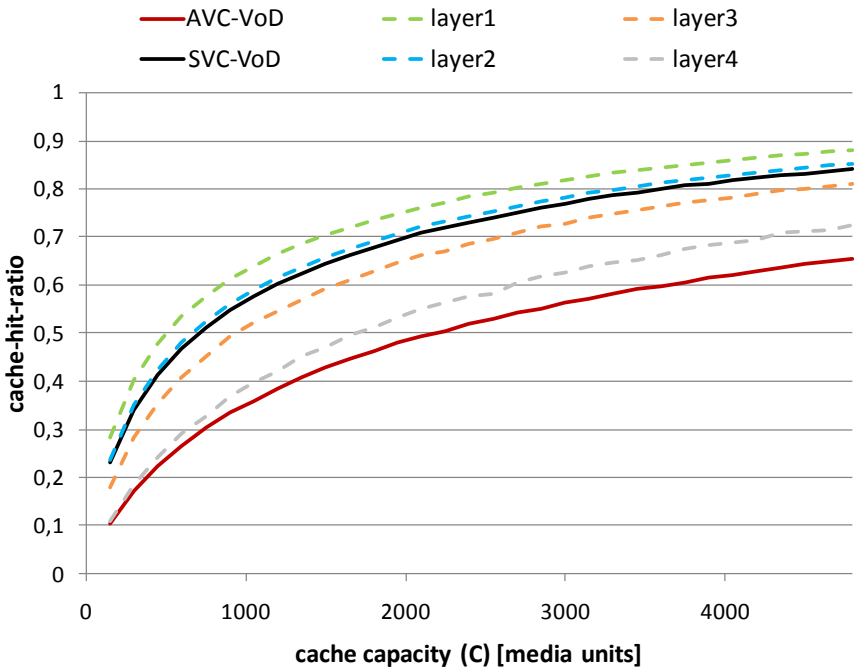
- More than 5000 video files among users can choose
- Users requests based on traces of a real implementation
- 3400 request per day on average
- 4 Representations offered at the server
- Two different environments:
  - Static clients with different equipment capabilities
  - Dynamic clients with varying available throughput
- Results obtained within European project OCEAN:

http://www.ict-ocean.eu/



Results – Part I

- Static clients (no adaptation)
- Clients with different equipment capabilities: 25% of each type



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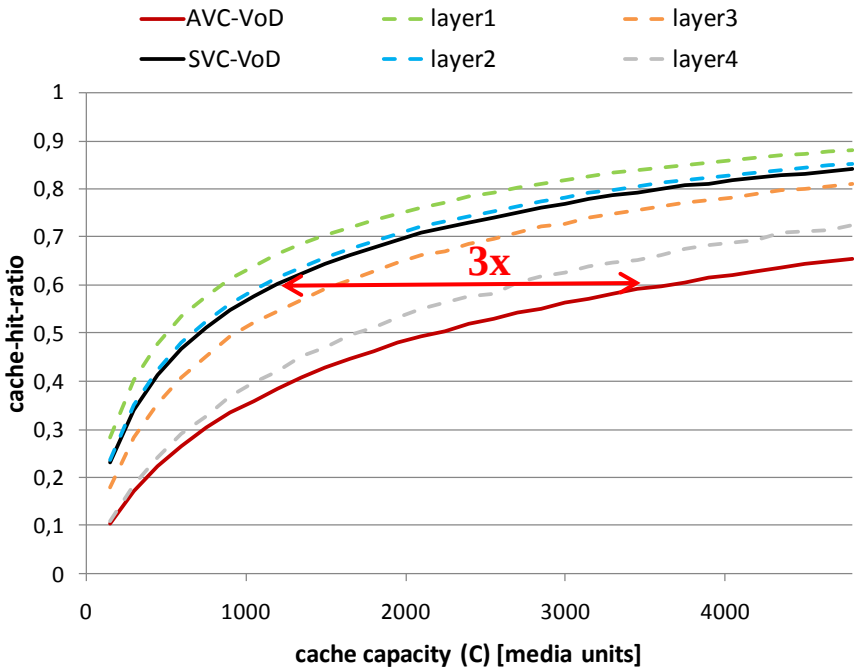
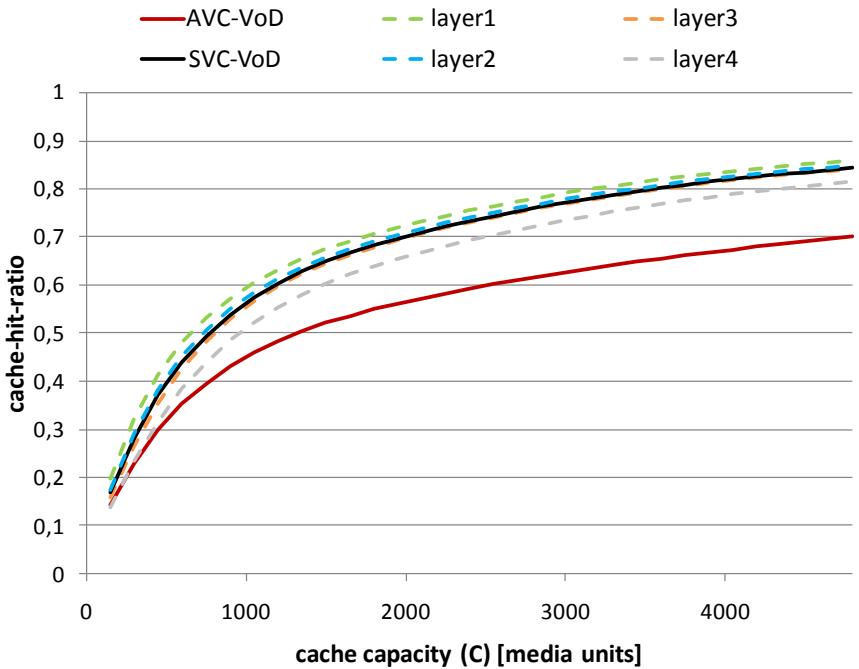


Results – Part II

- Dynamic clients adapting to network conditions
- Varying throughput simulated
- Rates distribution for clients $(r_1,r_2,r_3,r_4) = (9.1\%,9.4\%,19.1\%,62.3\%)$, where $r_i<r_j$ if $i<j$



Conclusion – Why is this relevant for W3C?

- Internet traffic increasing significantly
- Video streaming will take a large proportion of the traffic
- DASH expected to be a very successful technology boosting ubiquitous Internet TV
- With diversification of devices and access technologies several versions of each content are foreseen
- SVC is a key technology that allows reduction of the traffic in the network
- Service Providers can reduce their costs due to traffic reduction
- W3C considered to play a very important role on allowing ubiquitous Internet TV and boosting DASH success

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Thank you for your attention!

Contact:

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www.hhi.fraunhofer.de/ip/mc

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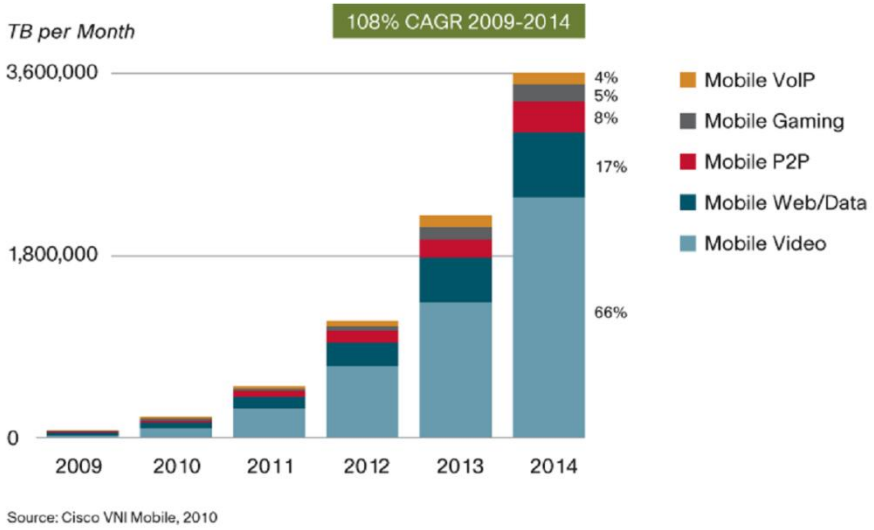
Berlin, Germany

Traffic Prediction

- Global Internet video streaming traffic shows an explosive growth
- With improvement in Mobile technologies, internet and video streaming ubiquitous and foreseen growth is huge



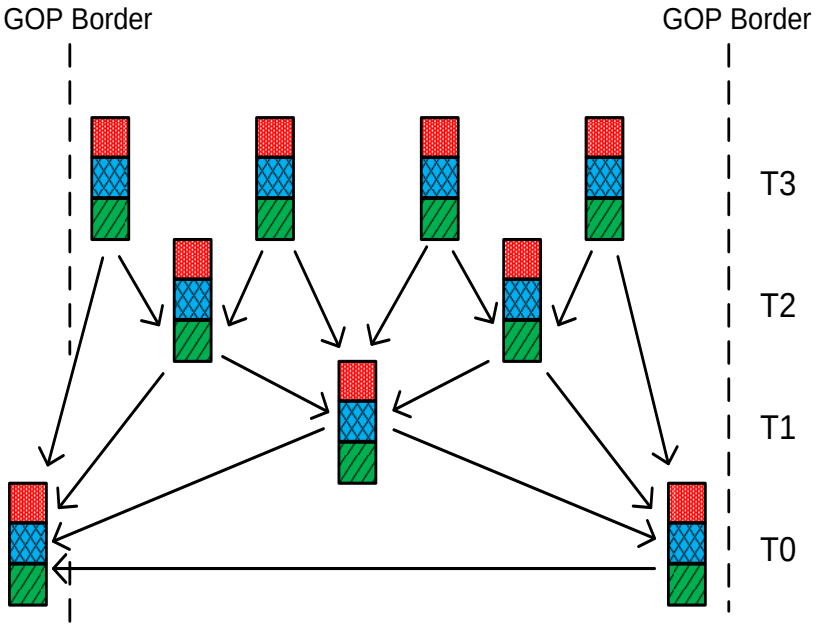
Source: Cisco White Paper: Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2009-2014 Figure 2

Example of a MPD for SVC

```
<?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>
  <!-- In this Period the SVC stream is split into three representations -->
  <Period>
    <AdaptationSet subsegmentAlignment="true" minBandwidth="512000" maxBandwidth="1024000" width="640" height="480" frameRate="30"
lang="en">
      <!-- Independent Representation -->
      <Representation mimeType="video/mp4" codecs="avc1.4D401E,mp4a.0x40" id="tag5" bandwidth="512000">
        <BaseURL>video-512k.mp4</BaseURL>
      </Representation>
      <!-- Representation dependent on above -->
      <Representation mimeType="video/mp4" codecs="avc2.56401E" id="tag6" dependencyId="tag5" bandwidth="768000">
        <BaseURL>video-768k.mp4</BaseURL>
      </Representation>
      <!-- Representation dependent on both above -->
      <Representation mimeType="video/mp4" codecs="avc2.56401E" id="tag7" dependencyId="tag5 tag6" bandwidth="1024000">
        <BaseURL>video-1024k.mp4</BaseURL>
      </Representation>
    </AdaptationSet>
  </Period>
</MPD>
```

Different representations/Operation Points (OP)

- OPs also based on smaller parts of layers



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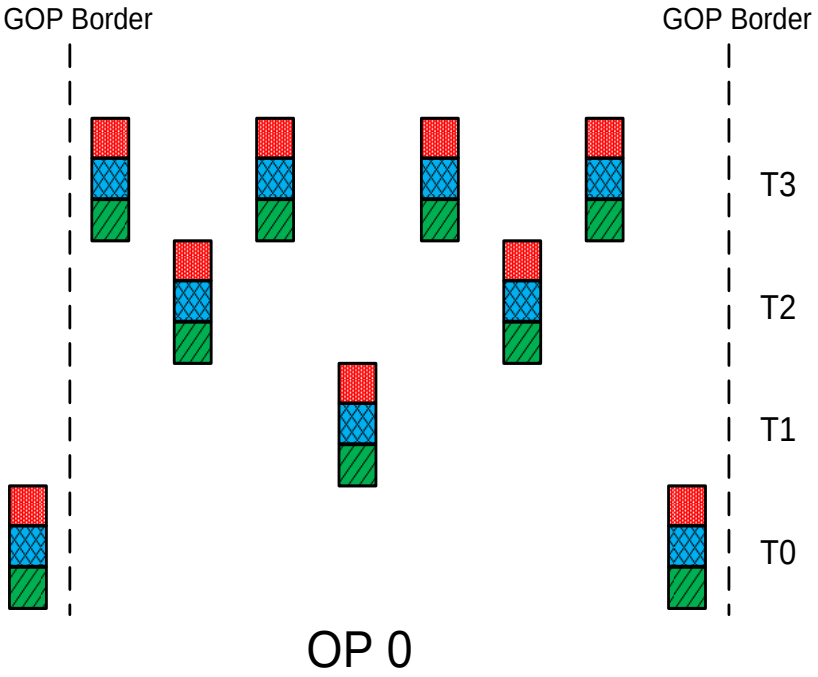

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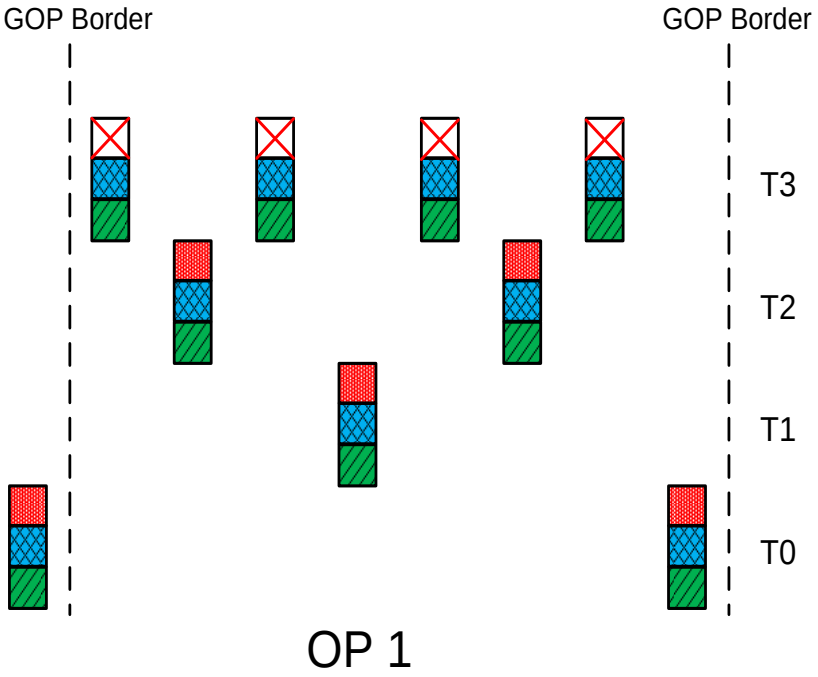

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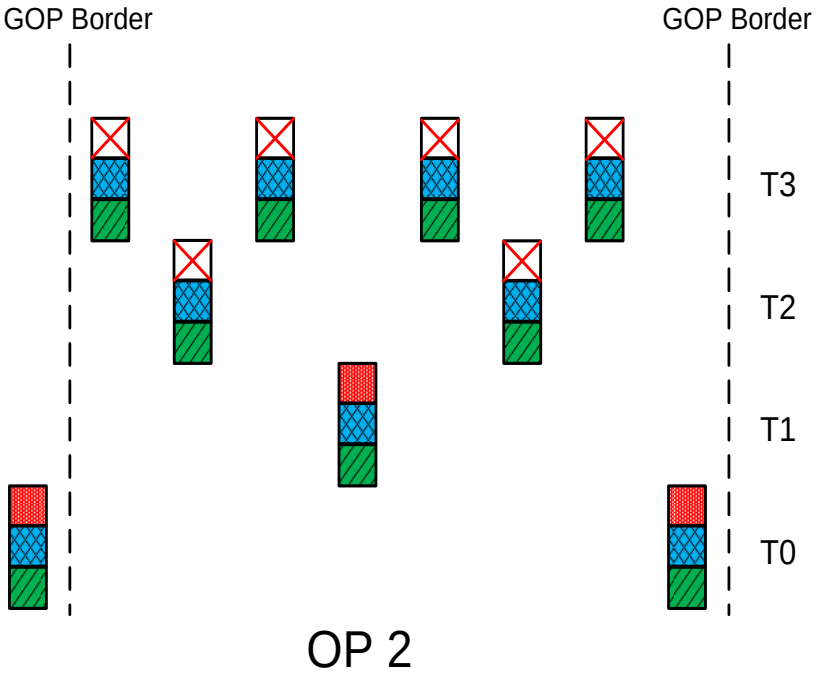

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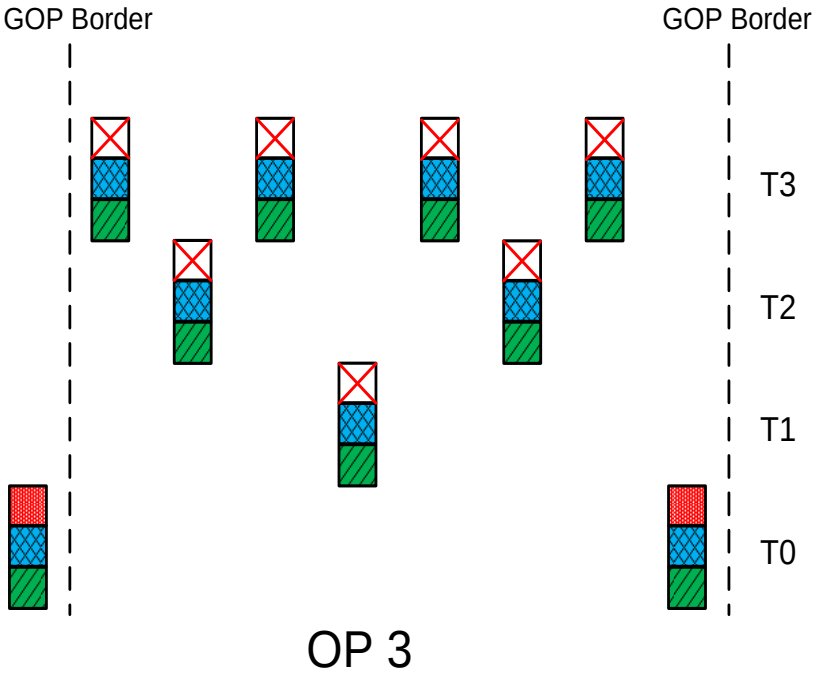

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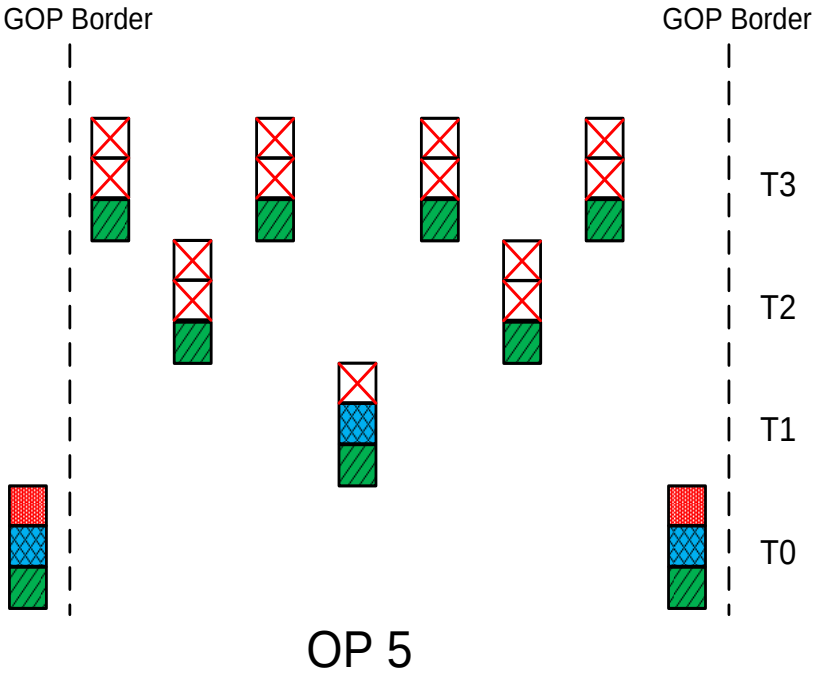

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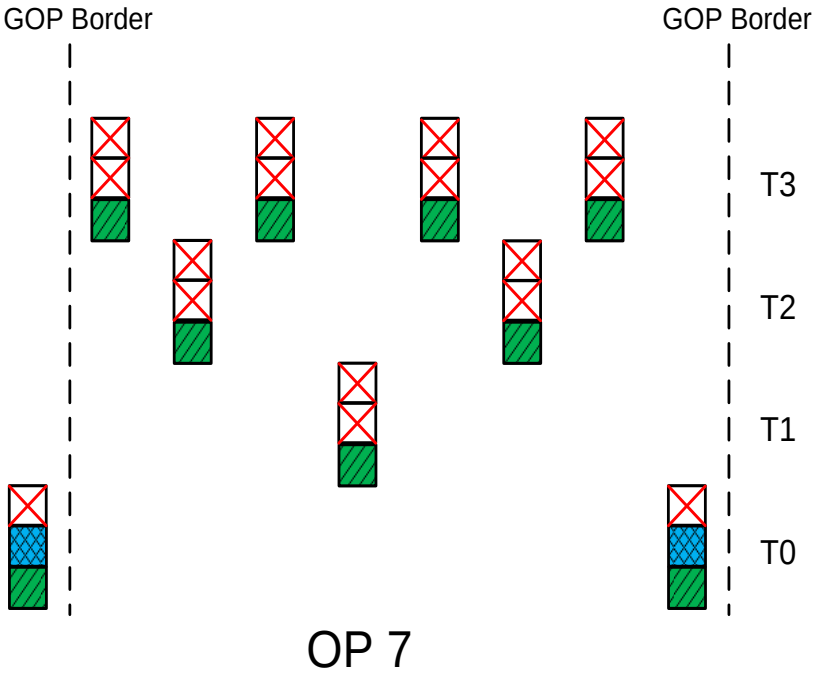

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