Cache as a Service: Leveraging SDN to Efficiently and Transparently Support Video-on-Demand on the Last Mile

Motivation

- Globally, Internet video traffic was 57% of all consumer Internet traffic in 2012 and will be 69% in 2017[1].
- Mobile video traffic exceeded 50% for the first time in 2012[2].
- High-Definition VoD surpassed Standard-Definition VoD in 2011. By 2016, 79% of Internet VoD will be HD[3].
- Trend to improve video quality even more as we move to Ultra-HD (4K-BK) and 3DTV that support 4 times higher resolution than HD.

Observations

- Video streaming is fast becoming an essential part of consumers’ lives.
- The network has now to transfer an enormous amount of video traffic (~45,000 Petabytes per month in 2016); big strain on the network.
- We need a solution that:
  - Ensures high-throughput end-to-end (especially with HD).
  - Minimizes distance between source video content server and user so that data transfer occurs quickly & reliably to the user -> increased Quality of Experience (QoE).

Challenges with Video-on-Demand

- Currently VoD requests are handled naively; there is an independent flow per request.
- These flows are duplicated minutes, hours or days later (by same or different user).
- We observe identical delivery of media objects through the same network segments.
- Consequently, the end-to-end capacity of network infrastructure must grow continuously to match the increasing number of Internet video users.
- The increasing popularity of VoD and especially of HD content worsens this.

OpenCache Architecture

OpenCache is an OpenFlow-assisted in-network caching service that provides efficient, transparent and highly configurable caching and distribution of VoD in the last mile.

OpenCache is:

- Fast (up to 4 times higher bitrate requested by MPEG-DASH)
- Reduced startup delay up to 35% -> increased QoE for end-user
- External link utilisation reduced to virtually zero (only background traffic remained)
- Increased video quality; requested bitrate 8 times higher -> increased QoE for end-user

Evaluation on OFELIA

- OFELIA is an OpenFlow pan-European experimentation testbed.
- Topology: Deployed OpenCache on three OFELIA islands distributed geographically.
  - Switzerland: ETH Zurich
  - Italy: Create-NET
  - Spain: i2CAT
- Tests: Over 120 inter-island (federated) VoD experiments using an adaptive video streaming technology (MPEG-DASH).

Key Results

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- Reduced startup delay up to 35% -> increased QoE for end-user
- External link utilisation reduced to virtually zero (only background traffic remained)

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