A Framework for QoE Analysis of Encrypted Video Streams

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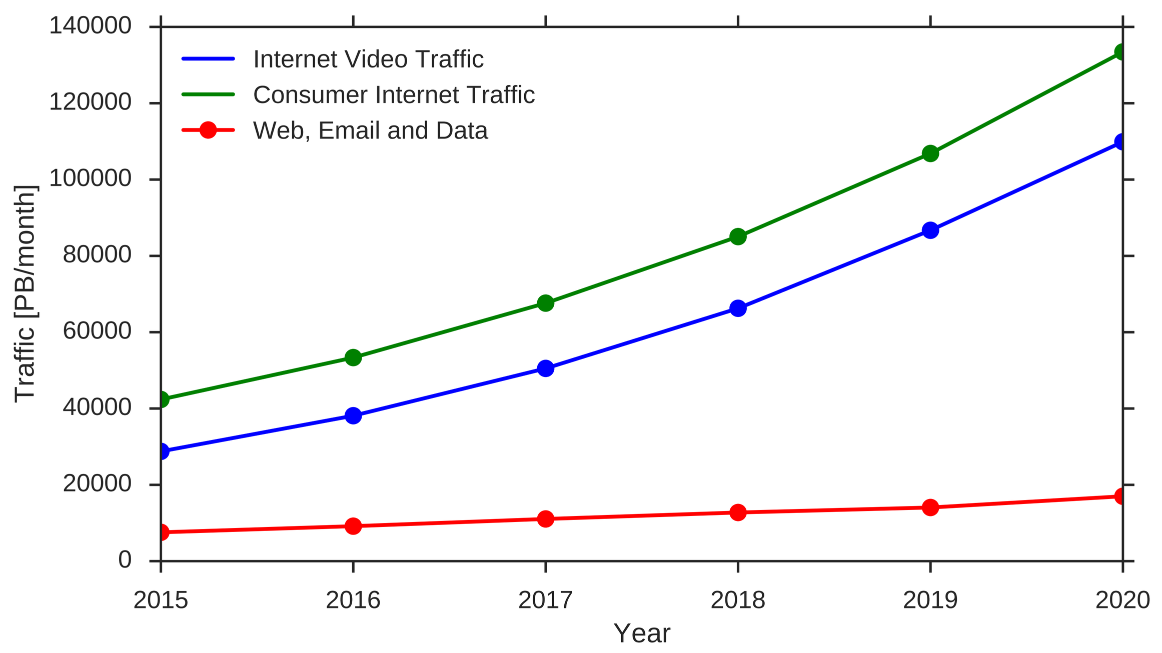
Introduction and Motivation

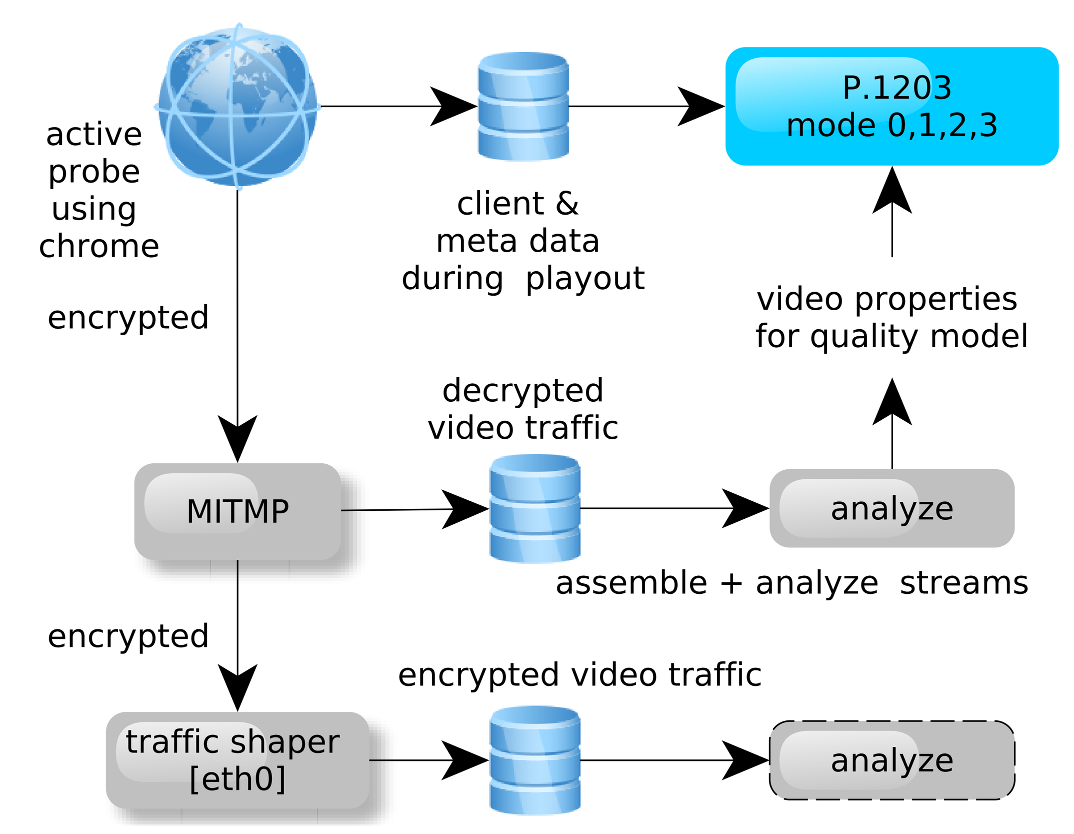


Internet Traffic Evolution [1]

- ▷ video streaming $\geq 70\%$ of the internet traffic [1, p 14]
- ▷ increasing by new technologies, 4k resolution, high framerate and HDR
- ▷ usage of efficient HTTP-based adaptive streaming (HAS) by popular video streaming providers (YouTube, Vimeo, Netflix and Amazon Prime) [3, 4]
- ▷ encrypted content transportation using HTTPS [5]
- ▷ hard to estimate video quality for encrypted streams
- ▷ access to bitstream and additional data required
- ▷ using different video quality models for estimation of QoE
- → introduce: a framework for QoE analysis of encrypted video streams

Our Approach

- ▷ video url and set of network settings (traffic shaping)
- ▷ start parallel:
  - ○ man-in-the-middle proxy, web browser session, encrypted network traffic recording,
  - ○ meta data extraction, active probing script
- ▷ store client-side data (player load time, startup delay, video duration, average stalling duration, stalling events, quality events)
- ▷ start analysis of the recorded man-in-the-middle dump
- ▷ assemble all segments into different video stream files
- ▷ aggregate and store all required video properties for the quality model
- ▷ estimate MOS values based on a video quality model, e.g., P.1203 [2]



Experimental Evaluation and Validation

Mean differences [ms], `wop` - `prx`

video	dsl [bit/s]	avg stalling	player load time	startup delay
first (55 s)	2 M	8473*	-620	8507*
	6 M	-536	-742	-534
	25 M	-472	-749	-486
second (121 s)	2 M	9784*	-463	8669*
	6 M	-322	-637	-329
	25 M	-788	-651	-785
third (331 s)	2 M	-800	-447	-715
	6 M	-851	-595	-855
	25 M	-902	-651	-908

- ▷ How much influence has the man-in-the-middle proxy to video quality?
- ▷ three different YouTube videos with short, medium, and long duration
- ▷ various traffic shaping conditions (dsl 2, 6, 25 Mbit/s parameters)
- ▷ for each video and traffic setting perform 32 runs
- ▷ each run does measurement with proxy (`prx`) and without `wop`
- ▷ measure video parameter that are available in `wop` setting
- ▷ calculate mean differences of all runs, identified some outliers (*)
- ▷ observe near constant offset → influence is constant

dataset: `https://github.com/Telecommunication-Telemedia-Assessment/mitmprobe_validation_dataset`

Conclusion and Future Work

- ▷ automated framework for building up datasets of encrypted video streams
- ▷ constant influence of man-in-the-middle proxy for video quality
- ▷ extending our system to a distributed measurement tool
- ▷ more in-depth analyses of the collected data
- ▷ extend active probing with simulation of real user interactions
- ▷ add more video streaming portals

[1] Cisco. *Whitepaper: Cisco Visual Networking Index:Forecast and Methodology, 2015-2020*. 2015.

[2] Alexander Raake et al. "Scalable Video Quality Model for ITU-T P.1203 (aka P.NATS) for Bitstream-based Monitoring of HTTP Adaptive Streaming". In: *QoMEX 2017*. to appear. IEEE. 2017.

[3] Michael Seufert et al. "A survey on quality of experience of HTTP adaptive streaming". In: *IEEE Commun. Surveys Tuts* 17.1 (2015), pp. 469–492.

[4] Christian Sieber et al. "Sacrificing efficiency for quality of experience: YouTube's redundant traffic behavior". In: *IFIP Networking*. IEEE. 2016, pp. 503–511.

[5] *YouTube's road to HTTPS*. `https://youtube-eng.googleblog.com/2016/08/youtubes-road-to-https.html`. Accessed: 2017-02-25.

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