Project: Advanced Web Technologies

Evaluation of HTTP/3 for Media Streaming

With the introduction of HTTP/3 [1] and QUIC [2] at its core, new features that improve existing over-the-top (OTT) adaptive-bitrate (ABR) media delivery are enabled. The UDP-based bi-directional transport paradigm enables new optimization potential for existing state-of-the art OTT ABR media delivery techniques, which are unidirectional and optimized for TCP. WebTransport [17] enables access to HTTP/3 and QUIC within Web Browsers.

Foremost with HTTP/3, scalable lower latency streaming can be expected compared to existing delivery techniques. Further, QUIC allows prioritization and retransmission [19] of media frames/segments/tracks (audio/video/subtitles) when they are requested and pushed to a client

Previous work [7] has identified performance gains when comparing QUIC with HTTP over TCP. Moreover recent work [8], [9] has concluded that existing throughput-based ABR algorithms do not perform well over QUIC. Algorithms [10] have been proposed to deal with packet loss and retransmission over QUIC. Further, new protocols have been standardized on top of QUIC (e.g. RUSH [3], WARP [16], QUICR[23]) and summarised [14]. Early implementations exist [15].

Standardization activities in IETF MOQ are ongoing, early drafts have been published and presented [20], [21] and [22]

You will explore how existing ABR techniques such as DASH/HLS perform over HTTP/3 similar to [18]

Your Tasks

- Setup, research and comparison of the following implementations:
  - Facebook / RUSH
    - Demo video (4m): https://youtu.be/adckQdZHECQ
    - Encoder & Player code: https://github.com/facebookexperimental/webcodecs-capture-play
    - Server/Relay code: https://github.com/facebookexperimental/go-media-webtransport-server
  - Twitch / WARP
    - https://github.com/kixelated/warp-demo
  - Cisco / QUICR
    - https://github.com/Quicr/qmedia
  - W3C
    - Part 1 - Real-Time Video Processing with WebCodecs and Streams: Processing Pipelines https://webrtchacks.com/real-time-video-processing-with-webcodecs-and-streams-processing-pipelines-part-1/
    - Part 2 - Video Frame Processing on the Web – WebAssembly, WebGPU, WebGL, WebCodecs, WebNN, and WebTransport https://webrtchacks.com/video-frame-processing-on-the-web-webassembly-webgpu-webgl-webcodecs-webnn-and-webtransport/

Links

- [1] HTTP/3. https://datatracker.ietf.org/doc/html/draft-ietf-quic-http-29
- [2] QUIC. https://www.rfc-editor.org/rfc/rfc9000.html
- [3] RUSH.https://www.ietf.org/archive/id/draft-kpugin-rush-00.html
- [4] MSE+WebTransport https://github.com/w3c/media-source/issues/256
- [5] WebTransport https://w3c.github.io/webtransport/
- [6] HTTP/3 support https://caniuse.com/http3
- [7] Sevket Arisu and Ali C. Begen. 2018. Quickly Starting Media Streams Using QUIC. In Proceedings of the 23rd Packet Video Workshop (PV '18). Association for Computing Machinery, New York, NY, USA, 1–6. DOI:https://doi.org/10.1145/3210424.3210426
- [8] Divyashri Bhat, Rajvardhan Deshmukh, and Michael Zink. 2018. Improving QoE of ABR Streaming Sessions through QUIC Retransmissions. In Proceedings of the 26th ACM international conference on Multimedia (MM '18). Association for Computing Machinery, New York, NY, USA, 1616–1624. DOI:https://doi.org/10.1145/3240508.3240664
- [9] Mondal and S. Chakraborty, "Does QUIC Suit Well With Modern Adaptive Bitrate Streaming Techniques?," in IEEE Networking Letters, vol. 2, no. 2, pp. 85-89, June 2020, doi: 10.1109/LNET.2020.2991867.
- [10] Minh Nguyen, Hadi Amirpour, Christian Timmerer, and Hermann Hellwagner. 2020. Scalable High Efficiency Video Coding based HTTP Adaptive Streaming over QUIC. In Proceedings of the Workshop on the Evolution, Performance, and Interoperability of QUIC (EPIQ '20). Association for Computing Machinery, New York, NY, USA, 28–34. DOI:https://doi.org/10.1145/3405796.3405829
- [11] MSE for WebCodecs - https://chromestatus.com/feature/5649291471224832
- [12] MSE in Workers - https://chromestatus.com/feature/5177263249162240
- [13] dash.js http://github.com/dash-Industry-Forum/dash.js/
- [14] https://www.ietf.org/id/draft-gruessing-moq-requirements-01.html
- [15] https://github.com/quicwg/base-drafts/wiki/Implementations
- [16] https://github.com/kixelated/warp-demo
- [17] https://web.dev/webtransport/
- [18] https://www.svta.org/2022/09/27/testing-quic-against-tcp-for-streaming-video-delivery-an-svta-proof-of-concept/
- [19] DoFP+: An HTTP/3-based Adaptive Bitrate Approach Using Retransmission Techniques | ATHENA Christian Doppler (CD) Laboratory (aau.at)
- [20] Operational Considerations for Streaming Media (ietf.org)
- [21] draft-jennings-moq-quicr-proto-01 (ietf.org)
- [22] Married To HTTP 3 with ROBIN MARX - SmashingConf San Francisco 2022 on Vimeo
- [23] https://github.com/Quicr/qmedia