Improving the performance of HTTP/3 communications when communicating simultaneously which uses CUBIC TCP and TCP BBR

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1. Introduction

HTTP (Hypertext transfer protocol) has been widely used for Web browsing. HTTP/1.1 and HTTP/2 have been used since 1990s. The newest version HTTP/3 [1] was published this year. In this paper, we evaluate the performance of HTTP/3 with two congestion controls.

2. Related work

2.1 HTTP/3

HTTP/3 is newest version of HTTP. This uses QUIC [2] on UDP for congestion control likeTCP. QUIC was documented as RFC 9000 in May 2021. Implementations of HTTP/3 over QUIC have congestion control algorithms based on TCP BBR [3] and CUBIC TCP.

2.2 TCP BBR

TCP BBR is a congestion control algorithm proposed by Cardwell et al. in 2016. TCP BBR estimates the physical propagation delay, which is called RTprop, and the bottleneck link bandwidth, which is called BtlBw, calculates BDP (Bandwidth-delay product) using these and then controls its congestion window size to be close to this calculated BDP. TCP BBR updates its RTprop when an RTT that is smaller than RTprop is detected orwhen 10 s passed from the last update. The second updating is called *expire*.

3. Evaluation

In this section, we evaluate the performance of HTTP/3 considering its congestion control algorithm. We measured file transmission times of two HTTP/3 connections using congestion control algorithms based on TCP BBR or CUBIC TCP. The two connections communicated concurrently sharing the bottleneck link. The line labeled with "original" in Fig. 1 shows the obtained throughput in our experimental network.

For discussion, we modified the implementation of the congestion control algorithm based on TCP BBR in the HTTP/3 implementation. In the modified implementation, RTprop is replaced by RPprop**r* just after *expire* of TCP BBR.*R* is a tuning parameter. We measured the performances of the modified TCP BBR and the original CUBIC TCP. The other lines in Fig. 1 show these throughputs. HTTP/3 throughputs based on both TCP BBR and CUBIC TCP increased in the cases the RTprop was extended. On the contrary, the HTTP/3 based on only CUBIC TCP increased in the cases RTprop was reduced.

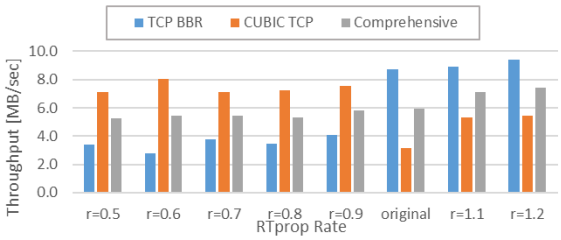

Fig. 1 HTTP/3 Throughput performances

4. Discussion

In section 3, we showed that extending RTprop reduced not only the time to complete file transmission by HTTP/3 based on TCP BBR algorithm but also that of CUBIC TCP. However, we think that this sometimes includes a negative aspect of CUBIC TCP's performance. The time to complete a file transmission of CUBIC TCP reduces also when a competitive TCP BBR connection finished its transmission in a shorter time by improving TCP BBR's performance even though TCP CUBIC's performance reduced during a competitive period.

Acknowledgments

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References

[1] M. Bishop, Ed. “Hypertext Transfer Protocol Version 3 (HTTP/3),” https://quicwg.org/base-drafts/draft-ietf-quic-http.html

[2] M. Thomson, Ed. “QUIC: A UDP-Based Multiplexed and Secure Transport” https://datatracker.ietf.org/doc/html/rfc9000

[3] Neal Cardwell, Y.Cheng, C. S.Gunn, S.HassasYeganeh, and V. Jacobson, “BBR: Congestion-Based CongestionControl,” Queue 14, 5, pages 50,34pages,DOI:https://doi.org/10.1145/3012426.3022184.

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