A Replicable and Extensible Comparison of QUIC and TCP

Henry Baxter and Liam Simmons

University of Victoria - CSC 466

What is QUIC?

QUIC is an encrypted, multiplexed, low latency protocol that was designed to improve HTTPS traffic. [1] As of 2017, QUIC accounts for 7% of all internet traffic. [2]

What are the features of QUIC?

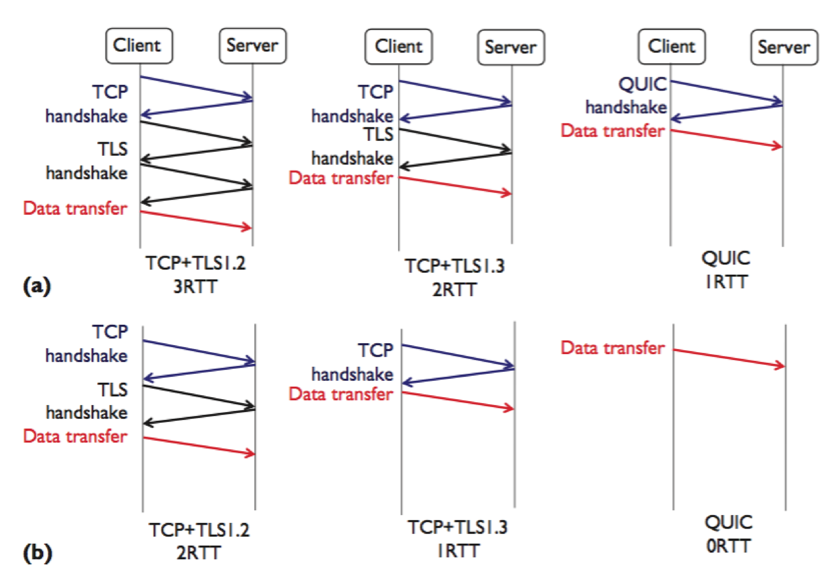

Figure 1: Handshake RTT of different protocols. (a) First-time connection establishment (b) Subsequent connections. Image credit [3]

- **0-RTT:** QUIC features 0-RTT connection re-establishment by using cached cryptographic session information.
- **Stream Multiplexing:** QUIC allows multiple streams across one flow, which avoids head-of-line blocking found in TCP
- **Congestion Control, Loss Recovery:** QUIC uses unique sequence numbers, to help distinguish retransmissions from original packets

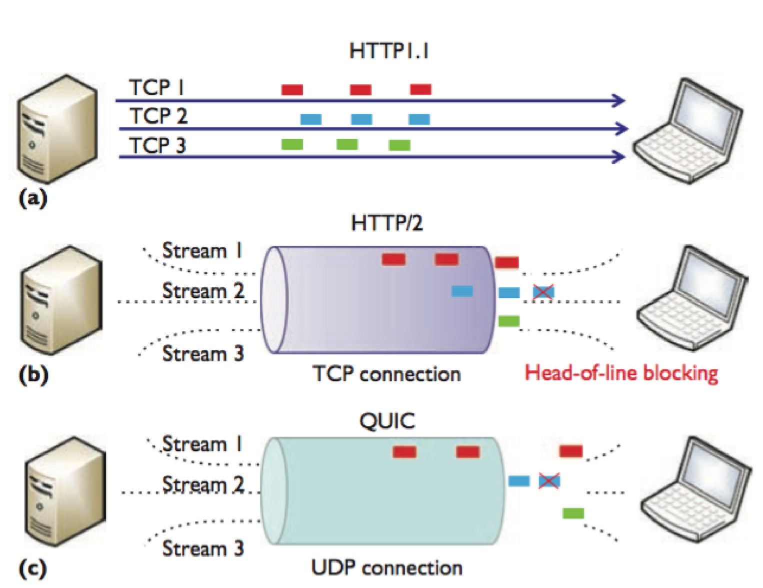

Figure 2: Multiplexing comparison over (a) HTTP1.1 (b) HTTP/2 and (c) QUIC. Image credit [3]

Motivation

- QUIC is a rapidly evolving protocol
- Analysis of QUIC is limited, as compared to TCP
- Focusing on replicability and extensibility, this study will allow for tracking protocol changes as they are made

Experimental Design

- Two instances of Chrome are launched, one using TCP, the other using QUIC
- Requests are made via two EC2 instances, on the same private VLAN
- One EC2 instance shapes traffic
- One EC2 instance hosts the TCP and QUIC servers
- Variations in pages requested and network conditions are made
- Page load time is calculated for multiple runs of each treatment
- Treatment load time is aggregated, plotted and analyzed

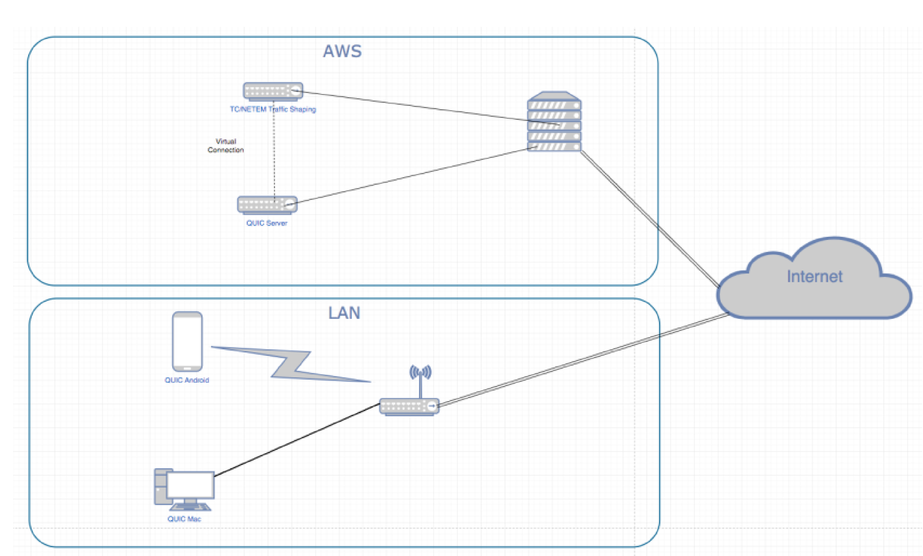

Figure 3: Testbed Setup

Number of Objects

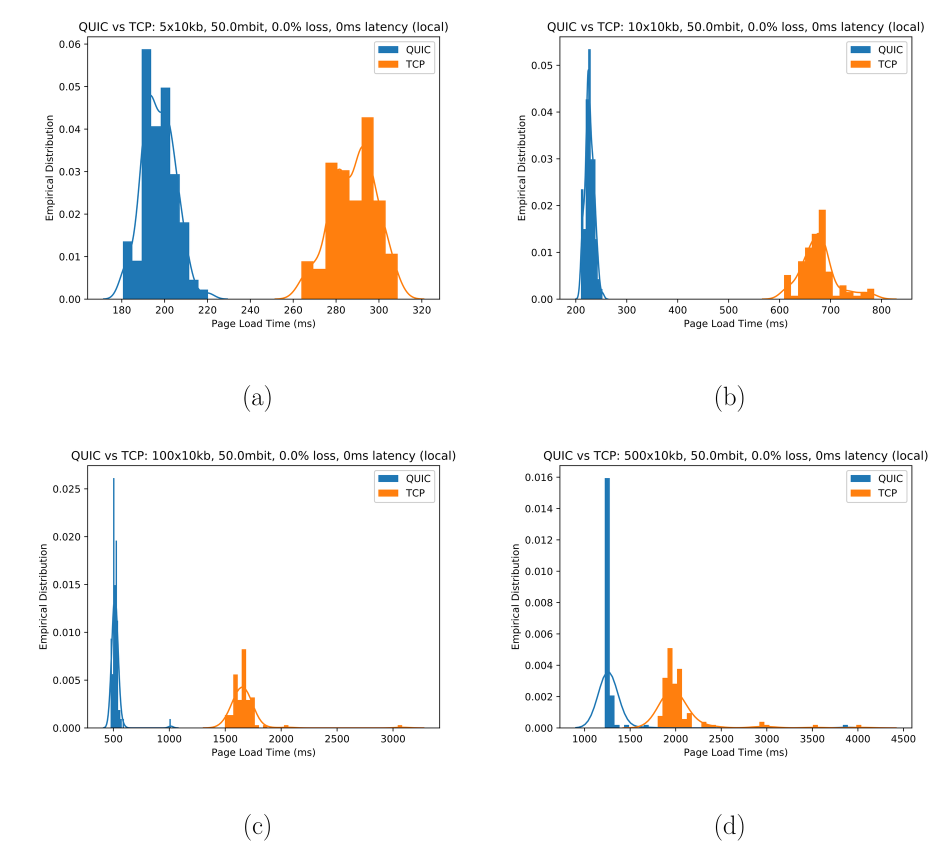

Figure 4: QUIC vs TCP for (a) 5 (b) 10 (c) 100 and (d) 500 objects

Object Size

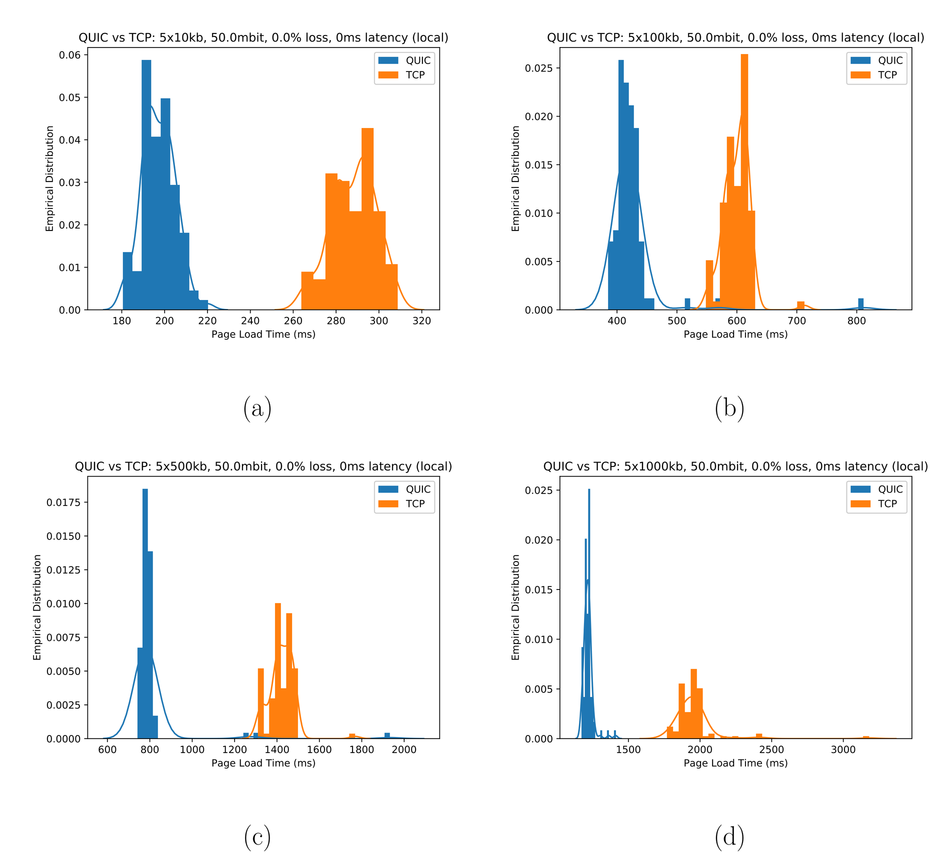

Figure 5: QUIC vs TCP for varying object sizes of (a) 10kB (b) 100kB (c) 500kB and (d) 1000kB

Packet Loss

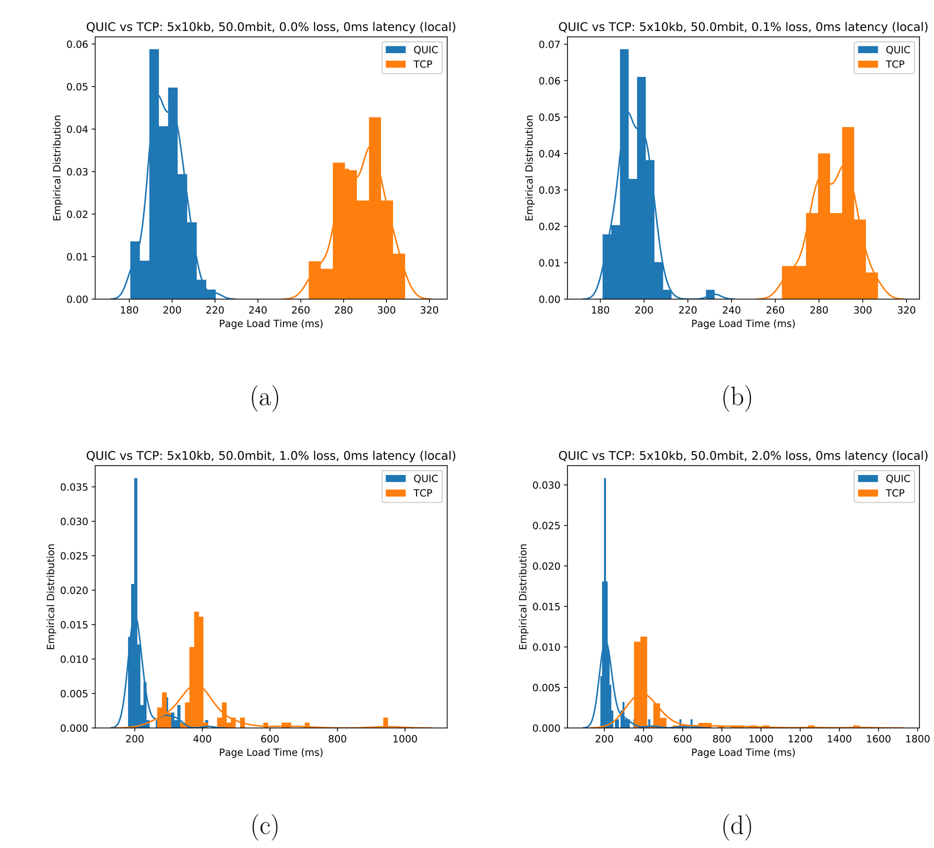

Figure 6: QUIC vs TCP for varying packet loss of (a) 0% (b) 0.1% (c) 1% and (d) 2%

Conclusion

- For all variables tested, QUIC outperforms TCP
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References

[1] Adam Langley et al.
The quic transport protocol: Design and internet-scale deployment.
In *Proceedings of the Conference of the ACM Special Interest Group on Data Communication*, SIGCOMM '17, pages 183–196, New York, NY, USA, 2017. ACM.

[2] Arash Molavi Kakhki et al.
Taking a long look at quic: An approach for rigorous evaluation of rapidly evolving transport protocols.
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[3] Y. Cui et al.
Innovating transport with quic: Design approaches and research challenges.
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