Comparison of PLT optimized HTTP/2 vs. HTTP/3 setups

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With the development of QUIC, Google has built the foundation for an internet draft of the future Internet standard HTTP/3. It implements encryption and TCP-like properties in the application layer on top of UDP (User Datagram Protocol). This distinguishes it from the current HTTP/2 standard, which uses TLS (Transport Layer Security) for encryption and TCP as the transport layer. This work aims at comparing these two standards based on the page load time of static web pages.

Introduction

In 2017, a team from the Northeastern University conducted numerous tests on the page load time (PLT) of web pages served over HTTP/2 and Google's QUIC protocol (HTTP/3). They compared the performance of TCP (Transmission Control Protocol) and QUIC across a wide range of emulated network conditions like bandwidth limitations, delay, packet loss etc. This helps to investigate how the protocols behave when they are congested. Different static pages were used, each containing a different combination of embedded resources. Their findings were published in the paper „Taking a long look at QUIC" with the core statement being that QUIC outperforms TCP in most cases. However, while some parameters within QUIC were adjusted in favour of more performance, the paper suggests that TCP on the other hand has not been tuned, although extensions and features being available.

Goal

In this thesis, the experiments on the PLT from the reference paper were extended and adjusted in order to be conducted on current software. A variety of configurations (kernel/TCP parameters, NIC features (Network Interface Card), etc.) were tested as part of an extensive parameter study to find out which settings have a significant impact on the page load time. The goal is to identify good settings for HTTP/2 to narrow the performance gap between HTTP/2 and QUIC as much as possible, or even reveal speed advantages for HTTP/2 in certain scenarios.

Results

Our parameter study showed that although some features resulted in a performance gain, it was often not significant or was only existent under very specific situations slowing down other scenarios. Our evaluation resulted in the congestion algorithm used influencing the results the most. Overall, our work shows that the standard configuration is already suitable for everyday situations. In specific use cases, however, certain features can provide a relevant speed advantage. Nevertheless, by switching the congestion algorithm of the server's TCP stack from CUBIC to BBR, we could demonstrate HTTP/2 being superior for several scenarios.
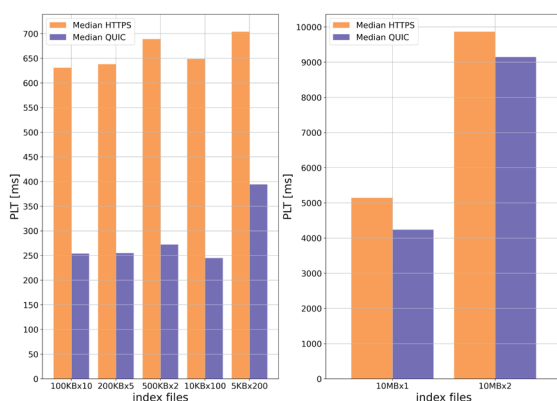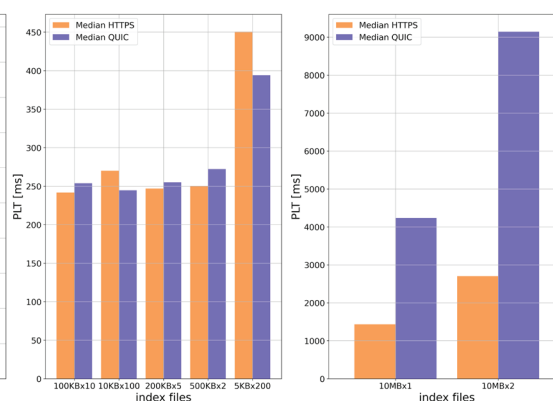
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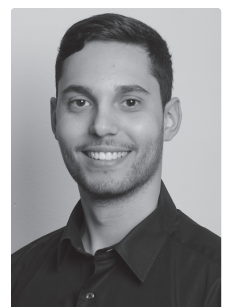
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Median comparison of PLT showing that our optimizations have turned HTTP/2 from the slower to the faster protocol for the «netTerrible» network emulation