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TUM Practical Research Experience Program (TUM PREP)

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PREP student in the lab (Image: Benz/TUM)

Project Overview			Project Code: IN 01	
Project name	Large-scale Performance Evaluation of QUIC			
TUM Department	Computer Science / Informatics			
TUM Chair / Institute	Chair of Connected Mobility, I11			
Research area	Computer Networks, Internet Measurements			
Student target group (departments, disciplines)	Computer Science, Computer Networking			
Project supervisor(s) – Name	Dr. Vaibhav Bajpai, Prof. Dr. Jörg Ott			
Project supervisor(s) – Contact Details	E-mail:	bajpaiv@in.tum.de	Phone:	



Project Description

QUIC is a new transport protocol proposed by Google and is currently being standardized by the Internet Engineering Task Force (IETF). The key goal is to reduce latency accompanied with web and video content delivery. QUIC is designed from the ground up because deploying extensions to TCP to support such latency-sensitive application has seen diminishing returns over the years. This has been due to the ossification of the Internet caused by intervening middle boxes on the path that inhibit wider deployment of extensions to TCP. QUIC uses UDP as a substrate and encrypts protocol headers to prevent middle boxes from making such modifications. QUIC is also written in user-space to allow rapid deployment of protocol updates that are not tied to regular OS release cycles. Google (and similarly popular content delivery providers) play a crucial role today in not only pushing QUIC adoption on a wider scale on end-to-end services, but also having the ability to shift significant traffic overnight over QUIC. For instance, Google Chrome and Google apps on Android when possible allow interaction with Google services (such as YouTube, *et al.*) over QUIC. This has led to an increased adoption of QUIC to reach 7% (as of 2017, reported by Google) of global Internet traffic.

Within our research group, we have developed and maintain a YouTube client that mimics play out of YouTube videos on the command-line. We recently updated this client codebase to support QUIC. We have also adapted an existing open-source implementation of QUIC used by a large CDN provider to add monitoring hooks in the client codebase to measure latency when establishing QUIC connections to any QUIC-enabled server. Additionally, we are currently developing an implementation of QUIC currently being standardized by the IETF.

The goal of this research project would be to build upon and leverage these implementations to perform a large-scale evaluation of the performance benefits of delivering web and video content over QUIC. We also manage ~100 vantage points connected around the globe where these QUIC client implementations could be deployed to study one (or more) of the following research and development tasks:

Task 1: Comparing the overall and region- and network- based failure rates of QUIC connections and whether the failure rates are destination- and service-dependent.

Task 2: Evaluating the latency benefits of QUIC connections to multiple flavors of TLS handshakes over TCP dissected by network-, region- and web service destinations.

Task 3: Analyzing the Quality of Experience (QoE) of YouTube content delivery over QUIC and comparing it with traditional delivery over TLS/TCP.

Task 4: Testing the interoperability of QUIC implementations that adhere to the QUIC specifications currently being defined by the IETF. Measuring scenarios where the interoperability breaks over the wider Internet.

The expected outcome would be a technical report submitted towards the end of the project, with a possibility of shaping it into a conference paper submission to a relevant conference. The participant will be asked to prepare a research poster summarizing the contributions of the technical report.

Working hours per week planned
(Mon-Fri, max. 40 hrs.)

40 hours / week



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Prerequisites			
Level (at the time of arrival)	<input type="checkbox"/> Undergraduate (3 rd Year)	<input type="checkbox"/> Senior Undergraduate (4 th Year) or Graduate	<input checked="" type="checkbox"/> Both
Prerequisites – Subject-related	<ul style="list-style-type: none">• Basic understanding of computer networks and protocols.• Basic understanding of operating systems• Basic understanding of statistics		
Prerequisites – Other	<ul style="list-style-type: none">• Good knowledge of C/C++• Good knowledge of a scripting language (Python)		