Passive Measurement of an Encrypted, Encapsulated Transport Protocol

Master thesis

Background

The QUIC [1] transport protocol, originally developed by Google but presently under standardization at the Internet Engineering Task Force [2], is designed to provide a service more applicable to the new version of the Hypertext Transfer Protocol (HTTP) underlying the Web than the TCP transport protocol that carries most Internet traffic today. It is also to be much less susceptible to observation and interference by middleboxes than TCP is.

It does this through encapsulation in UDP (in order to pass firewalls and NATs that only recognize TCP and UDP), and encryption of its transport-layer headers inside Transport Layer Security (TLS). This resistance is necessary to enable the Internet-wide deployment and continued evolution of this new transport protocol in the face of the great number of transport-specific middleboxes deployed in the Internet.

At the same time, the passive measurability of TCP traffic, allowing devices on path to more or less accurately estimate packet loss, reordering, and latency simply by observing the packets, is an important tool in network operations and management. Equivalent measurability for the QUIC transport protocol, without compromising its resistance to manipulation or exposing the internal workings of the transport protocol that would compromise its future evolution, is therefore an important goal.

Thesis Goals

There are a number of current proposals for minor changes to the QUIC transport protocol as defined, which are aimed at improving the ability to measure QUIC operation and performance. This thesis focuses on an analysis of the QUIC transport protocol as being defined, with and without these changes, with respect to their utility for passive measurement.

1. Creation of a partial implementation of the QUIC transport protocol as being defined within the IETF QUIC Working Group, following draft versions of RFCs in progress.

2. Evaluation of the applicability of existing passive measurement techniques to the unmodified QUIC protocol based on this implementation.

3. Experimentation with the applicability of modifications to the QUIC transport protocol to passive measurement.

4. Development of new proposals for enhancing the measurability of QUIC.

This thesis gives the student the opportunity to work at the cutting edge of current Internet transport protocol development, and to influence the future of the Internet's transport layer. Since it involves significant network programming, students applying for this thesis should have demonstrable experience and proficiency in at least one systems programming language suitable for the implementation of a transport protocol and test harness for it.

Contact: Brian Trammell, trammell@tik.ee.ethz.ch, ETZ H93
Mirja Kühlewind, mirja.kuehlewind@tik.ee.ethz.ch, ETZ H93

Professor: Prof. Laurent Vanbever

References:

1. https://tools.ietf.org/html/draft-ietf-quic-transport-04
2. https://github.com/quicwg/base-drafts