

# Internet Path Behavior Measurement

Semester / Master Thesis

## Background

Recent developments in Internet transport protocol design promise to increase the efficiency and performance of the applications running over them. For example, Explicit Congestion Notification (ECN) can signal network congestion without requiring packets to be lost and retransmitted, and TCP Fast Open (TFO) can be used to reduce time to first interaction by piggybacking application and security layer handshakes on the TCP handshake. Differentiated Services can be used to request different treatment from the network; a recent proposal, for example, addresses “less than best effort” treatment for background bulk traffic such as BitTorrent, reducing this traffic’s impact on higher-priority interactive traffic.

However, the deployability and effectiveness of these developments can be hindered by the presence of impairments that break these features, or the absence of in-network support for them. TCP Fast Open, for example, relies on TCP options that may be blocked or mangled by middleboxes, network devices that perform functions other than just forwarding packets. ECN requires Active Queue Management on the router with the bottleneck link in order to be effective.

This semester and/or master’s thesis continues a series of measurements done at the Networked Systems Group to determine the impact of in-network impairment on the deployability of new transport layer features. The specific measurements to be done within the scope of the thesis will be determined on an initial discussion with the thesis supervisors. We are currently specifically interested in one- or two-sided Internet measurements to determine the following:

- The extent of AQM deployment on certain Internet paths and in the Internet as a whole
- The extent to which the use of DSCP, which may cause packets to be hashed differently for equal-cost multipath routing, leads to reordering in the Internet
- The extent to which impairments of DSCP and ECN, which use parts of the same historical field in the IP header, are correlated
- The extent and nature of impairments to TCP Fast Open (TFO) on mobile networks

The thesis work will consist of designing and/or refining a measurement methodology to answer the question(s) selected, running one or more Internet measurement campaigns to generate raw data, the analysis of that raw data to answer the research questions, and the integration of that analysis into a platform for Internet path transparency measurement, so that measurement campaigns may be continued to observe any change in the condition of the Internet with respect to the specific measurements.

A good understanding of and deep interest in computer networking and the Internet protocol stack, as well as experience with a systems programming language and the UNIX environment, are useful prerequisites for this work.

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