FAST TCP:
Design, Implementation, Experiments

David X. Wei Cheng Jin Steven H. Low
Engineering & Applied Science, Caltech
http://netlab.caltech.edu

October 19, 2003

Abstract

Network congestion control uses a set of distributed algorithms to share network resources among competing users. It is important in situations where the availability of resources and the set of competing users vary over time unpredictably, and yet efficient sharing is desired. These constraints, unpredictable supply and demand and efficient operation, necessarily lead to feedback control as the only approach, where traffic sources dynamically adapt their rates to congestion in their paths. On the Internet, this is performed by the Transmission Control Protocol (TCP) in source and destination computers involved in data transfers.

The congestion control algorithm in the current TCP, which we refer to as Reno in this presentation, was developed in 1988 by Van Jacobson and has gone through several enhancements subsequently, e.g., New Reno, SACK, and rate-halving. It has performed remarkably well and is generally believed to have prevented severe congestion as the Internet scaled up by six orders of magnitude in size, speed, load, and connectivity. It is also well-known, however, that as bandwidth-delay product continues to grow, TCP Reno itself will eventually become a performance bottleneck.

We propose an alternative congestion control scheme for TCP, called FAST. Three key differences exist between FAST and Reno. First, FAST TCP is an equation-based algorithm like TFRC and hence eliminates packet-level oscillations. Second, FAST TCP uses queueing delay as the primary measure of congestion, which can be more reliably measured by end hosts than loss probability in fast long-distance networks. Third, FAST TCP has a stable flow dynamics and achieves weighted proportional fairness in equilibrium.

In this presentation, we explain the design rationale, the architecture, and main components in FAST TCP. We describe its equilibrium, fairness, and stability properties. We present our latest experiments with FAST TCP, in Dummynet, and in both high-speed and low-speed production networks. Finally, we discuss lessons learnt thus far, open issues, and the challenges in the approach taken by FAST TCP.