James Filliben

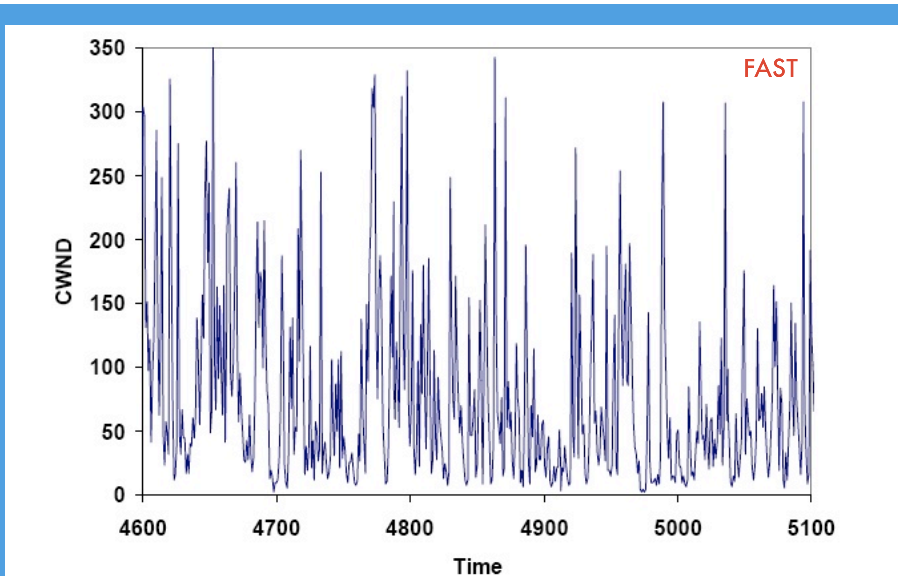
Kevin Mills

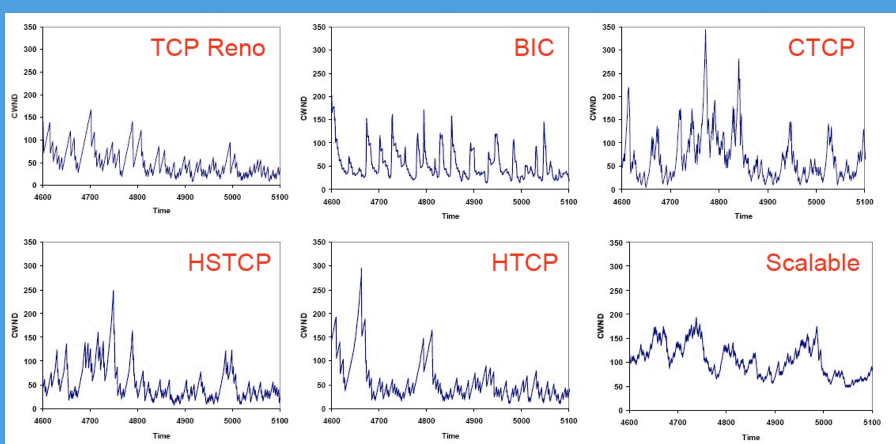
complex systems

IMAGE OF THE MONTH

May

Not so FAST





Each of the seven graphs on the left depicts a time series for congestion-window (CW) size on a simulated long-lived flow traversing the length of a highly congested network extending across the United States. Each graph depicts the evolution of the CW when one of seven congestion-control algorithms (CCA) (identified in red) is used within the network. The graphs show the behavior of each algorithm under the same time period and conditions. The x-axes cover 100 simulated seconds, showing 500 measurements taken at intervals of 200 milliseconds. The y-axes show the size of the CW at each measurement. Notice that the CW under the FAST algorithm oscillates more frequently over a larger range of amplitudes than the other CCA. These graphs reveal the cause related to some general findings about the behavior of FAST under spatiotemporal congestion.

More information available at: http://www.itl.nist.gov/ITLPrograms/ComplexSystems/

FAST is one of several proposed replacements for the standard TCP congestion-avoidance algorithm. The general aim of such replacement algorithms is to increase the ability of TCP to exploit higher transmission speeds becoming available within the Internet. Using simulation, under congested conditions FAST was found to exhibit a higher retransmission rate (including connection-request packets) that reduced user throughput on flows transiting congested areas and that increased the number of flows pending in the connecting state. As demonstrated above, this behavior appears to arise from rapid oscillations in congestion-window size when FAST flows transit routers with insufficient buffers to accommodate the flow volume. Practical implications of this behavior include: (1) flows take longer to connect; (2) flows take longer to complete; (3) user throughput lower for flows transiting congested areas; (4) fewer flows complete. For example, over a 25-minute period FAST completed from 10^5 to 10^7 fewer flows (depending on conditions) than other congestion-control algorithms.

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Information Technology Laboratory

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The Complex Systems Program is part of the National Institute of Standards and Technology's Information Technology Laboratory. Complex Systems are composed of large interrelated, interacting entities which taken together, exhibit macroscopic behavior which is not predictable by examination of the individual entities. The Complex Systems program seeks to understand the fundamental science of these systems and develop rigorous descriptions (analytic, statistical, or semantic) that enable prediction and control of their behavior.

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