Flow level models of Internet congestion control

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Abstract

Variability in the number of simultaneous flows present can have a substantial impact on the perceived performance of packet networks such as the Internet. In this talk we describe various flow level models of Internet congestion control, exploring the effect of different assumptions about the requirements of flows.

We begin with a model that represents the randomly varying number of flows present in a network where bandwidth is dynamically shared between elastic file transfers. The key feature here is that it is possible to define a traffic intensity for each resource in the network.

Next we describe recent work on a model that allows streaming traffic as well as file transfers, under a fairness assumption that includes TCP-friendliness as a special case. The data volume of a file transfer is an exogenous random variable, while its time duration depends on the flow rate it achieves. In contrast, it is the time duration of a streaming flow that is exogenously determined, while its instantaneous flow rate, and hence the total volume of data transferred, is dependent on the level of congestion.

We describe conditions which ensure stability for a fluid model of the system. We also assess the impact of each traffic type on the other: File transfers are seen by streaming traffic as reducing the available capacity, whereas for file transfers the presence of streaming traffic amounts to replacing sharp capacity constraints by relaxed

constraints. The integration of streaming traffic and file transfers has a stabilizing effect on the variability of the number of flows present in the system.

Joint work with Ruth Williams, Peter Key, Laurent Massoulié, and Alan Bain.

References:

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Peter Key, Laurent Massoulié, Alan Bain, and Frank Kelly, *A network flow model for mixtures of file transfers and streaming traffic*, MSR-TR-2003-37.