Analysis of the Increase and Decrease Algorithms for Congestion Avoidance in Computer Networks

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Congestion in computer networks is becoming an important issue due to increasing mismatch in link speeds caused by intermixing of old and new technology.

Traditional congestion control schemes help improve performance after congestion has occurred. A scheme that allows network to operate at the knee is called congestion avoidance scheme, as distinguished from a congestion control scheme that tries to keep the network operate in the zone to the left of the cliff. In these schemes the system determines its load level and sends feedback which is interpreted by the users as to increase or decrease their loads.

The change that a user makes to its load is a function of previous load and the system feedback. This function can be any linear or nonlinear function. Some examples of the linear control functions are: (1) Multiplicative Increase/Multiplicative Decrease, (2) Additive Increase/Additive Decrease, (3) Additive Increase/Multiplicative Decrease, (4) Multiplicative Increase/Additive Decrease.

The key criteria to evaluate these variants are: efficiency, fairness, distributedness and convergence.

In determining the set of feasible controls, it is helpful to view the system state as a trajectory through an n-dimensional vector space. In this space we can define fairness and efficiency lines. These two lines intersect at a point called "optimal point". The goal of control schemes should be to bring the system to this point regardless of the starting point.

Among four linear functions that presented earlier the "Additive Increase/Multiplicative Decrease" satisfies best all the criteria.

Although nonlinear controls offer us more flexibility in trying to direct the system towards the optimum point, they are dependent to system parameters such as the maximum number of users and the capacity at the knee. This hurts distributedness and robustness of these algorithms.