ABSTRACT

Quality-of-Service (QoS) provisioning in the Internet in the presence of unpredictable traffic dynamics is an important, but admittedly complex problem. The main goal of this thesis is to investigate the congestion control based techniques for better QoS support in the Internet. QoS is defined mainly in terms of throughput, delay and drop in packets. Congestion could be controlled either at end-to-end system or in the router or both. In this context, five related topics in this thesis are discussed. First, the Active Queue Management (AQM) schemes, which can be used for, better congestion control, are studied. Second, the design issues of packet drop functions in an AQM scheme are studied and fuzzy enabled drop functions are introduced. The integration of heterogeneous services raises the need for differentiated QoS, catering to the specific requirements of the various traffic flows and hence the effect of fuzzy logic based drop schemes in the Differentiated Services networks is studied. Then, adopting fuzzy logic in the queue parameters in Adaptive Virtual Queue is proposed. It is shown through extensive simulation that the fuzzy enabled mechanism is an effective and feasible solution for controlling congestion in bottleneck links in the network. Explicit Congestion Notification (ECN) is another technique used to inform the sources of traffic about the congestion in the network enabling the sources to control their traffic. The AQM schemes with and with out the presence of ECN schemes are studied. Also nowadays the network links are wired or wireless. The end system involved in the congestion control may misinterpret the wireless losses as congestion losses and react to the losses by throttling down the rate of data and hence degrading the performance of the system. Hence a biased queue management scheme is studied to differentiate the losses into congestion and wireless losses.
One of the objectives in the Internet design is to control the fairness/efficiency tradeoff effectively. That is, the system should allow the active flows to share the channel’s bandwidth. The real question therefore, is how to maximize bandwidth utilization and allocate resources fairly. If the protocol windows could grow sufficiently large, bandwidth will be wasted during convergence; convergence here is associated with a multiplicative rate decrease at half the previous window. An easy way to improve utilization could be to apply a more conservative multiplicative decrease; however, this will cause the system to reach equilibrium at a later stage, thus degrading fairness. Hence an improvement of the Linear Increase Multiplicative Decrease (LIMD) algorithm is studied that impacts positively both efficiency and fairness: efficiency is improved and fairness is achieved faster and smoother.