MaxNet and TCP Reno/RED on Mice Traffic

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Abstract: TCP congestion control is a mechanism to fully utilize and fairly share of network bandwidth. Aside from these properties, a good congestion control algorithm also requires quick response for mice traffic (e.g. HTTP traffic). However, on the Internet, hosts and intermediate routers only have local information, thus it is difficult to control sender rate to obtain all above properties in a distributed manner.

In TCP Reno, which is the most widely used congestion control algorithm, sending rate is increasing until packet loss happens. To avoid buffer overflow at router, AQM RED (Active Queue Management Random Early Detection) can be used in corporation with TCP Reno. The weakness of RED is that it does not take into account the number of flows arriving at a bottleneck link to perform appropriate behavior to heavy load. Assuming there are N flows sharing a bottleneck link. If a packet is marked or dropped, the offered load is reduced by a factor of $(0.5N^{-1})$. When N is large, $(0.5N^{-1}) \rightarrow 0$, which means the offered load will not be decreased, also the queue length at router does not change. This results in long response time for mice traffic because there is no left space at router for this kind of traffic to be absorbed.

MaxNet is a new congestion control mechanism using multi-bit signal instead of packet loss to control sending rate. MaxNet router controls the magnitude transient queue well regardless the number of new arrival flows. Assuming that there are N flows sharing a bottleneck link with capacity C_l and utilization is set to μ_l. When a new flow joins, it causes overload at most $(\mu_l.C_l.N^{-1})$. Obviously, the larger the N is, the smaller the magnitude of transient queue becomes and eventually, the transient queue size drops to zero when N is large enough.

In summary, MaxNet clears the buffer while Reno/RED always keeps a backlog in routers. Therefore, in case a mix of elephant traffic (e.g. FTP) and mice traffic, if the number of mice traffic is small, MaxNet has shorter response time for mice traffic than Reno/RED due to clear buffer. If the number of arrival mice flows is large, Reno without appropriate behavior eventually causes packet loss, degrading the throughput of elephant traffic. In addition, using the multi-bit signaling mechanism, MaxStart mechanism of MaxNet controls mice flows converging to the target rate more quickly than TCP Reno.

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