Using QoS for High Throughput TCP Transport Over Fat Long Pipes

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Extended Abstract

Several network applications require the transport of immense data collections either for data mining or data replication exercises (Particle Physics, Radio Astronomy, High Performance Computing, etc). Two recent developments can significantly contribute to realise this goal: Proposals for high throughput TCP and the availability of Differentiated Services [1] enabled networks.

In this paper we investigate the relation between QoS configuration in the routers and the dynamics of new proposals for high throughput TCP. We conduct extensive experimental tests in a high bandwidth, high propagation delay development network.

To perform our tests we used the DataTAG testbed which consists of a transatlantic link connecting Geneva to Chicago. We used Juniper M10 routers with DiffServ enabled GigaBit Ethernet cards (a choice made after having benchmarked several router manufacturers). This testbed is unique in providing a differentiated services network with high propagation delay and bandwidth capacity on the order of Gigabits per second. To generate traffic we used high-end multiprocessor PCs running the Linux 2.4.20 kernels.

Tests were conducted using traditional TCP (Vanilla TCP) flows on our DiffServ enabled network to check to what extent QoS can help in shielding these sets of flows. These tests measure the capability of Vanilla TCP to react and respond to changes in the network load in a protected environment. Assuming that high priority classes will be used by small number of flows, we show that Vanilla TCP is not able to utilise this fat long pipe because in practical terms is impossible to guarantee a lossless connection - even over QoS.

We then proceed to investigate how the current proposals for high throughput TCP perform in a QoS environment. These include High Speed TCP [3], Scalable TCP [4] and FAST [5] which were tested isolated and against each other. We present quantified results of how well these new proposals behave in this scenario. These results include comparisons on utilisation, stability, convergence and fairness.

Much work has been done researching fairness between flows [2] that share one or more links in their data path. Here we look at inter-class fairness issues; meaning the capability of the traffic in a class to stably use its allocated bandwidth and therefore not stealing the other classes allocated proportion. In a non-QoS network, aggressive TCP proposals steal bandwidth from Vanilla TCP flows. We run Vanilla TCP in a Best-Effort Class and quantify the effects of aggressive TCP flows running in an AF (Assured Forwarding) class. We then compare these results with non-QoS tests which involve Vanilla TCP competing directly against these aggressive TCP proposals. To cover a wider range of scenarios, we varied the number of flows in the Best-Effort Class.

A QoS enabled network will invariably contain EF traffic implemented with priority queueing to accommodate delay constrained applications. This will have a considerable impact in both AF (for high demand flows) and traditional Best-Effort classes. Therefore, we also present results of tests that introduce transient EF flows generated with constant bit rate traffic, measuring the impact on the other flows in the other classes.

Summarising, QoS is necessary in order to provide a minimum guaranteed bandwidth to a class under congestion, which in turn, if steadily used, allows enforcement of a specific level of fairness between classes, not otherwise guaranteed if different TCP stacks compete for the bandwidth in the same class. We also show that new TCP stacks are necessary to fully utilise any fat long pipes carried over QoS, and we quantify their performance through the bottleneck interface.

References

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