Effects of Filler Traffic in IP Networks[1]

Nasser Alzidi Adam Feldman Vincenzo Liberatore

On the Internet, there is a well-documented requirement that much more bandwidth be available than is used on average. This extra bandwidth is required to handle "network spikes", those times when network traffic peaks, using much more bandwidth than is normally needed. Sometimes these spikes can be quite large, requiring a network be provisioned to provide two to twenty times the bandwidth than it uses under normal circumstances in order for the network to maintain its adequate speed of operation and prevent degradation for its users. Thus, for a network to achieve acceptable performance, a good portion of its bandwidth must sit idle most of the time. Due to the oft high prices of bandwidth, this is either not feasible or leads to quite a waste of money. However, if this extra bandwidth could be used for other activities while it is not needed to handle a spike of traffic, then the network would be much more cost effective. The goal of this project is to determine a method of allowing the extra bandwidth to fill its idle time by carrying low priority traffic. When the network spike occurs, normal traffic would take priority over this "filler" traffic, allowing the network to use this bandwidth as if it had been idle. Since the filler traffic is composed of non-time sensitive data, the interruption the spike causes is expected and not disruptive. This way the network is equipped to handle all spikes of traffic without slowdown, while at the same time, the excess bandwidth is being used to accomplish work.

The problem in executing this idea is deciding the nature and specifics of the filler traffic in such a way that prevents it from interfering in any way with the normal, or pre-existing, traffic, yet ensures that it will eventually reach its destination. To see the effects different types of traffic have on the pre-existing traffic, the results of a network simulation, using traffic data from a Harvard trace and completed with NS-2, were studied. The simulation was executed many times for the same input data, to see the effects of changing different parameters, such as size and type of filler traffic (CBR or FTP), filler buffer, and bandwidth and latency of the central link of the simulated network. The results of this experiment are packet dynamic, breaking down into four items, which were charted over the experiments, for a given changing parameter: average packet delay, percent of dropped packets, ack compression, and the amount of bandwidth used. Each of these result categories were plotted separately based on which type of traffic (pre-existing and filler) and which direction, to show how the filler traffic in one direction affects the pre-existing traffic in both directions.

The resulting output charts indicate that the idea of implementing filler traffic is feasible. They also confirm that the exact parameters used can have a profound impact on the effect the filler traffic has on the pre-existing traffic. If the filler packets are too large or sent at too high a rate, then the pre-existing traffic is slowed. On the other hand, the usefulness of the filler traffic is also dependent on the exact parameters used. For example, if the filler buffer is very small, then the majority of the filler packets will be dropped, resulting in little or no work being done by having the filler traffic.

The next step is to study the effects of this filler traffic across a network with a low bandwidth delay product (BDP), such as that of a bank of modems. Since a modem network is much slower than a high-speed local network, there is potential for filler traffic to adversely affect the former even though the latter is unaffected. Once it is determined how these two very different types of networks are affected by each type of filler traffic, a general scheme of using specific filler traffic can be developed and tested for effectiveness.

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[1] Electrical Engineering and Computer Science Department, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, OH 44106-7221. alzidi@eecs.cwru.edu, axf36@po.cwru.edu, vl@eecs.cwru.edu.