Measuring Internet/MBone Packet Loss and Delay: Experimental results and reflections on the measurement process

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In this talk we present the results of three Internet-based measurement studies. While the goals of these three studies are distinct, they are unified by their use of Internet performance measurements as an integral part of the research. Together, they illustrate some of the benefits and potential shortcomings of such a research paradigm

In the first part of this talk, we present and analyze packet loss data collected simultaneously at up to 12 hosts at geographically distinct locations in Europe and the US. These hosts are connected via the Multicast Backbone (MBone) network. The primary goal of this work is to examine the *spatial and temporal correlation in packet loss* among participants in a multicast session. (Informally, by spatially correlated loss, we mean the loss, i.e., lack of reception, of the same packet at many sites; by temporally correlated loss, we mean the loss of consecutive packets at a given receiver.) Our results show that:

- For most of the traces, the loss on the backbone links of the MBone multicast network is observed to be small (2% or less), as compared to the average loss seen by a receiver. However, due to occasional backbone outages lasting from a few seconds to a few minutes, the spatially correlated loss can sometimes be quite high.

- There is a significant amount of burst loss (consecutive losses) at each site. One or more extremely long loss bursts, each lasting from a few seconds up to 3 minutes (around 2000 consecutive packets) in length, occur in almost every trace.

- Most of the loss bursts consist of isolated single losses, but a few extremely long loss bursts occur in almost every trace.

The second part of this talk focuses on point-to-point Internet delay measurements, and adaptive audio playout algorithms that are motivated by observations drawn from these delay measurements. We first discuss the tradeoff between packet playout delay and late packet loss. We then present a particular playout algorithm that detects ”spikes” in the measured network delay of sender-to-receiver audio packets and dynamically adjusts playout on the basis of these delay measurements.

In the final part of this talk we discuss an experimental effort which aims to study the per-hop queueing delays experienced by a packet as it travels from source to destination. Informally, the goal of this work is to determine whether or not packets suffer a large fraction of their queueing delay at only a single router on an end-to-end path. We describe the per-hop delay measurements we were able to make using IP options and what we can, and can not, infer from the results.

Throughout this talk, we focus on measurement methodology; the successes, complicating factors, and difficulties encountered; and the larger lessons learned about the measurement process.

References

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