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White Paper

How to Properly Measure and Correct Packet Loss

Silver Peak avoids common packet delivery issues across the WAN

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Shared Wide Area Networks (WANs), like MPLS and Internet VPNs, are prone to network congestion during periods of heavy utilization. When different traffic is vying for limited shared resources, packets inevitably will be dropped or delivered out of order, a concept known as "packet loss".

As more enterprises deploy real-time traffic, like voice, video and other unified communications, packet loss is an increasingly significant problem. That is because dropped and out-of-order packets degrade the quality of latency sensitive applications – e.g. packet loss causes video pixilation, choppy phone calls, or terminated sessions.

In addition, loss is increasingly problematic as more enterprises look to lower disaster recovery costs by performing data replication over shared WANs. As figure 1 shows, when a small amount of packet loss (0.1%) is combined with a marginal amount of latency (50 ms), data throughput will never exceed 10 Mbps per flow – regardless of how much bandwidth is available. This can severely hamper key enterprise initiatives that require high sustained data throughput, like replication.

The problem is that most enterprises don't know packet loss exists on their WANs as they don't have the proper tools for measuring it. (Service Providers only exacerbate the problem by offering SLAs that are based on monthly averages, which can be quite misleading. An enterprise can experience several hours of loss during several work days and still statistically have around 0% loss over the course of a month).

This paper explains how packet loss can be properly measured throughout an enterprise, and what can be done to mitigate its effects in real-time.

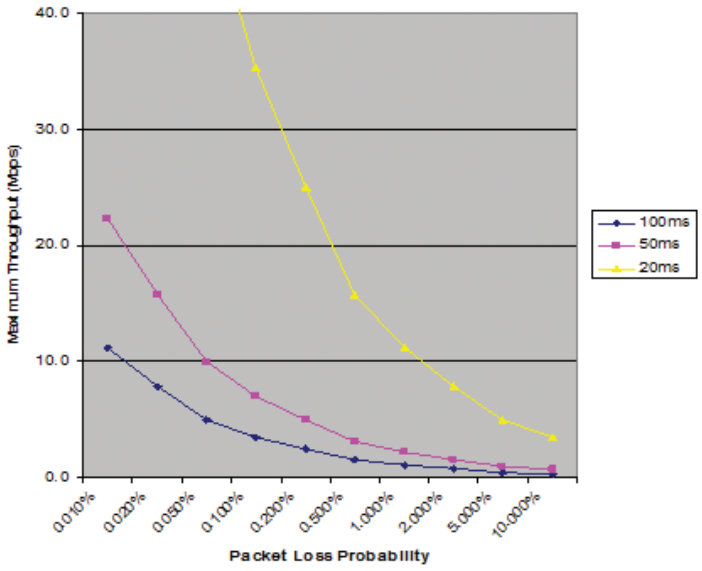

Figure 1- Maximum Throughput for Different Packet Loss Ratios and Round Trip Times

The Limitations of Measuring Loss with ICMP (i.e. Pings):

The first step to understanding (and fixing) packet loss is to accurately measure its existence. Many enterprises do this using ICMP Pings. This involves sending one ping per second between hosts and counting how many times the request is lost.

Unfortunately, the "ping method" of analyzing loss is prone to incorrect measurements based on statistical limitations.

For examples, let's assume we are dealing with a WAN with 0.1% average packet loss, which is common in most MPLS networks. This network is expected to lose 1 in every 1000 packets, which equates to one dropped packet every 17 minutes. Since a good statistical measurement requires at least 40 data points to be valid, a ping test would have to run for 12 hours, non-stop, to produce an accurate measurement of loss. Further complicating matters is the fact that fluctuations in the loss levels over this period will skew the results and invalidate the test. In other words, ping measurements are only valid if performed over a long period when packet loss is constant, which rarely occurs.

Measuring Loss in Real-Time:

Silver Peak uses an entirely different method of calculating loss. Silver Peak sequences each and every packet with a number and knows exactly which numbers are expected at the receiving end. With this information at the disposal of Silver Peak appliances, loss can be very precisely monitored.

For example, assume that a DS-3 is connecting two locations. At 45 Mbps, there is approximately 4000 packets transmitted every second. Using the same 0.1% packet loss as in the previous example, there would be four loss events every second (1 in 1000 packets lost), on average. It would take Silver Peak appliances only 10 seconds to accurately detect this loss! In addition to the greatly improved accuracy of this method, the shorter time required for capturing the metric is much less likely to encompass a major change in loss which might otherwise invalidate the test.

The "Ping Method" of measuring loss is prone to inaccuracy

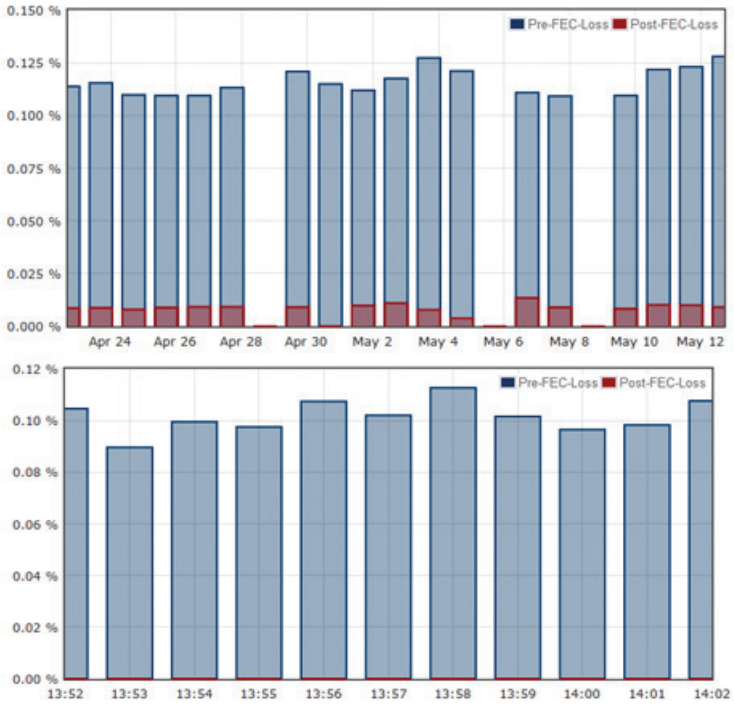

Figure 2- Silver Peak accurately reports on WAN packet loss, down to the individual minute, day or month

Fixing Packet Loss

With accurate measurements of packet loss (real-time and historical), Silver Peak helps enterprises keep service providers honest. In other words, end users can ensure that their MPLS and Internet VPN WANs are performing up to expectations.

In addition, Silver Peak provides advanced Network integrity features to mitigate the impact of packet loss when it does occur. More specifically, the following techniques overcome lost and out of order packets in real-time:

- **Adaptive Forward Error Correction (FEC)** - Silver Peak uses packet-level FEC to reconstitute lost packets at the far end of a WAN link, avoiding delays that come with multiple-round-trip retransmissions. This enables WANs to easily recover from packet loss due to a variety of network layer conditions, such as queue overflows and constrained bandwidth links. The Silver Peak solution dynamically adjusts the FEC overhead in response to changing link conditions for maximum effectiveness in environments with high packet loss.
- **Real-time Packet Order Correction (POC).** Silver Peak appliances re-sequence packets on the far end of a WAN link "on the fly" to avoid re-transmissions that occur when packets arrive out of order. By performing the functionality in a dedicated WAN optimization device (as opposed to an end station or router), enterprises have the scalability needed to handle high volume, high throughput data streams with minimal added latency. POC is performed in real-time and across all IP flows (regardless of transport protocol).
- **Quality of Service (QoS).** Silver Peak provides a variety of Quality of Service (QoS) solutions for enterprises. In addition to honoring existing QoS markings, the Silver Peak solution provides native support for advanced QoS, including sophisticated application classification logic with Deep Packet Inspection (DPI), a variety of packet marking techniques, queuing, and traffic shaping.

Do other WAN optimization vendors address packet loss? Most don't detect loss at all, and therefore don't have a solution for addressing this significant WAN challenge. Those that do detect loss rely on the ICMP ping method described above, which is fraught with inaccuracies. If loss is detected, some of these solutions can aggressively re-transmit TCP packets during periods of congestion. One problem with this approach is that it only works on TCP traffic. (Most real-time traffic uses UDP, not TCP, as a transport protocol). A second problem is that any re-transmission (regardless of how aggressive it is) adds latency, which can adversely impact the performance of most real-time applications. Lastly, aggressively re-transmitting a single application is very "unfriendly" to other applications using the WAN.

With Silver Peak, enterprises have all the tools needed to accurately detect and correct packet loss in MPLS and Internet VPNs. This enables enterprises to get all the benefits of a shared WAN (i.e. cost effective bandwidth), without sacrificing performance.

By containing every packet in real-time, Silver Peak accurately detects packet loss in a matter of seconds