



**Competitive Performance Testing
Application Acceleration Appliances**

December 2005

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1 Executive Summary

1.1 Purpose

Silver Peak Systems™ engaged Miercom to independently test the NX-3500's ability to improve the performance of common applications delivered across a distributed enterprise, including file transfers, disaster recovery, Voice over IP (VoIP), and Citrix®.

For reference, the Silver Peak NX-3500 was compared to Juniper's® WXC 500. Juniper was invited to provide support for this application acceleration competitive testing roundup.

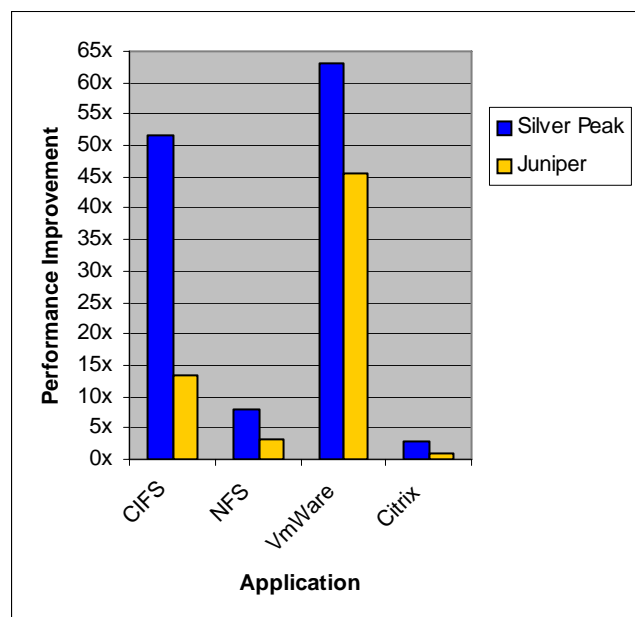
1.2 Summary of Findings

Overall testing proved that the Silver Peak NX-3500 provides significant performance improvements across a wide breadth of enterprise applications, including bulk TCP, bulk UDP, real-time media, and interactive applications. The Silver Peak NX-3500 showed significantly greater enhancements in data reduction and application response time when compared to the WXC 500 - on first and second passes, and particularly in environments with bi-directional traffic flow.

Silver Peak's Network Memory™ technology provided the most significant improvements in application response time – as much as 60x in some instances. Peak performance gains are presented in the chart below.

Figure 1: Peak Performance Improvements (All Tests)

“Silver Peak provides significant peak performance gains across a wide breadth of business applications.”



Of special note was the NX-3500's ability to address the challenges of delivering Voice over IP and Citrix over the WAN, two applications that are often not addressed by many acceleration products. Voice tests (shown on page 12 and 13) indicate that the NX-3500 can dramatically improve voice quality and reduce jitter in congested networks, surpassing toll quality in some instances. Interactive applications, like Citrix Presentation Server™ (shown on page 14), showed noticeable improvements in application response time in addition to quantifiable reductions in data transfer across the WAN.

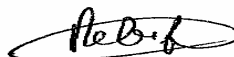
The full suite of applications tested included the following tests: bi-directional throughput tests using Common Internet File System (CIFS over TCP), data replication using VMware® (via FTP), NFS (over UDP), Citrix and VoIP quality tests. These applications were chosen to represent a broad sampling of real-world business applications, covering a wide array of transport protocols (TCP and UDP), media (voice and data), and performance characteristics (bulk transfer, interactive, and real-time). Testing used real-world products and simulation equipment that is readily available via the Internet, enabling the testing scenarios to be easily reproduced elsewhere.

Key observations of the Silver Peak NX-3500 that differentiate the product from other application acceleration appliances we have tested include bi-directional pattern recognition, data reduction for UDP traffic, assured voice quality, and support for interactive applications. The competitive advantage due to the effectiveness of these features became apparent during the performance testing conducted, which is documented in this report.

Both Silver Peak and Juniper demonstrated excellent ability to handle large volumes of TCP sessions. Neither product exhibited TCP flow limits that would limit scalability.

It is important to note that test results vary depending upon the clients and servers used, the type of files being transferred, WAN link conditions, and other variables. For this reason, this report is meant to provide a relative comparison between the Silver Peak NX-3500 and Juniper WXC 500 under identical, and as close as possible to real-world, conditions.

As performance will vary under different circumstances, this report should not be used to establish absolute metrics for application acceleration for either product, or as a comparison to other acceleration products not tested here.



Rob Smithers
CEO
Miercom

2 Technology Similarities and Differences

The two products in this competitive test were chosen because of similarities in the way each handle enterprise applications – at least at a high level. Both leverage forms of compression, QoS, protocol acceleration, and latency mitigation. In addition, both use forms of pattern recognition to perform data reduction and local storage to deliver information locally where possible. To test all of these technologies, applications were run repeatedly. The first time, the appliances were “cold” - they had no stored information of any kind in their local memory. The second time the appliances were “warm” –they had seen the data once already. According to vendors' claims, this should enable the appliances to provide extra performance enhancements by eliminating the transfer of repetitive data across the WAN.

Both the NX-3500 and the WXC 500 were configured to support 256 Kbps of WAN capacity. This was chosen to replicate a real-world WAN scenario and to test comparatively priced products (full pricing below). Some tests were also run across a 1 Mbps WAN link to provide additional results for further comparison.

It was interesting to see that in virtually all head-to-head comparisons, the Silver Peak NX-3500 showed significantly greater performance benefits across the complete range of applications – in both first and second passes. The first pass gains, we suspect, were due to better compression and latency mitigation techniques in the Silver Peak appliance. In addition, Silver Peak employs adaptive Forward Error Correction (FEC) at the packet level, which may have improved performance in some instances. Second and subsequent tests demonstrated Silver Peak's true differentiation, a data reduction technology that they call “Network Memory”. Network Memory is used by the Silver Peak NX appliances to examine byte streams of data as they are sent between clients and servers. Information passing through an appliance is stored by the device as a local instance. Whenever future requests are made for this same information (or similar information), it is delivered locally from the appliance instead of being re-transmitted across the WAN.

The concept of using memory to remember WAN traffic and advanced fingerprinting techniques to identify patterns in real-time provides significant performance improvement when delivering applications across a WAN – ranging from 10x to 20x on average and 20x to 200x under peak loads depending on the application. While Juniper has their own method of data reduction, called “Network Sequence Caching”, the Silver Peak product consistently outperformed its counterpart. We were able to observe several key differences in our testing that created this advantage, including support for bi-directional traffic and support for both TCP and UDP applications.

Silver Peak claims that their method of fingerprinting, their hashing algorithms, and the way that they store instances of information on their appliances led to the performance numbers we observed, but this was impossible for us to prove directly.

3 Performance Verification

3.1 File Services (CIFS and NFS)

The first test was meant to replicate one of the most common enterprise applications: file transfers. As Microsoft® is a dominant platform for file services, we sent and received a sampling of different file types using the Common Internet File System (CIFS) protocol. On first pass (over a “cold” appliance, with files being sent from the client to the server), both products provided performance gains, with the NX-3500 slightly edging out the Juniper solution. The big difference came on subsequent passes (over a “warm” appliance). Silver Peak provided a 52x performance improvement at its peak, and a 36x improvement on average across the sampling of file types. At the “low” end, Silver Peak still provided a 24x improvement when doing a CIFS transfer from clients to servers. The Juniper WXC 500 peaked at 8x in the client-to-server scenario, with an average improvement of 8x – they were pretty consistent regardless of the type of file being sent.

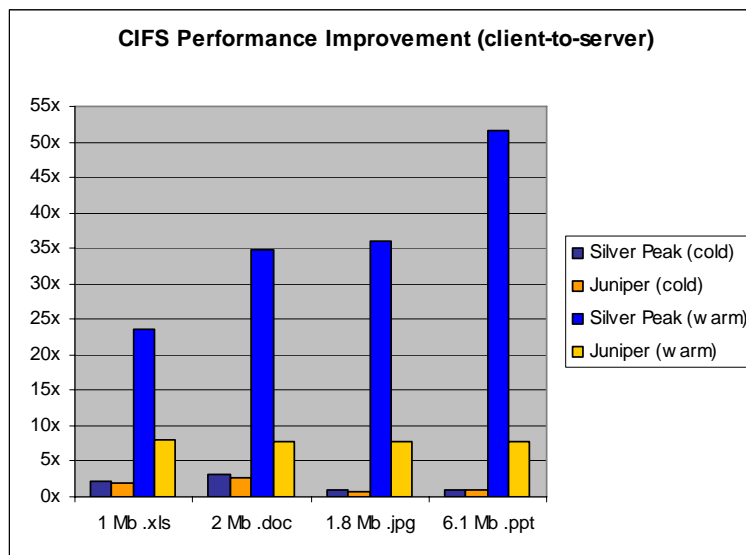


Figure 2: Client-to-Server Performance Improvement (CIFS)

There was a larger disparity when the same file was sent from the server to the client – the reverse direction of the previous test. Silver Peak picked up where it left off on the client-to-server test, providing 23x – 42x improvements on the first transfer. It was apparent that the data reduction capabilities of the Silver Peak solution were bi-directional.

The Juniper box had to “re-learn” the file when going in the reverse direction. As a result, the first pass numbers for the server-to-client transfer were on par with the cold numbers from the client-to-server transfer. Performance improvements were eventually seen on subsequent passes in the Juniper environment (reaching as much as 13x), but gains were typically 1/3 of those seen in the Silver Peak appliance.

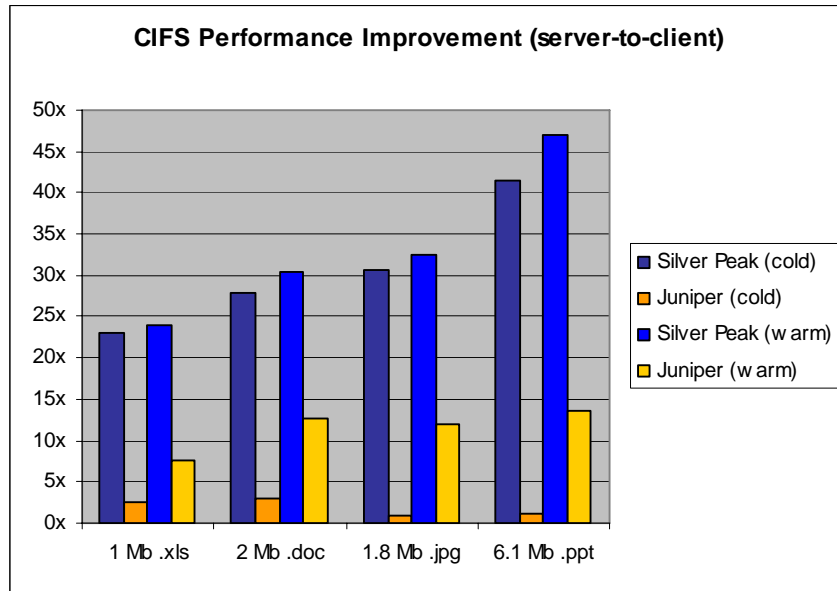


Figure 3: Server-to-Client Performance Improvement (CIFS)

As many enterprises use UNIX for file services, we also tested NFS. The overall gains were not as high as with CIFS, but there were significant benefits. NFS runs over UDP, so Silver Peak provides an order of magnitude improvement on warm passes. Silver Peak was able to use Network memory to get data reduction, which led to an almost 8x performance improvement. Juniper was not able to leverage Network Sequence Caching, because it only works on TCP applications.

Juniper's performance improvements remained fairly constant throughout the test (1x to 3x), regardless of whether the appliances were warm or cold.

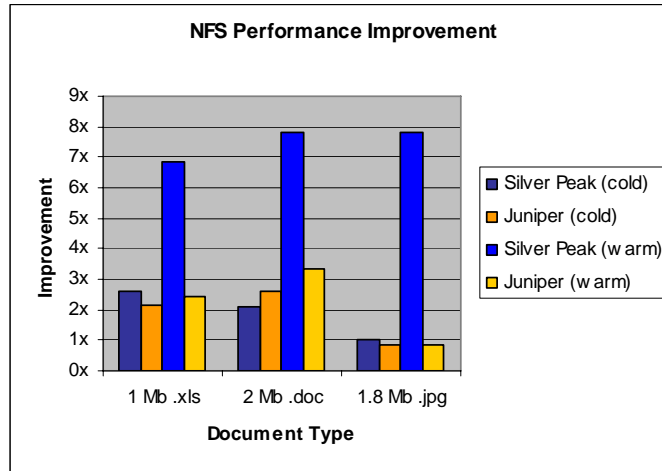


Figure 4: Performance Improvement (NFS)

3.2 Disaster Recovery VMware Tests

In a recovery situation with centralized server store and backup, it may be necessary to push a huge amount of data to distributed clients at remote sites. Or, many enterprises perform data replication between a data center and a disaster recovery facility on a regular basis. In both backup and recovery scenarios, large volumes of repetitive data are sent across the WAN.

By saving WAN bandwidth and improving transaction times substantially, application acceleration products can be an important tool for disaster recovery environments. To demonstrate this, we designed a test that pushed a large pre-compressed Windows XP image using VMware between a server and a client PC. This test was performed in both directions, to simulate both backup and recovery. The time required to transfer these image files was measured to see what effect application acceleration products have on the disaster recovery process.

Both products had little effect on the initial download, as the VMware file used was already pre-compressed. Subsequent downloads, however, showed enormous improvement. Silver Peak provided a 55x improvement on warm download, which increased to over 60x in the reverse direction – for both cold and warm transfers. This, again, was a good demonstration of bi-directional data reduction. Juniper provided a 40x improvement in the warm download, but then provided no improvement when doing a cold upload in the reverse direction. Subsequent passes got the WXC 500 back to the 40x gain previously seen in the reverse direction.

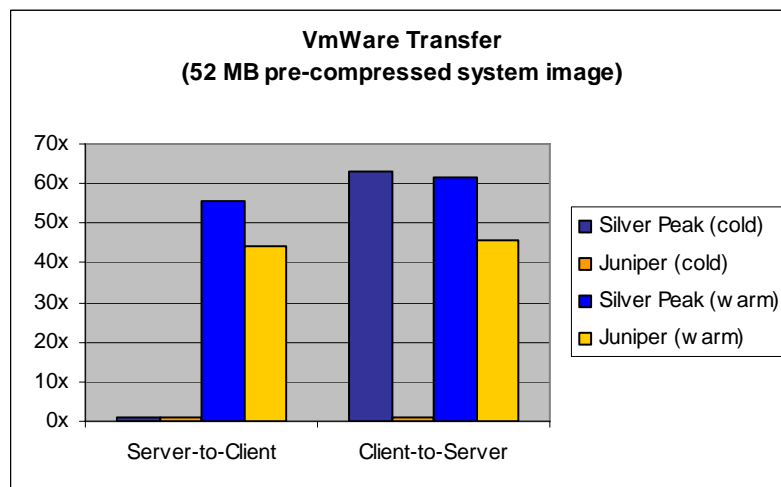


Figure 5: Disaster Recovery Testing Using VMware

It is important to note that we chose to use a pre-compressed VMware image in our testing due to time constraints. After the testing was complete, additional testing was conducted on the Silver Peak appliance for VMware transfers using an uncompressed image (451 MB). In baseline testing, the uncompressed file took approximately 55 minutes to transfer. Silver Peak reduced this to just over 5 minutes on its first pass using compression and acceleration techniques, which was a very significant performance improvement (11x) over baseline testing and the results seen when transferring a pre-compressed image. Subsequent transfers were reduced to approximately 1 minute, a 50x improvement that is on par with the Silver Peak results seen in tests using a pre-compressed file.

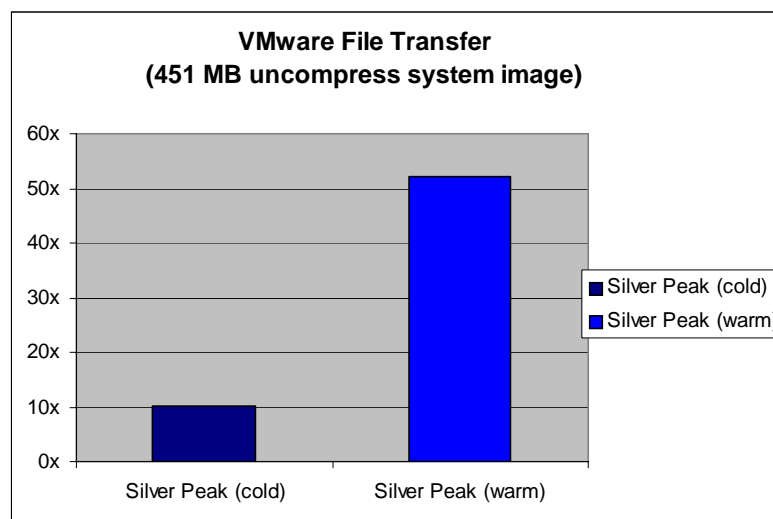


Figure 6: Disaster Recovery Testing Using VMware Silver Peak Optimized

3.3 VoIP Quality Assessment Testing

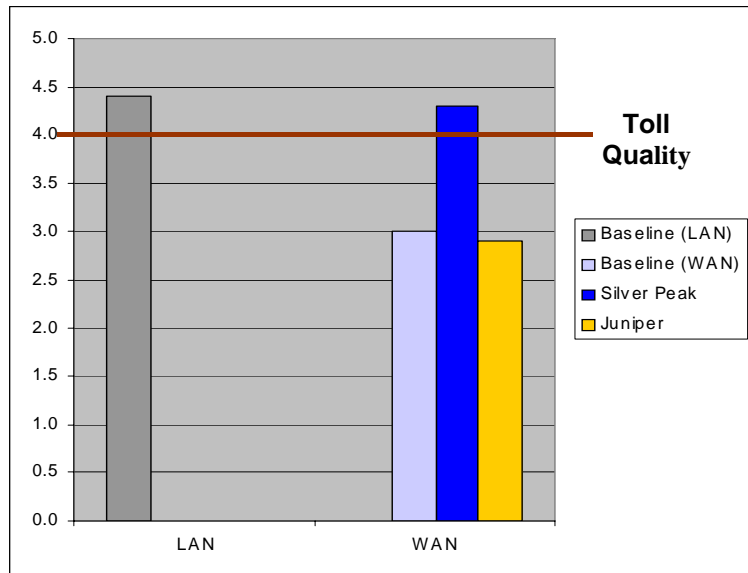
Voice over IP (VoIP) is one of the fastest growing applications in the enterprise. To see how well acceleration products handle VoIP, we performed end-to-end quality tests using the AppareNet™ Enterprise Voice 2.8 product from Apparent Networks, Inc. The AppareNet product reported Mean Opinion Scores (MOS) on a 1-5 scale, 5 being the best and 4.0 equivalent to toll quality. The system also reported latency and jitter on the network. We applied four simultaneous calls of G.711 VoIP traffic (UDP) at 64Kbps, over a 256Kbps WAN link with impairments. This load was intentionally selected to observe projected performance for a congested WAN environment.

Baseline testing showed a sharp drop in voice quality when going from the LAN to WAN, as expected looking at both the MOS and jitter results. Silver Peak's product improved voice quality on our test network by improving MOS and reducing jitter.

The MOS score dropped from 4.4 on the LAN to 3.0 on the WAN. When tests were run with the Silver Peak NX-3500, the voice quality improved with a MOS score of 4.3. The Juniper solution, on the other hand, actually reduced voice quality to an MOS score of 2.9, well below toll quality standard.

Figure 7: VoIP Voice Quality by Mean Opinion Score (MOS)

“...with the Silver Peak NX-3500, the voice quality improved with a MOS score of 4.3. The Juniper solution, on the other hand, actually reduced voice quality...”

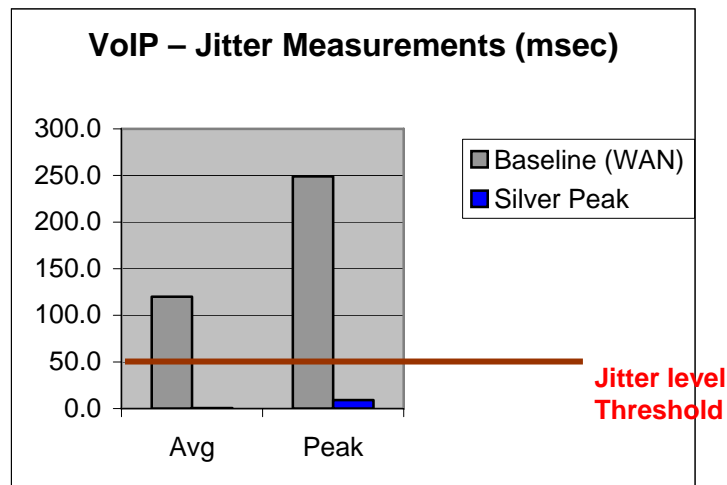


The jitter measured on the congested WAN connection with no acceleration products present (Baseline WAN) was recorded at an average 120 msec and peak 249 msec. When tests were run with the Silver Peak NX-3500, the voice quality improved. Average network jitter was reduced to 0.6 msec; with peak jitter measured at 9.1 msec. The standard deviation of Juniper's jitter measurements was too great to be used in this comparison.

On a private campus without congestion, jitter measurements can be as low as 1 to 5 msec. Connections over public networks can range from 5 to 40 msec. Most VoIP gateway products can compensate for jitter up to 160 msec with dynamic buffering. When network jitter exceeds these buffer tolerances, packets are typically dropped, resulting in poor voice quality for end users. As a general rule of thumb, jitter should remain below 200 msec to avoid noticeable degradation in VoIP quality.

Figure 8: Network Suitability for VoIP – Jitter Measurements (msec)

“...Silver Peak NX-3500, the voice quality improved. Average network jitter was reduced to 0.6 msec...”



While most application acceleration vendors do not recommend using their products for VoIP and other real-time traffic, the Silver Peak NX-3500 demonstrated that it could maintain toll quality across the WAN while substantially improving latency and jitter characteristics with its Quality of Service (QoS) capabilities. This is a significant benefit for enterprises looking to deploy VoIP across a wide area network.

3.4 Citrix – Interactive Application Testing

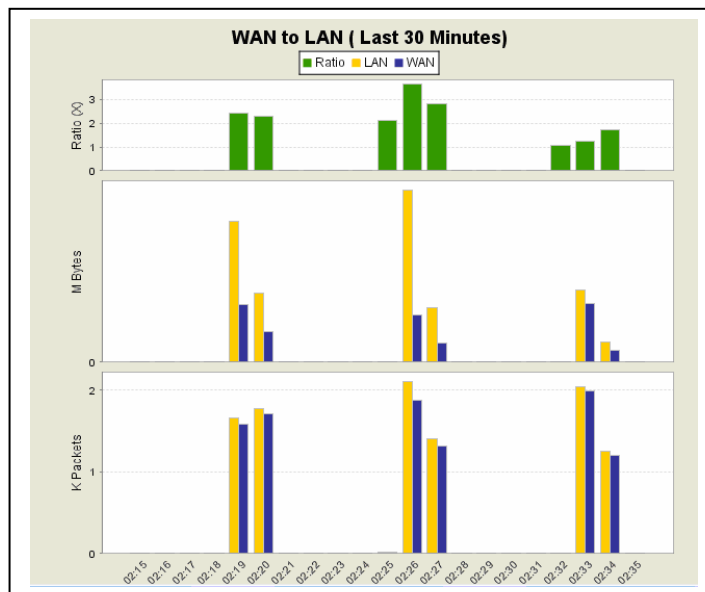
It is often difficult to accelerate interactive applications, such as Citrix. However, as this application is prevalent in almost all large enterprises, we wanted to see how the products in this test review would handle this type of traffic. To do this, we executed repetitive file opens and file saves on a desktop accessing a central Citrix Presentation Server™ via a WAN connection. We compared LAN traffic to WAN traffic to see how much data reduction was being provided by each acceleration device.

We did not expect significant data reduction on first pass when compression and encryption was enabled on the Citrix server. Juniper showed approximately a 1:1 mapping between LAN and WAN in this scenario, confirming our expectations. We were surprised to see Silver Peak provide a small, but significant performance increase – about 23% data reduction.

When compression and encryption were disabled within the Citrix server, Silver Peak demonstrated a significant performance improvement – a greater than 2x gain on first pass and more than a 3x gain on subsequent passes. (These values were provided using statistics from Silver Peak's management system). This is an important observation as it highlights two things. One, Silver Peak provided a significant increase in Citrix performance over the WAN. Second, Silver Peak is able to offload the Citrix server by moving compression and encryption out of the application and into the acceleration appliance. As these functions are processor intensive, offloading them to another device can improve the scale and performance of the application server. Note: Juniper's management system did not indicate any noticeable data reduction in this Citrix environment.

Figure 9: Performance Increase for Citrix Presentation Server Traffic

“Silver Peak's GUI accurately reports more than a 3X performance increase when optimizing remote traffic for Citrix Presentation Server.”



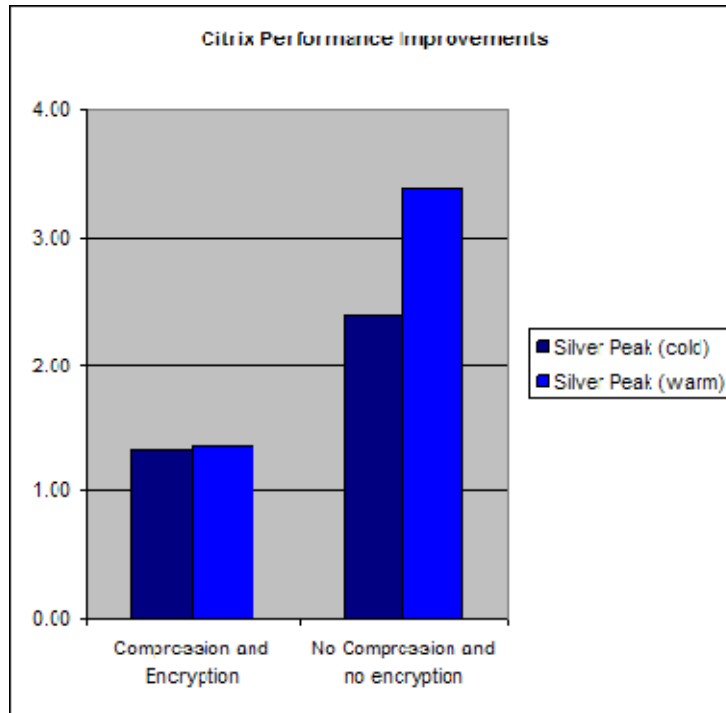


Figure 10: Citrix Data Reduction Silver Peak Optimized

The measured data reductions were noticeable in application response time. There was no noticeable delay in application performance when performing the above tasks via the Silver Peak appliance; the server felt like it was local. Juniper's product, on the other hand, induced a noticeable delay when running the Citrix application; there was a lack of responsiveness when using Citrix via the WAN.

3.5 Scalability and Flows Tests

The majority of tests in this report were conducted under light traffic load, as the primary purpose was to verify performance metrics. However, to satisfy enterprise requirements, these appliances must provide similar performance gains under heavy load.

We chose TCP flow limits as a way of measuring load. The number of TCP connections across a WAN can rapidly grow when many users across many branch offices are accessing centralized servers. Some application acceleration appliances are forced to originate and terminate TCP connections, and are therefore limited by the number of maximum TCP flows that can be supported - as little as 200 flows per appliance in some instances. We decided to put Juniper and Silver Peak to the test by creating 2,000 concurrent TCP sessions (using `tcpsink` and `tcpsource`), and then repeating the CIFS tests previously performed. This should be more than enough TCP sessions to support a mid to large branch, which is the type of location being targeted with these two appliances.

Both products provided almost the exact same performance improvements under heavy load that they did under light load. In this respect, neither the NX-3500 or WXC 500 showed any noticeable TCP flow limitations in our tests.

3.6 *Other Enterprise Considerations*

Quality of Service – QoS is important to application acceleration solutions as it guarantees performance and quality for different application types. Both solutions in this test purport to have QoS, including application and packet specific classification and enforcement.

Data security – Given the fact that both appliances store information locally, there was a concern regarding data security. Silver Peak claims to provide 128 bit hardware based AES encryption to protect local data stores in the NX appliances. We are unaware of a similar feature in the Juniper WXC appliances, or any other network appliance for that matter. Both vendors also claim that their respective products support IPsec tunneling between appliances to protect data across the WAN.

Resiliency – Removing single points of failure and ensuring maximum network uptime is one of the goals of any network design.

Both products claimed fail-to-wire capabilities when deployed in-line with WAN routers, and redundancy via VRRP and other protocols when deployed out-of-path. We tested the fail-to-wire capabilities of the NX-3500 and saw reboot and pass-through times that were more than adequate – 55 seconds and 5.1 seconds respectively. Other resiliency features to consider, which were not specifically tested, include redundant power and RAID drives.

4 Test Bed Setup

Identical test bed conditions were applied to the Silver Peak NX-3500 and to the other competitive system evaluated in this study. The test methodology and test bed setup was designed to rely on open source test tools and other equipment to make this test easily reproducible in customer demonstration environments. The Silver Peak NX-3500 (Network Acceleration Appliance) was running version 1.2.4 firmware and configured with factory default settings except for basic configuration parameters for IP address WAN capacity. The competitive product evaluated was tested using latest available firmware and default settings for configuration.

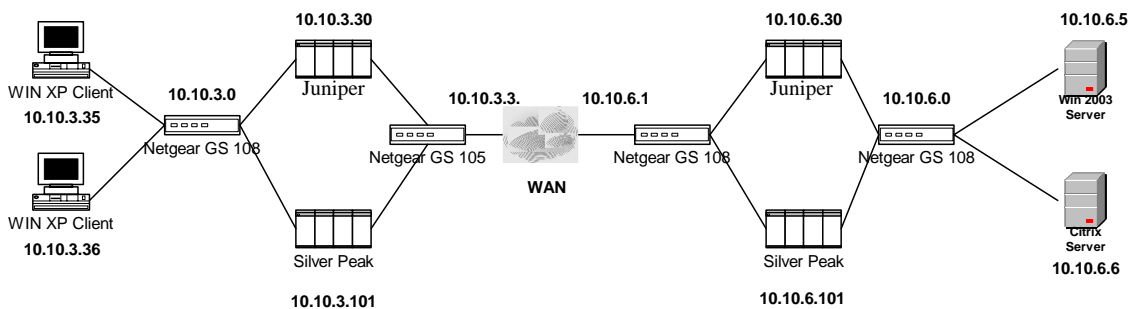


Figure 11: Test Bed Diagram

The test bed consisted of 2 Dell® D800 XP SP2 clients connected to a Netgear GS 108 Gigabit switch on the Branch side. During all testing a Juniper WXC 500 and a Silver Peak were interchanged on both the Headquarters and Remote side of the WAN.

The WAN in our test bed consisted of a Netgear® GS 108 on the Branch side, a NisNet Linux Server ver 2.0.12 WAN Emulator, and a Netgear GS 108 Gigabit Switch on the Headquarters side. On the Headquarters side a Juniper WXC 500 ver 5.1.3 and a Silver Peak network optimizer ver 1.2.4 were alternately inserted inline with a Netgear GS 108 during testing. The Headquarters consisted of a Citrix Server and a Win 2003 Server. During testing Windows Utilities NTFS Utility, WGET.exe, CIFS copy and Timethis.exe were used to measure all results. To measure MOS VoIP Quality results Apparent Network's AppareNet Enterprise Voice 2.8 was used. Multiple measurements were run and averages taken. Tests were conducted at WAN capacities 256Mbps to 1 Mbps. We deliberately tested a wide variety of traffic types: file transfer, interactive applications like Citrix, real-time application like voice, and application that use both TCP and UDP to represent common enterprise scenarios.

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