



Lab Testing Summary Report

July 2006
Report 060725

Product Category:
**WAN Optimization
Appliances**

Vendors Tested:
Citrix Systems™

**Riverbed
Technology™**

Products Tested:
**WANScaler™ 8800,
v.3.1.3**

Steelhead™ 5010, v.2.1.6



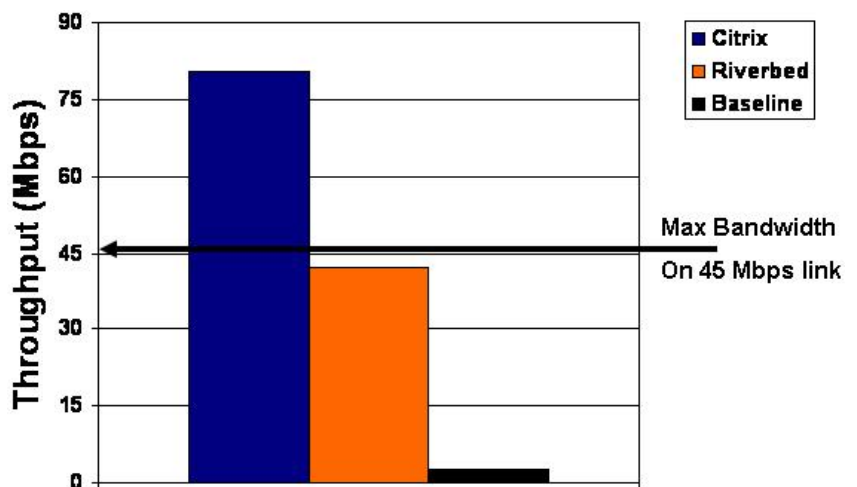
Key findings and conclusions:

- The WANScaler 8800 accelerates data disaster recovery and centralized backup times by more than 3000%
- On WAN links with variable latencies and packet loss, the WANScaler 8800 out performs the Riverbed Steelhead 5010 by more than 10x.
- Citrix delivers ultra-high compression ratios of several thousand to one, allowing much greater effective throughput while reducing congestion.
- WANScaler 8800 scales to high bandwidth levels, high levels of compression, and can effectively support centralized backup and disaster recovery for remote servers.

Citrix Systems Inc. engaged Miercom to independently verify the performance and operations of its WANScaler 8800 appliance and a competitive offering – Riverbed Technology’s Steelhead 5010. The Miercom testing found the WANScaler 8800 distinguished itself in several key respects: completes server-to-server data protection and disaster recovery faster on common WAN link speeds and utilizes WAN links more efficiently with superior flow control and compression.

Verifying Faster Data Protection and Data Disaster Recovery

First, Citrix’s unique transparent architecture accelerates data protection and disaster recovery transfers over a variety of commonly used WAN links including difficult-to-optimize WAN links with variable latency and bursty packet loss. Using a leading industry data protection solution from Double-Take Software (www.doubletake.com) to mirror



Verified Performance. The WANScaler 8800 accelerates the backup of a 20 GB data file on a 45 Mbps link with 100 ms latency (e.g. New York to London), 30 times faster than the unaccelerated baseline.

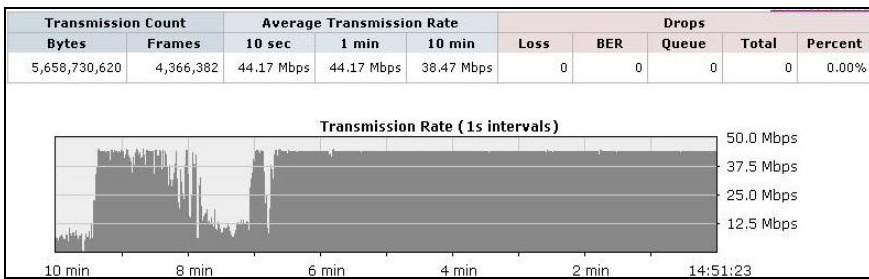


Figure 1 - More Throughput. The Apposite Linktropy 4500 screenshot shows the WANScaler 8800 using all available bandwidth on a 45 Mbps DS-3 link.

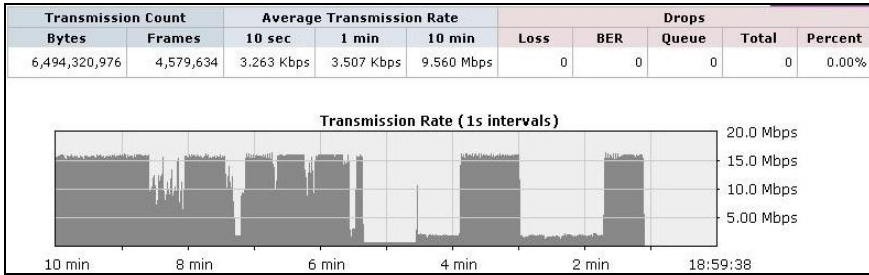


Figure 2 - Limited to 16Mbps. The Apposite Linktropy 4500 screenshot shows the Steelhead 5010 is limited to 16 Mbps on a 45 Mbps T3 link.

Note difference in graph scale between figures 1 and 2.

20 GB of office productivity files – in Citrix Systems’ environment – from a simulated remote office server to a central datacenter server, we recorded the unaccelerated transfer time of 16 hours and 53 minutes. Following the unaccelerated scenario, we then tested the WANScaler 8800 and Riverbed 5010. We observed that the WANScaler 8800 outperforms the Steelhead 5010 by 2-to-1 and the unaccelerated network by 30-to-1. The WANScaler 8800 completes the entire server-to-server transfer, over a 45 Mbps link with 100 ms of latency, in 34 minutes. The Steelhead 5010 completed the same transfer in 65 minutes.

The WANScaler 8800’s performance advantage stems from its ability to maximize all available WAN bandwidth (fig.1). In contrast, the Steelhead limits its performance to 16 Mbps out of the 45 Mbps available on the link (fig. 2). All performance statistics were collected via the Double-Take reporting and the Apposite Linktropy™ 4500 WAN emulator.

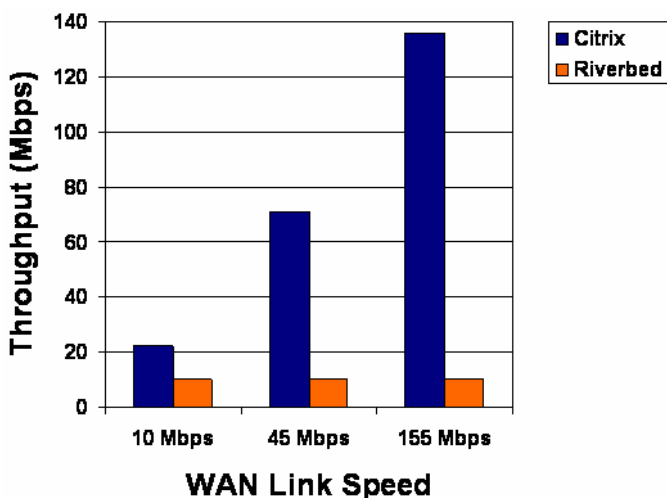


Figure 3 – Performing on WAN links with variable latency and packet loss. The WANScaler 8800 optimizes real-world WAN links with constantly changing conditions.

Real WANs Have Packet Loss

After testing the 20 GB data backup on a perfect 45 Mbps with 100 ms of latency and no packet loss, we decided to challenge Citrix Systems by proposing that the data backup performance testing continue with some packet loss and variable latency added. In our 18 years of testing experience, Miercom understands that real WAN networks experience constant changes in latency and are impacted by random packet loss. The test environment should simulate these conditions as realistically as possible.

The Linktropy 4500 features include ability to set average latency (e.g. 100 ms), a minimum latency, latency standard deviation (boundary for latency variation), average packet loss, and bit error rate (1×10^{-14}).

We reconfigured the Linktropy 4500 to impair the WAN link with an average 100 ms of latency, a minimum latency of 80 ms, standard of 10 ms for latency variance, 0.1% packet loss, and 1×10^{-14} . We consider these changes as a more

representation of a remote WAN link, such as between New York City and London.

After reconfiguring the Linktropy WAN emulator for a more realistic testing environment, we tested transferring the same 20 GB of data over simulated WAN speeds of commonly deployed 10 Mbps, 45 Mbps (T3), and 155 Mbps (OC-3) WAN links.

The repeatable results in figure 3, collected from the Double-Take application, demonstrate that the WANScaler 8800 completes 20 GB server backups up to 13x faster than Steelhead 5010.

The effective WAN throughput results for the three tested WAN link speeds are shown below in table 1.

Measured WAN Link Speed Results

	10 Mbps	45 Mbps	155 Mbps
WANScaler 8800	22.5 Mbps	70.7 Mbps	136.4 Mbps
Steelhead 5010	10.3 Mbps	10.4 Mbps	10.4 Mbps

Table 1 – Effective throughput for each test iteration calculated by the Double-Take application.

Flexible, Adaptive Performance On All Links

After comparing all of the data collected on server backup performance, we were able to characterize individual product performance between perfect and impaired 45 Mbps WAN links. At 45 Mbps, WANScaler 8800’s performance degrades by 12.25 percent, from 80.5 Mbps to 70.7 Mbps at 0.1 percent packet loss. In contrast, the Steelhead 5010’s performance degrades 75 percent from 42.1 Mbps to 10.4 Mbps. These performance metrics are displayed graphically in figure 4 on page 3.

Flow Control Reduces Transfer Time

Flow control reduces the negative effect of packet loss and link latencies on data traversing the WAN. In our testing, we found that better TCP flow control reduces the time to complete a data transfer. To test flow control, we used the same impaired 45 Mbps link and 900 MB of uncompressible data files. Using the uncompressible files prevented any compression features influencing the flow control testing.

Transferring the 900 MB of data for the first time with FTP; the WANScaler 8800 transfers the data in 3 minutes using all of the available bandwidth (fig. 5). In contrast, the Steelhead's transfer time is significantly longer and filled up the Apposite's 10 minute buffer history (fig. 6). Additionally, the Steelhead did not maximize the available 45 Mbps bandwidth; averaging only 3.178 Mbps over the 10 minute buffer history. The data clearly shows that WANScaler 8800's flow control is the more efficient, resulting in more than 3x faster transfer time.

Higher Compression Improves WAN Utilization

Compressing traffic reduces the amount of data that traverses the WAN link and improves overall data transfer time. We tested the ability of the WANScaler 8800 and Steelhead 5010 to compress FTP traffic. Transferring 900 MB of data across the same impaired WAN link for the first time, both devices compressed the data to a ratio of approximately 1:1, as seen in figures 5 and 6 under "Transmission Count" and "Bytes". (See Test Bed Setup on page 4 for how compression ratio was calculated)

Transferring the same data a second time, the WANScaler 8800 sent only 192,786 bytes representing the entire 900 MB of data in less than 20 seconds. In turn, the Steelhead 5010 transmitted 6,041,324 bytes representing the same 900 MB of data in 2 minutes. The results in figures 7 and 8 clearly display the WANScaler 8800 achieving a compression ratio of 4600:1 versus the Steelhead's 150:1.

Optimal for Datacenters

Featuring higher compression ratios, a more robust ability to negate the additional performance penalties from real-world WANs, and faster server backups, the WANScaler 8800 outperforms the Steelhead 5010, making it a top-notch choice for datacenter deployments.

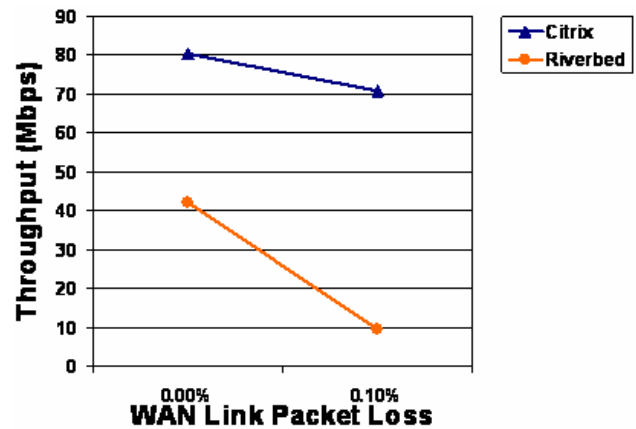


Figure 4 – Performance on WAN links with variable latency and packet loss. Unlike the Steelhead 5010, the Orbital 8800 powers through constant changes in link conditions found on real WAN links.



Figure 5 – 1st Pass Performance. WANScaler 8800 transferring 900 Mbps of data over a 45 Mbps link with impairments. WANScaler completes the transfer in 3 min.

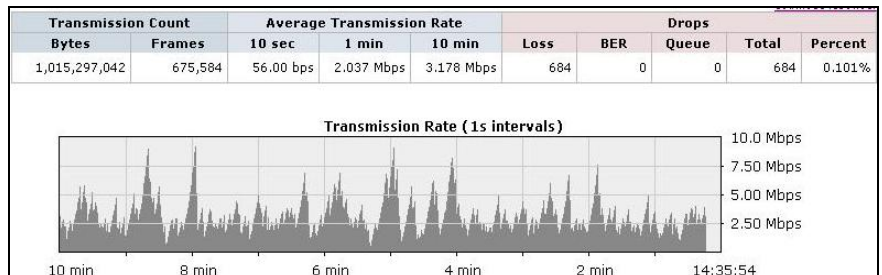


Figure 6 – Steelhead 5010 averages only 3.178 Mbps over a 10 minute window to transfer the same 900 MB. Flow control is a key factor.

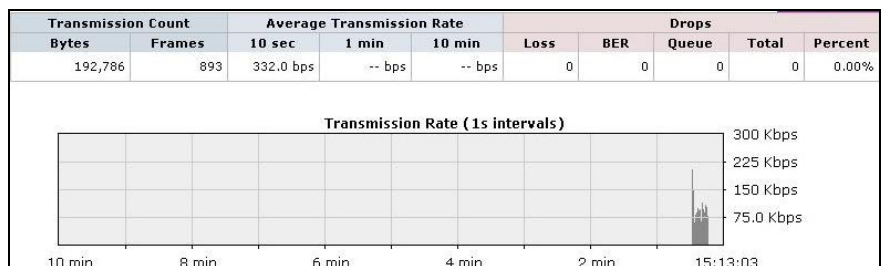


Figure 7 – 4600:1 Compression. WANScaler 8800's 2nd pass compression improves data transfer by 6X from 3 minutes to 20 seconds.

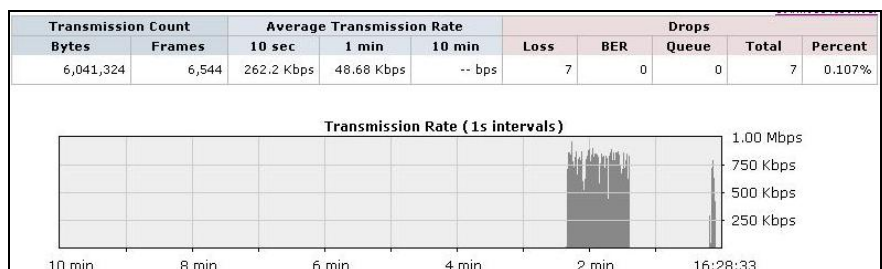
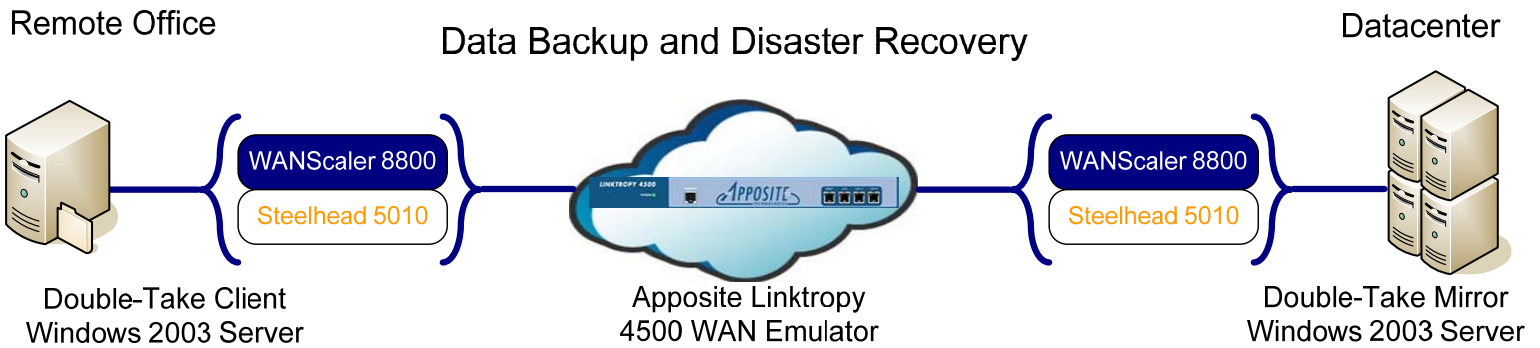


Figure 8 – Steelhead 5010 achieves only a 150:1 compression ratio.

Test-bed Setup



Devices Under Test The devices under test (DUTs) are the WANScaler 8800 and the Steelhead 5010 WAN optimization appliances. Key testing objectives are to determine which vendor's solution completes server-to-server data backup faster and which supports higher bandwidth utilization. Both are significant requirements for datacenter deployments.

Data Recovery and Backup Test Over WAN

Testing data backup and disaster recovery application performance was completed with a simulated remote office and datacenter with a WAN emulator. Two servers, running Microsoft Windows 2003 Server operating system, acted as the remote office and datacenter, respectively. The WAN emulator used to emulate real WAN link conditions was the Linktropy 4500, v. 1.1.2, from Apposite Technologies. To generate server-to-server backup traffic between a simulated remote office and datacenter, we used a leading industry data backup solution from Double-Take Software. The Double-Take software, version 4.4.2.1.1447, was installed on both Windows based servers.

To simulate long distance WAN conditions (e.g., between New York and London), the Linktropy 4500 was configured with an average 100 ms of latency, minimum 80 ms latency, standard deviation of 10 ms, 0.1% random packet loss, and 1×10^{-14} bit error rate (BER) for each WAN link speed tested. The Double-Take software was minimally configured to complete 20 gigabyte data backup without Double-Take compression.

The DUT appliances were tested one at a time for each WAN link speed of 10 Mbps, 45 Mbps (T3), and 155 Mbps (OC-3); first the WANScaler 8800, then the Steelhead 5010, and finally the baseline un-accelerated case. For each test, we carefully noted the configuration and set-up process, which included clearing any data cached in memory or hard disks from all equipment. At the completion of each test, the impartial performance results were collected from the reporting features in the Linktropy emulator and Double-Take reporting. The unaccelerated baseline case was only tested on the perfect T3 link due to time constraints for testing.

Compression and Flow Control Performance

Using the same 45 Mbps test setup from the server backup testing, 900 MB of data was transferred from the remote office server to the datacenter server via FTP. SmartFTPclient 2.0.996.43 was used to transfer the data from the native FTP server included with Windows Server 2003. The file transfer provided data to compute the compression ratio and determine flow control efficiency. To ensure fairness, impartial performance results were collected from third party applications and not the DUT.

Compression performance was measured by data collected from the Apposite reporting. The compression ratio was calculated as the amount of data (900 MB) transferred by FTP divided by the actual number of bytes transferred over the WAN link – as reported by the Apposite device.

Flow control performance was also measured by data collected from the Apposite reporting. Flow control effectiveness was determined by how well a product utilized the available 45 Mbps of WAN bandwidth, with variable latency and 0.1% packet loss, to minimize the time to complete a data transfer.

Note: All publicly available materials from the competitive vendors, along with the considerable technical expertise and judgment of the testers, were applied to ensure these vendors' units were appropriately and properly configured for each test scenario. The vendors' products were minimally configured from factory defaults. Riverbed was invited by Miercom to actively support this comparative testing, but declined.

Miercom Verified Performance

Based on Miercom's thorough workout of the WANScaler 8800 – and examination of its configuration, operation and performance, as described herein – Miercom attests to its performance, in particular:

- The WANScaler 8800 reduces the time to complete a data backup by more than 3000%.
- WANScaler 8800 outperforms Steelhead 5010 by 13x on real world WAN links with variable latency and random packet loss.
- The Citrix appliance compresses data up to 4600:1.
- WANScaler 8800, with superior flow control, compression, and data backup acceleration, is ideal for the datacenter.



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