



## Lab Testing Summary Report

December 2007  
Report 071215e

Product Category:  
**Network Optimization  
Appliances**

Vendors Tested:  
**Cisco Systems  
Riverbed Technology**

Products Tested:  
**Cisco WAE 7371**

**Riverbed Technology  
Steelhead 6020**

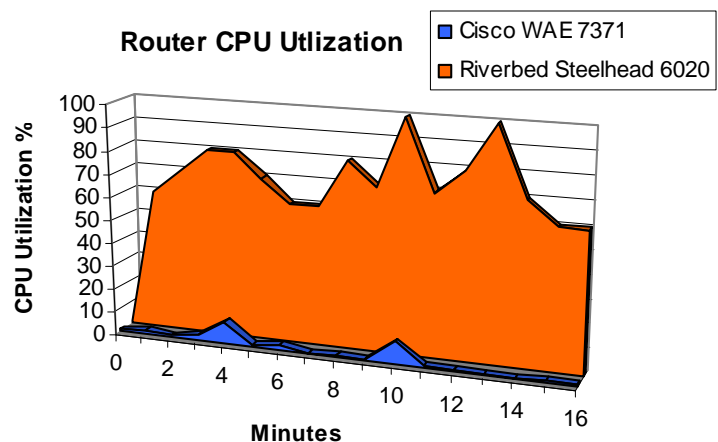


### Cisco WAE 7371 Test Summary:

- Superior performance and scalability proven with tests exceeding 50,000 HTTP connections at 350 cps
- Load reduction measured up to 89% for remote data center servers proven in testing
- Rock solid stability and reliability demonstrated even after completing an aggressive battery of load tests
- Superior performance for network optimization under heavy and sustained load conditions

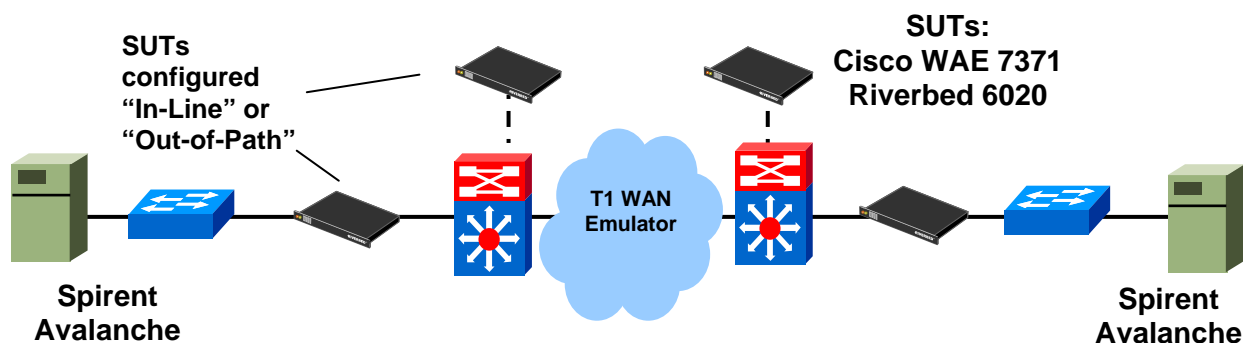
Cisco Systems submitted the Cisco WAE 7371 network optimization appliance to be competitively assessed in areas of scalability, performance and reliability. This report includes a comparison of the Cisco WAE 7371 and the Riverbed Steelhead 6020. A comprehensive battery of tests was applied to both products. It examined well beyond the typical “drag race” performance metrics presented in less sophisticated analyses conducted by other testing organizations. This testing examined the impact of the appliances on the underlying network including network switch CPU and server utilization.

Although both products demonstrated an excellent ability to optimize traffic under lightly loaded conditions, the impact they have on switch CPU utilization became apparent in moderate load conditions when devices were set up in an “Out-of-Path” configuration. The Riverbed Steelhead 6020 required an unacceptably high amount of CPU utilization while the Cisco WAE 7371 could take advantage of hardware acceleration in the Catalyst



*“Less is more” - reduced strain on network infrastructure – Cisco WAE 7371 consumes significantly less CPU resources from the routed network than the Riverbed Steelhead 6020 while conducting “Out-of-Path” performance tests.*

## Test-bed Setup



### Devices Under Test and Test Tools:

- (2) Cisco WAE 7371 - WAAS version 4.0.13.b.23
- (2) Riverbed Steelhead 6020 - RiOS version 4.1.0b e
- Spirent Avalanche version 7.5.4 build 44864
- Shunra Storm VE Network Appliance version 5.2 build 65.1.22
- (2) Cisco Catalyst 6503 Switches: WS-C6503-E, 12.2(18)SXF10, WCCPv2

### Test-bed Description:

Systems under test (SUTs) were connected as shown above in either an “In-Line” or “Out-of-Path” configuration. A Spirent Avalanche test system was utilized to generate end-to-end HTTP connection traffic across the L3 network and the T1 WAN simulated by a Shunra Storm WAN emulator. An open source benchmark tool for Microsoft Office applications was used to script and measure response times for basic Microsoft Office application file operations in the series of tests. Benchmark executes a scripted set of operations and measures the time, which is a good indication of the expected user experience on the network.

**“Out-of-Path” Test / WCCP Test:** SUTs were configured in an “Out-of-Path”/WCCP configuration (see diagram above). HTTP session traffic tests were conducted up to 350 connections per second while downloading of a 512 KB file using Microsoft IIS Server, (Internet Explorer client). Measure Catalyst Switch CPU utilization.

**“In-Line” Connections Test:** SUTs were configured in an “In-Line” configuration (see diagram above). Conduct HTTP session traffic tests up to 110% of the rated connection per second and simultaneous connection handling capacity of the appliances. Verify with Avalanche set to HTTP downloads of a 512 KB file from a Microsoft IIS Server, (Internet Explorer client). Connections set to time out after 300 seconds. Test up to 50,000 connections for Cisco WAE 7371 and 40,000 connections for Riverbed Steelhead 6020. Avalanche ramp up was set to 300 seconds.

**File Services and Server Utilization Test (CIFS):** The CIFS (Common Internet File System) tests measured the speed performance of the appliances’ ability to accelerate common Microsoft file services such as file opens, closes, and changes. This test measured the performance improvement that Network Optimization Appliances provide for CIFS operations, as well as measured the impact on data center server utilization and network load.

**Note:** Each vendor’s publicly available materials were utilized in the analysis and conduct of testing to produce this report. The technical expertise of the test engineers was applied to ensure the vendors’ units were properly configured. Riverbed Technology declined invitation to provide input for this testing and was extended invitation to retest their product.

### “Out-of-Path” / WCCP Test Performance

6503 Switches to offload CPU utilization.

A series of four test and assessment areas was included in the evaluation. The areas consisted of Scalability and Performance “Out-of-Path,” Scalability and Performance “In-Line,” Server Utilization and Reliability.

The first page graphic shows the impact of router CPU utilization using both products during Scalability and Performance “Out-of-Path” testing. The Cisco WAE 7371, as well as any acceleration product that complies with Cisco’s open standard Web Caching Control

Protocol, can take advantage of the available hardware acceleration provided by the Catalyst Switches. Web Cache Control Protocol (WCCP) is a published open standard from Cisco. It provides for enhanced performance using the switch's hardware. In the test bed, the SUTs were connected to the router in an "out-of-path" configuration (see test bed diagram previous page) and the optimization performance was measured for establishing HTTP sessions. A load of 300 connections/sec was applied using a 512 KB file.

With minimal load on the switch's CPU resources, the Cisco WAE 7371 proved it was able to optimize the full load of HTTP connections. The Cisco WAE 7371 sustained over 300 connections/second with up to 50,000 connections with minimal CPU load on the switch in the network. However, in the same test, the Riverbed Steelhead 6020 could only optimize a fraction of the traffic applied under heavy load conditions and it consumed more than 90% of the switch's CPU utilization.

### "In-Line" Connections Test Performance

The devices under test were reconfigured in an "In-Line" mode, the second common configuration for these types of appliances. This test measured the appliances' ability to achieve rated HTTP traffic connection per second and their simultaneous connection handling capacity. Loads were applied to test the rated capacity of 50,000 connections for the Cisco WAE 7371 and 40,000 for the Riverbed Steelhead 6020. The Cisco WAE 7371 passed all in-line scalability tests. See screenshots on right.

The Riverbed Steelhead 6020 could not achieve the desired load capacity. When attempting the rated 40,000 connection capacity, the device would failover more than half of its connections to pass-thru. When pushed beyond 40,000 connections, the device would failover even a greater percentage and offer optimization well under the rated capacity.

```

ex Telnet 171.68.96.249
bob-dc#sho stat tfo
Total number of optimized connections      : 50082
No. of active connections                  : 50000
No. of pending (to be accepted) connections : 0
No. of connections closed normally         : 0
No. of connections closed with error       : 82
Total number of peers                       : 1
No. of entries into overload mode          : 8
No. of connections reset due to -
Socket write failure                       : 0
Socket read failure                        : 0
Opt socket close while waiting to write    : 0
Unopt socket close while waiting to write  : 0
Opt socket error close while waiting to read : 66
Unopt socket error close while waiting to read : 0
DRE decode failure                         : 0
DRE encode failure                         : 0
Connection init failure                    : 0
Opt socket unexpected close while waiting to read : 0
Exceeded maximum number of supported connections : 1
Buffer allocation or manipulation failed   : 0
Peer received reset from end host          : 15
DRE connection state out of sync          : 0
bob-dc#sho stat tfo

```

Cisco WAE 7371 was proven to optimize 50,000 sustained HTTP Sessions for "In-Line" configuration.

```

ex Telnet 171.68.96.249
C 10.100.0.8 50745 10.100.1.8 80 2007/11/06 01:11:15
C 10.100.0.8 50750 10.100.1.8 80 2007/11/06 01:11:15
C 10.100.0.8 50752 10.100.1.8 80 2007/11/06 01:11:15
C 10.100.0.8 50758 10.100.1.8 80 2007/11/06 01:11:15
C 10.100.0.8 50761 10.100.1.8 80 2007/11/06 01:11:15
C 10.100.0.8 63024 10.100.1.8 80 2007/11/06 01:09:10
C 10.100.0.8 63200 10.100.1.8 80 2007/11/06 01:09:15
C 10.100.0.8 63539 10.100.1.8 80 2007/11/06 01:09:35
C 10.100.0.8 64124 10.100.1.8 80 2007/11/06 01:09:43
C 10.100.0.9 55956 10.100.1.8 80 2007/11/06 01:07:42
C 10.100.0.9 61503 10.100.1.8 80 2007/11/06 01:11:15
C 10.100.0.9 61703 10.100.1.8 80 2007/11/06 01:11:14
C 10.100.0.9 62708 10.100.1.8 80 2007/11/06 01:11:15
Established Optimized (O): 11483
Half-Opened Optimized (O): 0
Half-Closed Optimized (C): 116
Pass Through (P): 46138
Forwarded (F): 0
Discarded (not shown): 0
Denied (not shown): 0
Total: 57737

```

Riverbed Steelhead 6020 fails more than 50% of its connections to pass-thru mode when 40,000 HTTP connections are attempted. At heavier loads the device can optimize to only 25% rated capacity.

### File Services and Server Utilization Test

In the file services testing, the SUTs were placed in an In-Line configuration. An open source test script was used to replicate Microsoft file services' file opens, closes and changes. Different file types were sent and received using the Common Internet File System (CIFS) protocol.

The tests looked not only at the performance improvement for the CIFS operations (time and WAN bandwidth reductions) but also at the associated impact on server utilization and local network load.

Both products demonstrated an excellent ability to improve CIFS operation performance ranging from a 60% to an 80% application response time improvement. A key differentiator: the

Cisco WAE 7371 reduced the server network load by 89% while the Riverbed product doubled the amount of data required to be generated by the server.

### Network Utilization % Improvement

Cisco WAE 7371		Riverbed Steelhead 6020		No optimization appliance	
OUT:	IN:	OUT:	IN:	OUT:	IN:
2.16 MB	23.8 MB	39.3 MB	23.9 MB	20.5 MB	24.3 MB
89%	2%	<92%>	2%	n/a	n/a

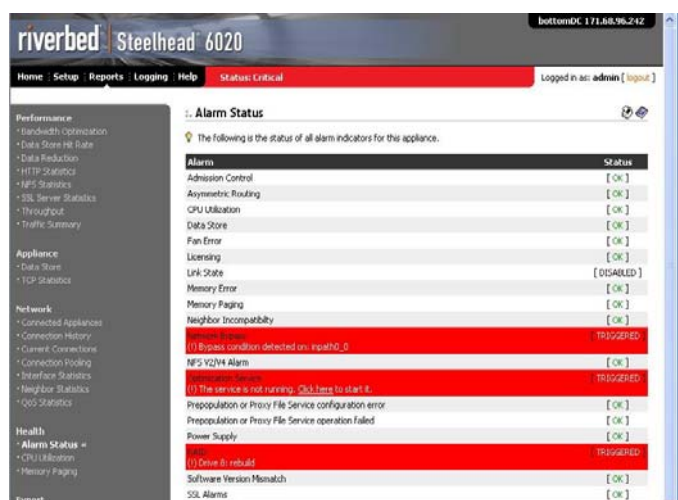
Cisco WAE 7371 provides reduction of network and server load for data center servers, whereas competitive products may actually worsen the network.

Organizations implementing network optimization solutions should consider the additional server resources required in deploying these solutions and avoid those that are data center unfriendly.

### Reliability Analysis

During the testing, the Cisco WAE 7371 was found to be reliable and exhibited no signs of system instability or system lock up.

However, the Riverbed Steelhead 6020 exhibited multiple repeatable instances of issues (see below). These included system false alert notifications, system instability and system crashes with heavy load. Of particular concern was the way the device could not recover by



Riverbed Steelhead 6020 exhibited numerous instances of system instability during testing, even with traffic load well under the rated capacity of the appliance.

itself, or resume normal operation without a hard power reboot of the system, even when the load applied was removed.

The failures were observed with test loads applied within the published specified capacity of the products. Our intent was not to conduct kill tests, but to replicate the use expected for a moderately- to heavily- loaded network.

The problems exhibited with the Riverbed Steelhead 6020 were very surprising. However, the problems were repeatable despite applying a firmware upgrade and testing multiple hardware platforms.

Tests were repeated using both different Riverbed Steelhead 6020 hardware devices as well as different versions of system firmware. The most recently available operating system according to the vendor's Web site was used for the final testing included in this report.

Test results conducted on previous versions of firmware exhibited problems similar to the current release, including the instability observed under heavy load conditions.

### Re-test Challenge

Riverbed was offered a re-test challenge and opportunity to have their product assessed again at no charge. Riverbed was also extended an opportunity to comment on this review and actively participate. Both offers were declined.

### Test results applicability

As network environments may be radically different for each deployment, we recommend custom pre-deployment testing before applying any product to a production network. Miercom offers objective, vendor-independent pre-deployment testing services.

Contact Miercom for available updates on test results for the products included in this report or other related network optimization products or technology.

## Miercom Performance Verified Seal of Approval

Based upon extensive validation testing focused on performance, system scalability and reliability, the Cisco WAE 7371 Network Optimization Appliance clearly meets its specifications and capabilities. It will exceed customer expectations. The Cisco WAE 7371 proved its effectiveness and resiliency and thereby earned the Miercom Performance Verified™ Certification.



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## About Miercom's Product Testing Services

With hundreds of its product-comparison analyses published over the years in such leading network trade periodicals as *Business Communications Review* and *Network World*, Miercom's reputation as the leading, independent product test center is unquestioned. Founded in 1988, the company has pioneered the comparative assessment of networking hardware and software, having developed methodologies for testing products from SAN switches to VoIP gateways and IP PBX's. Miercom's private test services include competitive product analyses, as well as individual product evaluations. Products submitted for review are typically evaluated under the "Performance Verified™" program, in which networking-related products must endure a comprehensive, independent assessment of the products' usability and performance. Products that meet the appropriate criteria and performance levels receive the "Performance Verified™" certification.



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Report 071215e