Miercom

Lab Testing Summary Report

May 2007
Report 070529

Product Category:
Network Acceleration

Vendor Tested:
Cisco Systems

Product Tested:
**Cisco Wide Area Application Services (WAAS)** v4.0.7

CISCO ™

Miercom **PERFORMANCE VERIFIED** ™

Key findings and conclusions:

- **Cisco WAAS demonstrated excellent performance with compression, speed, and throughput**

- **Cisco WAAS provides steady performance for Microsoft Exchange without generating application errors**

- **WAAS shows fairness of connection throughput and performance consistency across concurrent users and multiple workloads**

- **Cisco WAAS optimization does not degrade under load or create unfair performance between workloads**

- **In drag and drop file tests, Cisco WAAS provides strong performance for CIFS acceleration, and fast implementation of acceleration for transferring large files, copying a 170MB file in 25 seconds**

C isco Systems engaged Miercom to verify the operation of the Cisco Wide Area Application Services (WAAS) solution v4.0.7 Software installed on dedicated appliances as well as integrated service module in the Integrated Services Router. Configured across a realistically simulated WAN remote branch to data center connection, the WAAS solution showed itself to be effective in providing network load fairness, CIFS overhead mitigation, and transparent WAN optimization. The WAAS solution delivered no errors on measured performance from both server and client perspective.

In three different topologies WAAS also demonstrated effective compression and acceleration of traffic while reducing WAN overhead and increasing WAN throughput. These features can allow more transaction throughput with good user response time with the existing network infrastructure.

With the combination of features across the full scope of network traffic and activity, the Cisco WAAS software solution enables enterprises to centralize file servers and storage in the corporate data center, and enables consolidation of the number of servers required to handle existing traffic.
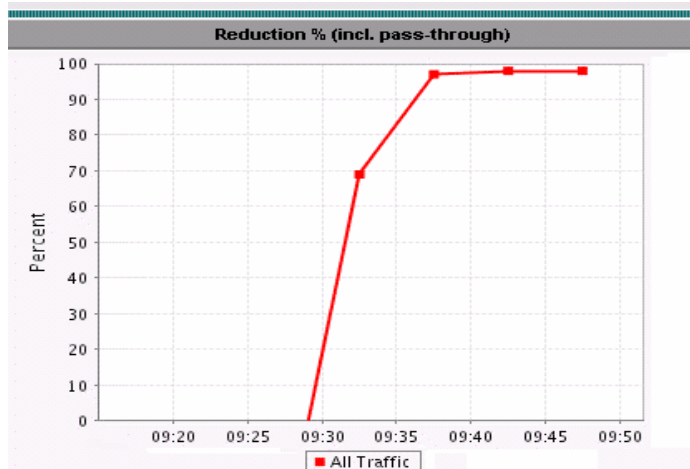
Traffic Reduction –Cisco Central Manager display showing WAAS ramping up to 99% measured compression of all traffic, typical of the HTTP, FTP, and CIFS test performed.
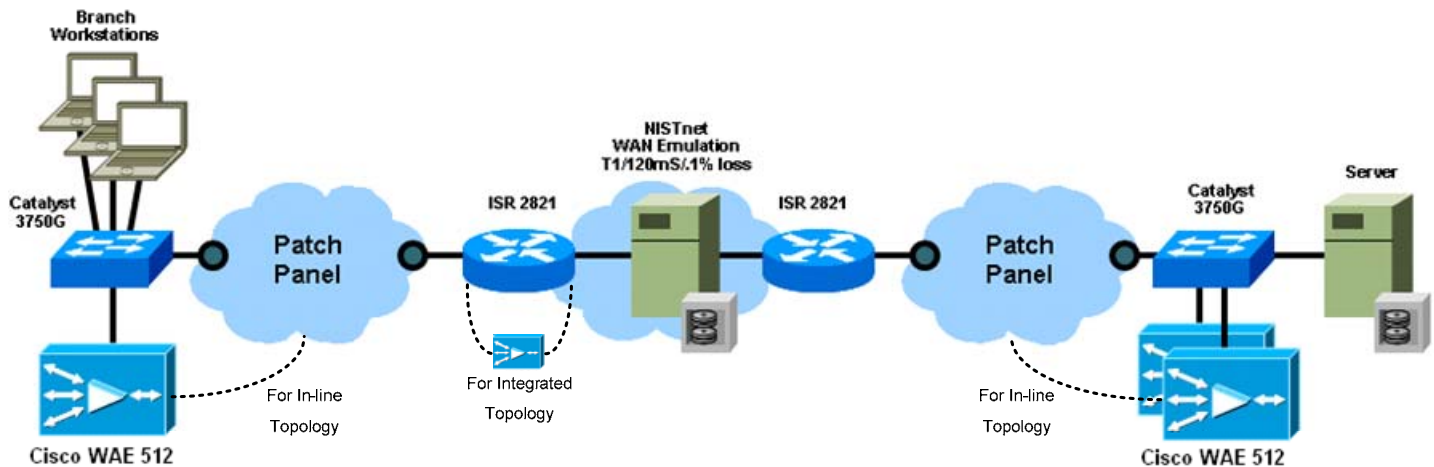
Test Bed

Devices Under Test - Test Bed. The Cisco WAAS solution was tested, version v4.0.7 in three different topologies. **Out-of-path:** The first topology consisted of multiple Cisco WAE 512 (Wide Area Engines) with one at the branch edge, one at the core (each configured as a out-of-path device), and third serving as a central manager. **Integrated:** The second topology consisted of a Cisco WAE 512 appliance at the datacenter and a Cisco WAE-502 module in the Cisco 2821 router. **In-line:** For the third topology, two Cisco WAE 512 appliances were configured for in-line traffic. The devices were placed in the test bed via the patch panel. The WAN was emulated using NISTNet v2.0.12 on RedHat Linux AS9 on a P4 3.0 GHz platform. WAN emulation was set, for all tests, to T1, with 120ms of latency, and .1% packet loss. Two Cisco 2821 Integrated Services Routers provided the T1 gateway at both branch and data center ends. The branch office clients were three P4 3.0 GHz PCs, with 1GB of memory, running WinXP SP2. The data center server was IBM X346 server with 4GB of memory, running Windows 2000 SP 1, Exchange Server 2003, IIS v6.0 for web services. A Cisco Catalyst 3750G switch connected to the client workstations and the WAAS device at the branch office, and a Catalyst 3750G at the data center end connected the WAEs and the data center server. For in-line the upstream interface was connected directly to the ISR 2821 router while the downstream interface was connected to the 3750G.

Tools: IxChariot network load testing software, v6.0 was used to generate the traffic in the designated "load" versions of test performed. IxChariot generated background traffic across the WAN that was composed of file downloads with random content. Cisco WAFS (Wide Area File Services) Benchmark Tool v1.1.1 scripts were used to create user actions and measure response times for basic Microsoft Office application file operations. File types of .xls, .ppt, and .doc, one each of the following sizes were used: 50K, 100K, 200K, 500K, 1M, 2M. NetBench v7.0.3 was used to measure the performance of file servers as they handle network file requests from clients. NetBench was used in test that measured the performance of file servers as they handle network file requests from clients. Microsoft Exchange Load Simulator 2003 v 6.5.7529.0. Exchange Server 2003 Performance Manager was used to capture statistics in the test bed.

Tests

HTTP/FTP and Load Fairness - Compression percentage in this suite of download tests was measured as a ratio of average throughput speed reported by WGET HTTP and FTP commands final statistics using the same file mix used by Benchmark stated above, with the inclusion of a 170MB ISO binary image file.

CIFS Performance - The CIFS (Common Internet File System) tests measured the speed performance of the appliances in copying files by drag-and-drop downloads from a simulated data center desktop to a branch office desktop using the same file mix used by Benchmark below.

Office Benchmark User Activity - Cisco WAFS (Wide Area File Services) Benchmark Tool for Microsoft Office Applications was used to script and measure response times for basic Microsoft Office application file operations in this series of tests. Benchmark executed a scripted set of operations and measured the time to execute as a quantitative indication of the user experience on the network.

Exchange Loadsim Performance - A profile consisting of 50 simulated enterprise users connected across a T1 WAN link to the data center server were used to test the performance acceleration and optimization. The tests produced approximately 230 Exchange transactions per minute for 30 minutes.

NetBench Server Performance - The NetBench Enterprise Disk Mix Test (ENT_DM.TST) was used to measure CIFS performance in this series of tests. The Enterprise Disk Mix is, according to NetBench documentation "a more transaction intensive version of the Standard Disk Mix" designed to be run on enterprise class servers".

Results

A battery of tests in five categories, including HTTP/FTP and Load Fairness, CIFS Performance Results, Office Benchmark User Activity, Exchange Loadsim testing, and NetBench Server Performance testing, were run on the Cisco WAAS solution under controlled and repeatable conditions. The tests were performed with and without background load traffic across the WAN, measuring performance metrics for pre- and post-cache initialization performance with the Cisco WAE appliances in three different realistic network topologies.

HTTP/FTP and Load Fairness Results

The hot transfer of a 15MB .ppt file and a 170MB ISO file with no background load showed exemplary results. The 15MB file was downloaded in 2 to 3 seconds ranging from 7.53MBps for integrated topology, 8.43MBps for the in-line and 9.71MBps for out-of-path configuration. The 170MB file download was timed at 15 to 20 seconds at 11.05MBps out-of-path topology, 8.07MBps for integrated and 8.53MBps for the in-line topologies. Overall, compression rates for WAAS remained at 98% or above with similar results in FTP trials, demonstrating that the WAAS solution optimizes traffic efficiently regardless of the underlying protocol. With an Ixia background traffic load the throughput of the WAAS measured 9.79MBps for the out-of-path configuration.
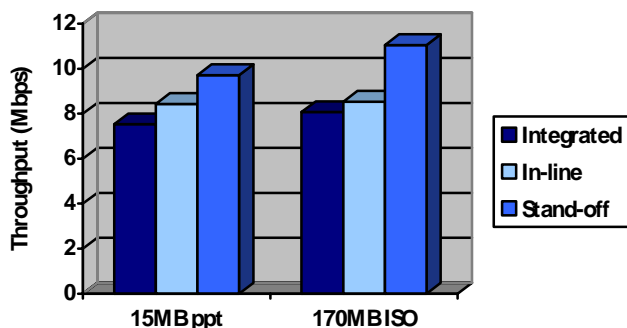

Figure 1: HTTP/FTP and Load Fairness

With two IxChariot load sessions running, and the manual binary download initiated, WAAS showed an excellent throughput at 6.72MBps. The fairness of bandwidth allocation was also a striking result, with the WAAS showing that the three simultaneous sessions received almost the same percentage of bandwidth at 6.72MBps, 33% of 20.22MBps total system throughput. According to Cisco, the WAAS architecture was designed to optimize acceleration on the network "ecosystem" as a whole rather than focusing on point-to-point improvements, as these results indicate. Similar results were shown in the other topologies with an equal 50% being allocated to each of two streams.

CIFS Performance Results

The CIFS (Common Internet File System) tests measured the performance of the appliances in copying files via drag-and-drop downloads from a simulated data center desktop to a branch office desktop, demonstrating the improved CIFS performance that Cisco WAAS provides for large-object access within the Windows environment without overloading the server. File copy services are off-loaded allowing a server to handle more traffic with the existing equipment. For a cold-cache, first-time download, documents of varying format and size (1M, 5M, and 15M) averaged less than 4 seconds to download regardless of the topology used. Large file sizes dramatically illustrate these benefits. A 170MB ISO image file downloaded in 28 seconds hot as compared to over 20 minutes in a cold cache scenario (over 35 minutes with no acceleration device in the topology). Miercom tests have shown that average download times on competitive appliances with a hot cache under the same conditions can run as high as 48 seconds.

Office Benchmark User Activity Results

Cisco WAFS (Wide Area File Services) Benchmark Tool for Microsoft Office Applications was used to script and measure response times for basic Microsoft Office file operations in this series of tests. The Benchmark executed a scripted set of operations and measured the time to completion. Tests were run with and without IxChariot background load, each with a cold and hot run. No-load test results were recorded as a percent improvement over the native WAN speed (seconds to complete). The results were averaged by file size (see Test Bed for file types included) ranging from 50K to 2M. The load tests were compiled to compare the relative performance of the appliances. The results of executing the Office Benchmark scripts cold showed WAAS delivered fast OPEN times in all file groups. Table 1 through 3 following displays the hot OPEN results.

Exchange LoadSim Test Results

Microsoft's LoadSim tool for Exchange Server 2003 was used to benchmark the performance of Exchange Outlook to test the WAN performance improvement WAAS delivers in an environment running Exchange 2003. The no load test showed that WAAS achieved excellent combined upload and download compression with an average 4.2X

compression over the native WAN throughput in the out-of-path topology and comparable performance in the other two topologies. The load test of Exchange transactions showed that with the added WAN traffic, WAAS maintained the compression average at 4.2X with no evidence of performance degradation under heavy loads. No synchronization errors were produced in any of the topologies tested, as found in other comparable optimization appliances.

NetBench Server Performance Results
NetBench was used to create CIFS traffic to measure Windows non-Exchange transactional operations across a WAN. With an intensive mix of transactions designed to run on enterprise class servers, and zero "think time" (inter-transaction submission time) the tests performed are considered high volume and stressful to the network. It was determined that WAAS will accelerate transactions and provide industry-level response times to the client while reducing WAN overhead. While providing excellent levels of application throughput, Cisco provided up to 90% offload of the origin server, which produced only 35 to 50Kbps of throughput with no load and 21 to 38Kbps while under load depending on the topology tested. The application layer throughput reported was multiple megabits per second. WAAS acceleration for the CIFS protocol helps to ensure high performance access to files on distant servers while safely offloading the file server itself.

Performance and offloading can position organizations to centralize file servers and associated storage, and enable consolidation of the number of necessary servers.

Transparent Operation
During testing, the topologies were reconfigured by re-cabling the test bed. Once network connectivity was established, no additional programming or discovery process was required to enable the WAN acceleration aspects of the test bed. In all topologies, the acceleration and caching tables began building immediately as traffic was passed. This transparent operation kept the configuration simple and straight forward.

Conclusion
Regardless of the topology used the Cisco Wide Area Application Service software v4.0.7 demonstrated the ability to improve the end user experience with faster response times and quicker file downloads. Multiple traffic streams were balanced fairly ensure that all experienced the same level of acceleration and optimization. Deployment was simplified by Cisco's transparent operation and discovery process which eliminated lengthy or complicated setup and configuration. Overall, Cisco WAAS was shown to be highly effective providing the same level of functionality regardless of topology.

Table 1: Performance improvement with and without background load for different files sizes across multiple topologies.

File Size	Topology	No Load		With Load	
		Download Time (sec)	Improvement Over Native WAN	Download Time (sec)	Improvement Over Native WAN
50K	Out-of-path	5.0	61%	5.3	57%
	Integrated	6.6	47%	7.3	42%
	In-line	3.5	69%	4.8	62%
100K	Out-of-path	3.7	74%	4.2	69%
	Integrated	6.6	58%	8.9	43%
	In-line	3.3	75%	5.0	69%
200K	Out-of-path	3.8	68%	4.1	66%
	Integrated	5.4	57%	11.2	10%
	In-line	3.1	75%	4.7	62%
500K	Out-of-path	4.1	72%	5.3	65%
	Integrated	7.5	51%	8.8	43%
	In-line	3.2	78%	4.9	68%
1M	Out-of-path	5.8	70%	4.9	74%
	Integrated	5.7	74%	8.9	59%
	In-line	3.3	80%	5.4	75%
2M	Out-of-path	4.5	83%	6.1	78%
	Integrated	6.1	79%	8.5	71%
	In-line	3.0	86%	5.0	83%

Miercom Performance Verified

Based on Miercom's examination and testing of the Cisco Wide Area Application Services (WAAS) v4.0.7 software and review of its configuration, deployment and operation as described herein, Miercom hereby issues the Performance Verified certification for the product in this report. Miercom certifies the following key observations made during this review:

- **Cisco WAAS demonstrated excellent performance with compression, speed, and throughput**

- **Cisco WAAS provides steady performance for Microsoft Exchange without generating application errors**

- **WAAS shows fairness of connection throughput and performance consistency across concurrent users and multiple workloads**

- **Cisco WAAS optimization does not degrade under load or create unfair performance between workloads**

- **In drag and drop file tests, Cisco WAAS provides strong performance for CIFS acceleration, and fast implementation of acceleration for transferring large files, copying a 170MB file in 25 seconds**

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