Independent Performance Comparison

Cisco Systems WAAS with Akamai Connect

vs

Riverbed Technology Steelhead

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Contents

Executive Summary

Miercom was engaged to perform comparative testing of the relative effectiveness of Cisco System's WAAS (Wide Area Application Services), with Akamai Connect, and comparable and competitive application-acceleration and WAN-optimization product from Riverbed Technology.

Test cases were devised and applied that exercised aspects of the products both in a single-side topology, where an optimization node is deployed in a remote branch, and a dual-side environment, where nodes are deployed in the data center and at the remote branch.

This report summarizes the results of the testing in key areas including:

- Comparative load times for popular Websites.
- Ability to cache different file and data types, including large files and cache persistence.
- Ability to optimize simultaneous file downloads.
- Live streaming and YouTube caching.

Key Findings

Cisco solution caches larger file sizes than Riverbed	Riverbed's Web-proxy provides caching benefits only for files smaller than 2 Gbytes. Tests confirmed that Cisco solution can cache a downloaded Apple OS X update file that is 5.7 Gbytes. Subsequent downloads took just 1.3 minutes with Cisco, but more than an hour with Riverbed.
Cisco solution cache survives a power reboot; Riverbed cache is lost in the event of a reboot or restart	Riverbed's web HTTP object cache is non-persistent – the cache object is lost if the system reboots for any reason. But not so for the Cisco solution, if the system reboots, previously cached objects are still available and rendered after the reload.
When Riverbed's web proxy is enabled they do not provide Layer-4 optimization, especially in dual-side deployments, where the Cisco solution excels	Riverbed's HTTP object cache treats all HTTP traffic in single-sided mode, even when deployed in a dual-side topology. This is a problem especially when HTTP traffic is un-cacheable; Riverbed provides no Layer-4 benefits with this traffic when web proxy is enabled. Tests showed that Cisco solution in a dual-side environment delivers Layer 4 benefits – through data redundancy elimination, LZ compression and transport flow optimization, whether the content is cacheable or not.
Cisco solution and Riverbed deliver comparable WAN-link optimization for multi-link, live-video streams	Both Cisco solution and Riverbed deliver effective stream-splitting technology for content including live video streams. If multiple clients access the same content over the WAN, both products can significantly reduce WAN bandwidth used, as if only one client is accessing the content over the WAN link.

Cisco solution lets admins pre-position web content; Riverbed does not	The Cisco solution provides the option to pre-position content. Admins can readily deliver content based on a schedule and information they specify on the WAAS Central Manager. Riverbed products tested support no such capability.
Cisco solution outperforms Riverbed in Simultaneous file Downloads	Cisco solution First Byte Read capability is designed to reduce the WAN bandwidth required when multiple clients are simultaneously downloading the same large files; only the first client goes over the WAN link and all subsequent clients feed off the first stream. This behavior happens for both dual and single sided with no additional configuration needed.

Miercom has independently verified key performance aspects of the Cisco solution, and the comparable offerings of Riverbed Technology. With superior application acceleration and optimization, cache content survivability on reboot, support for larger file sizes and proven better performance in both single-side and dual-side scenarios, we proudly present the ***Miercom Performance Verified*** certification to the Cisco solution.

Robert Smithers
CEO
Miercom

About the Products Tested

The products tested are offerings from Cisco Systems and Akamai Technologies, and from Riverbed Technology, all of which perform WAN optimization and application acceleration. In a nutshell, they do this by applying compression, caching, protocol efficiencies and other innovative techniques to WAN data flows, the result being that interactive applications and data retrieval perform faster. Since less WAN bandwidth and transmitted data bytes are needed to convey the same information, remote data operations can often realize cost reductions.

These products take many forms – from appliances to virtualized software modules. The Cisco and Akamai software combination ran on virtualized systems in our test bed. The Riverbed Steelhead products tested included an appliance and a virtualized software module.

Cisco Solution

Cisco WAAS – Wide Area Application Services – is one component of Cisco's Intelligent WAN (IWAN) offerings. The two Cisco solution software packages tested – vWAAS-2500 and vWAAS-6000 – ran on VMware ESXi virtualized systems.

The Cisco solution has incorporated another software module, Akamai Connect, from Akamai Technologies, Inc., with its WAAS offering. Akamai Connect addresses caching and acceleration technology behind the firewall into the branch office. Akamai Connect adds support for these features and functions:

- Transparent caching leverages Akamai's heuristic algorithms to make caching decisions for content, they have no specific knowledge about company intranet web sites or internal applications.
- Connected caching allows for improved caching efficiency for any content delivered by Akamai Intelligent Platform, which delivers between 15 and 30 percent of all Web traffic.
- Content pre-positioning, allows the user to set policies to proactively "pre-warm" content in the HTTP cache during non-peak hours, reducing network load during peak-use times.
- Dynamic URL HTTP permits caching of websites which leverage dynamic URLs to reference the same content, such as YouTube.

The "Virtual WAAS" products tested here – vWAAS-2500 which ran on a UCS-E blade that goes into a ISR4451 and vWAAS-6000 which ran on Cisco Unified Computing System (UCS) servers.

For purposes of this paper, Akamai Connect is an advanced license that can be added to any ISR-WAAS on 4000 series, any wave appliance up to 694, and virtual form factor up to vWAAS6K. Akamai Connect wan enabled at the branch office, in this particular case it was only enabled at the vWAAS-2500 instance.

Riverbed

The Riverbed Steelhead CX770 is a six-pound appliance that is offered for application acceleration and WAN optimization. Salient details of the Steelhead CX770 are shown in the table below. Product materials say the CX770 combines data reduction, as well as TCP, UDP, and application-level protocol optimization across the WAN.

The Riverbed Virtual Steelhead VCX7055M, like the Cisco solution, is a software module that runs on a virtualized system. It can be deployed with virtualization packages including VMware vSphere and Microsoft Hyper-V.

Both Riverbed Steelhead products tested ran version 9.1 of the vendor's RiOS software.

Side by Side:

Cisco Solution and Riverbed Steelhead Products Tested

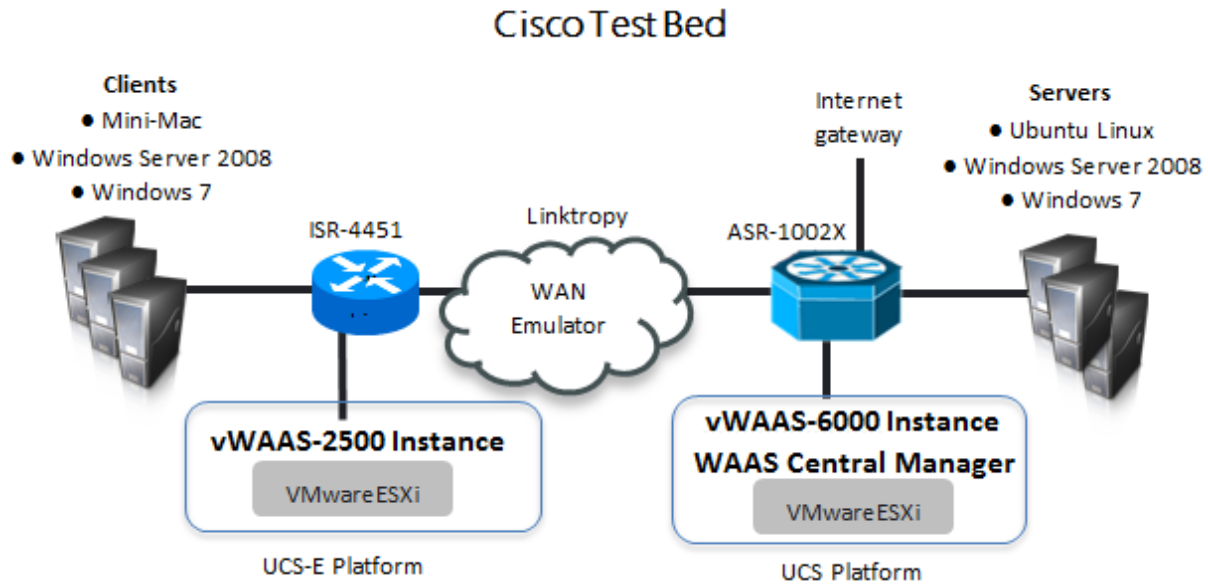
	Cisco vWAAS-2500	**Cisco vWAAS-6000**	**Riverbed CX770**	**Riverbed VCX VCX7055M**
Platform	Software on virtual system	Software on virtual system	Appliance	Software on virtual system
How deployed in tests	Branch	Data center	Branch	Data center
In single-side testing	**X**		**X**	
In dual-side testing	**X**	**X**	**X**	**X**
Min memory required	8 GB	11 GB	4 GB	48 GB
Min disk required	750 GB	900 GB	150 GB	2418 GB
Virtual CPUs required	4	4	---	24
Connections/flows	2,500	6,000	2,300	100,000
Optimized WAN Capacity	150 Mbps	200 Mbps	20 Mbps	1 Gbps

The Cisco solution system requirements include concurrent support for Akamai Connect.

Test Bed Set-up

The test cases for this testing include both dual-side and single-side deployments. In the single-side environment, only one WAN-optimization device is deployed – at the remote branch office site. In the Cisco solution test bed see diagram below, the remote-branch-office device is an instance of vWAAS-2500 running on a VMware ESXi virtualized system on a Cisco UCS-E platform.

For dual-side testing, a second Cisco solution WAN-optimization node was deployed, which would be in the customer's cloud or in the customer's headquarters data center, remote from the branch office. In the Cisco solution test bed, the central-site WAN-optimization node was an instance of vWAAS-6000, along with the WAAS Central Manager (WCM) software, running on a VMware ESXi virtualized system on a Cisco UCS platform see below.



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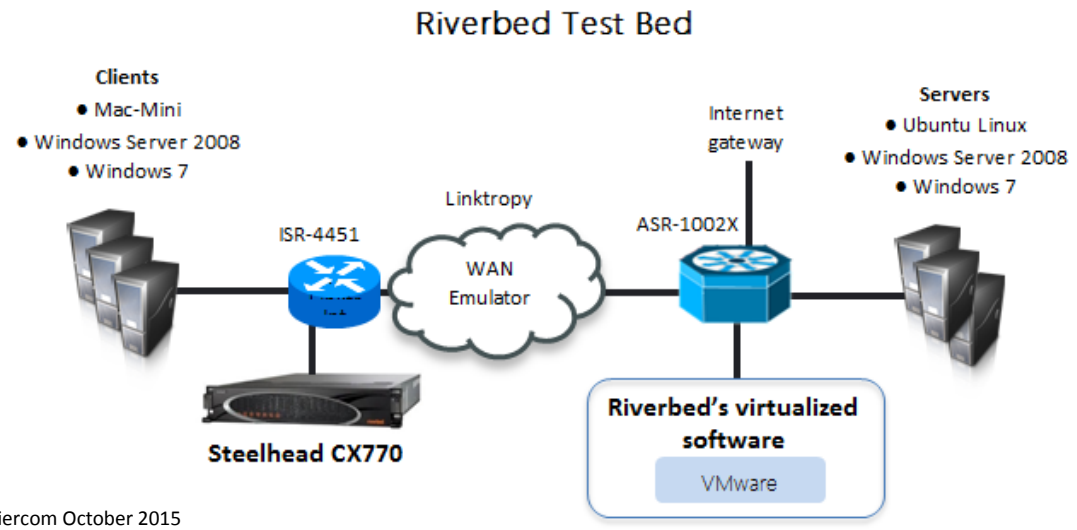
On both WAAS nodes, version 5.5.3 of the Cisco solution was run in the testing. The Akamai Connect software was enabled in every test along with WAAS.

Most of the test environment was identical between the Cisco solution and the Riverbed test beds. As shown in the following Riverbed test bed diagram, the branch-office and data-center WAN-optimization nodes were both members of the vendor's Steelhead product family – the CX770 at the remote branch, and the VCX7055M at the cloud/data center.



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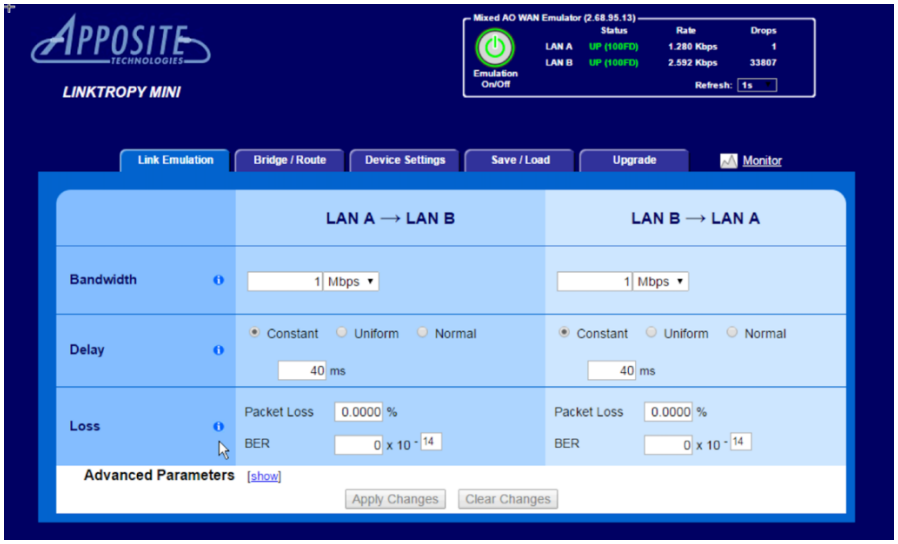
The Riverbed CX770 is an appliance designed for mid-sized offices. The second, central-site Riverbed node was software that runs on a virtualized system, in this case on a VMware platform. Both Riverbed nodes ran RiOS version 9.1 of the vendor's software.

Also common to both test beds was the same WAN simulator, which imposes bandwidth limitations and latency on test traffic passing in both directions, replicating the behavior of a Wide Area Network. In this testing the Linktropy Mini, from Apposite Technologies, was used to simulate WAN conditions. The below screen shot shows the Linktropy configuration interface, in this case as set-up for the YouTube test.

WAN Simulator Configuration for YouTube Test



The simulated WAN conditions were designed to mirror typical customer environments.

In all the tests, the Linktropy simulator applied 40 milliseconds of one-way network delay (latency) to all passing data (see table below). This is a modest amount of latency, typical of a terrestrial WAN connection of about a thousand miles. This means that the round-trip delay,

the minimum amount of time it takes to send a short message and receive a reply, such as an ICMP ping, would be at least 80 milliseconds.

A variable WAN setting was the throughput bandwidth. Whether set for 1.5 or 100 Mbps depended on the nature of the test. The 1- and 1.5-Mbps throughput rates were used as part of a regional office WAN profile; the 100-Mbps rate was used for download test cases. The below table shows the battery of tests applied, their purpose, and the simulated WAN settings for the tests.

Test Cases

Single- or Dual Side	Test Case	What's measured	WAN bandwidth	One-way latency
Single-Side	Popular Web sites	Object Caching	1.5 Mbps	40 ms
Single-Side	Apple OS X download	Large File Caching	100 Mbps	40 ms
Single-Side	Persistent Cache	Persistent v non-persistent Cache	100 Mbps	40 ms
Dual-Side	Popular websites	Caching with THDL Optimization*	1.5 Mbps	40 ms
Dual-Side	Apple OS X download	Large-file Caching	100 Mbps	40 ms
Dual-Side	1-GB non-cacheable file download	THDL optimization for non-cacheable files*	100 Mbps	40 ms
Dual-Side	Simultaneous file downloads	First-byte Caching	100 Mbps	40 ms
Dual-Side	Live streaming	First-byte caching	100 Mbps	40 ms
Dual-Side	YouTube caching	Caching of Dynamic Links	1 Mbps	40 ms
Dual-Side	Pre-positioning	Scheduling Pre-caching	1.5 Mbps	40 ms

*THDL is an acronym for optimization and acceleration aspects supported by the Cisco solution: It stands for TCP, HTTP, Data Redundancy Elimination and Lempel-Ziv IP compression.

Besides throughput and latency, no other simulated WAN conditions were applied, although the Linktropy simulator supports imposition of various other impairments, including Bit Error Rates and packet loss.

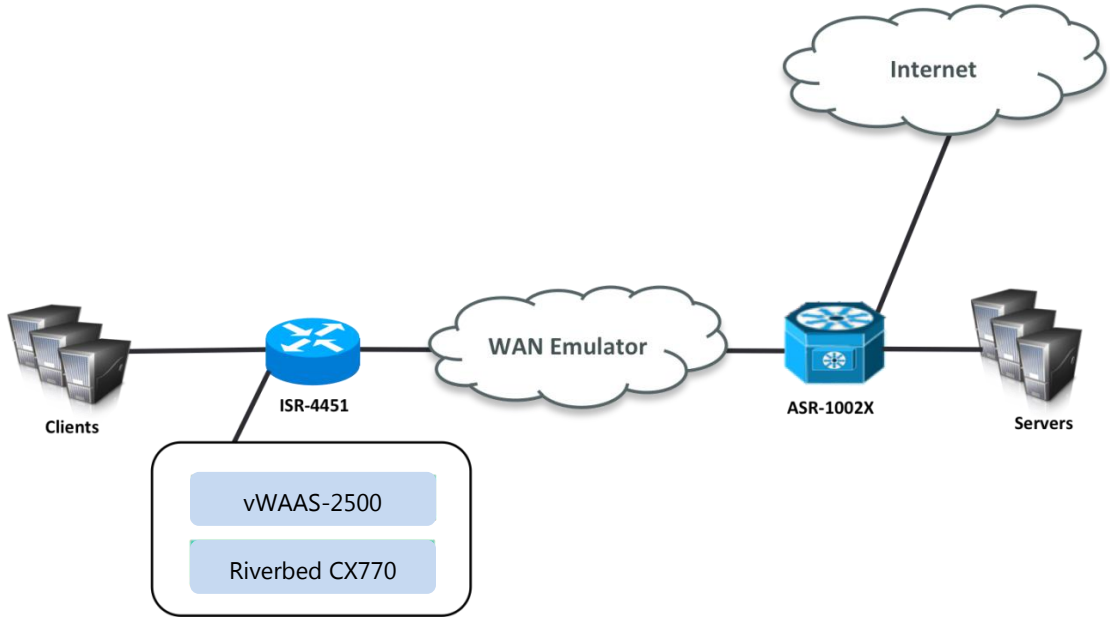
The same test beds remained assembled throughout the testing. As the testing progressed, the Cisco and the Riverbed devices were disabled or enabled – at their interface ports to the ISR or ASR routers – depending on the particular test being run:

- **Baseline tests**. Both the branch-side and the data center-side WAN-optimization devices are disabled when the baseline tests were run.
- **Single-side tests**. The data center-side node is disabled when running single-side tests, leaving the branch-side system to go it alone.
- **Dual-side tests**. Both branch and data center nodes are enabled for the dual-side tests.

Single-side Tests and Test Results

Application-acceleration and WAN-optimization products employ a variety of techniques and technologies in performing their processing-intensive job, which includes caching, compression and protocol efficiencies. Some of these, techniques work better in a two-side deployment, with devices in both the core and edge, than in a single-side environment (edge only). For example, Layer-4 protocol efficiencies are generally achieved only in a dual-side deployment, because both ends need to collaborate tightly over the WAN link.

In single-side tests, a single device is deployed at the remote branch site, also called client-side deployment. In the Cisco solution testing this was the vWAAS-2500 package. Riverbed single-side testing employed the Steelhead CX770 appliance. See diagram below.



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Generally, an application-acceleration/WAN-optimization product deployed in a single-side topology may exhibit certain behavioral characteristics, such as: good HTTP object caching, caching in the branch only, and pre-positioning

These single-side test cases are detailed in this section.

- Popular Website loads
- Apple OS X download, and
- Persistent vs non-persistent cache.

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Single-side Tests: Popular Website loads

What's measured: The time it takes to download popular Website homepages. In single-side testing, only one edge device operating at the remote branch is deployed for application acceleration/WAN optimization.

How we did it: A baseline time to load the particular Website was measured initially – with all Cisco solution and Riverbed nodes disabled. The Website download is done on a Mac Mini "client" through the emulated WAN. Several repeat loads are measured, using the load time indicated on the Chrome Incognito browser window. The load time is measured by the Chrome browser. The Chrome browser's cache is cleared before each test run.

With all else being equal, there can still be significant variance in downloading Web home pages, given the fluctuations in Internet performance, congestion, and so on. So another baseline download was taken (after clearing the cache), before either the Cisco solution or Riverbed was tested. This was to see if there was significant difference between the two readings. We also took multiple readings for both Cisco solution and Riverbed after carefully measuring the first pass again, after clearing the cache each time.

On occasion the repeated load times did vary significantly. We would then record, but disregard such values – for baselines, and for Cisco solution and Riverbed measurements.

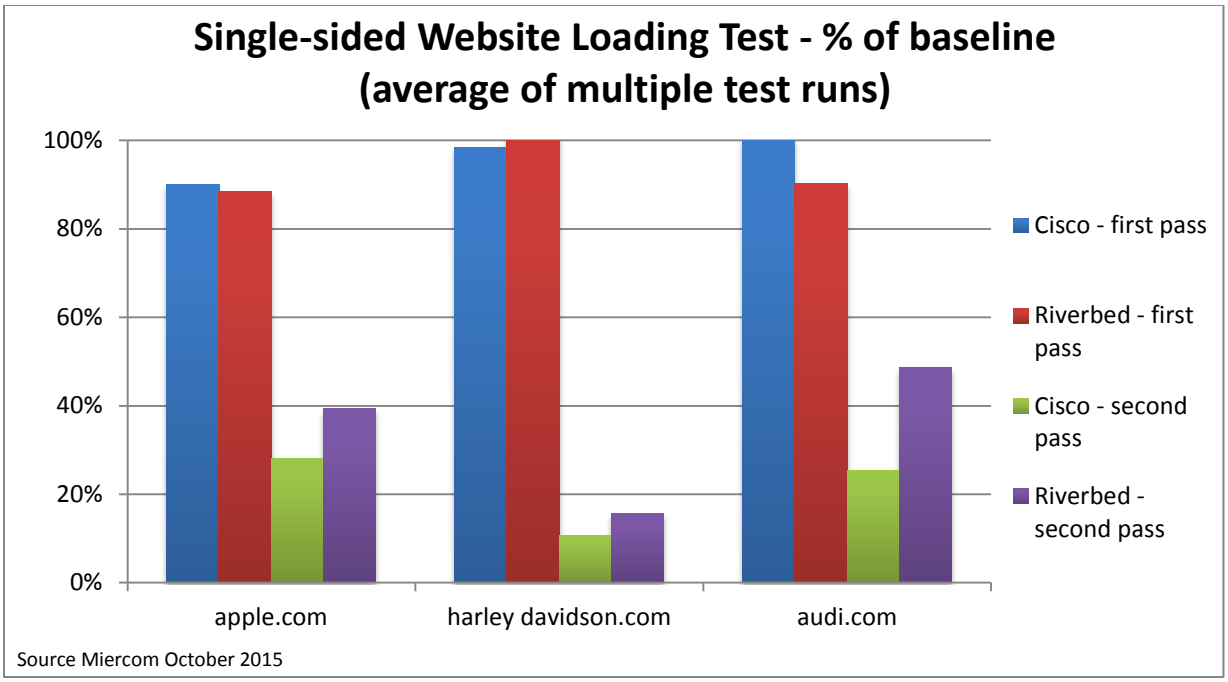
On the first pass – where no real improvement in the baseline load time was expected – all caches were first cleared in the Cisco and Riverbed systems, as well as in the Chrome browser itself. The Cisco and Riverbed systems in general showed comparable results for each first pass.

The client station's Chrome browser cache was then cleared and the load test re-run a second time. This result would show the load-time optimizations achieved by Cisco solution and then Riverbed.

The homepages of several popular Websites were loaded: Apple (apple.com), Harley-Davidson (harley-davidson.com) and Audi (audi.com). The same procedure was applied:

- A baseline was obtained which is the average of at least two loads, after the client's cache was cleared each time.
- The Cisco solution branch node (vWAAS-2500) was tested for the first pass, and then multiple subsequent test runs, for each of the three Websites.
- The Cisco solution node was disabled and the Riverbed device enabled.
- The Riverbed was tested for the first pass, and then multiple subsequent test runs.

The results are shown as a percentage of the baseline – the average of at least two comparable test runs. The baseline times varied, of course, but were typically on the order of 8 to 10 seconds.



Single Sided Website Test - Load time Average (seconds)

	Cisco		
	baseline	**first pass**	**2nd pass**
apple.com	6.99	6.58	1.61
harley davidson.com	30.47	29.43	8.83
audi.com	8.50	7.17	1.79

Single Sided Website Test - Load time Average (seconds)

	Riverbed		
	baseline	**first pass**	**second pass**
apple.com	6.42	6.05	2.11
harley davidson.com	31.43	30.31	9.83
audi.com	7.91	8.00	1.61

The results of the single-side Website-load tests show that the Cisco solution enabled the selected Website homepages to be downloaded by a client – the second and subsequent times – in less time than the Riverbed CX770, on average. The percentages shown above are a representation of the percentage of the baseline.

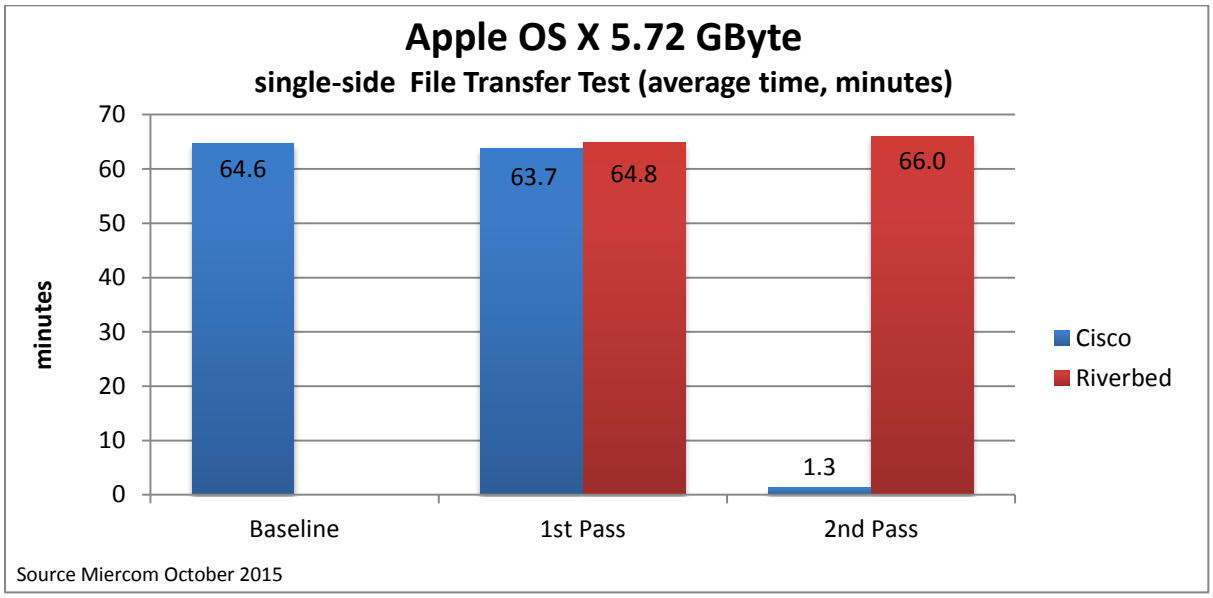
Single-side Tests: Apple OS X download

What's measured: The time it takes to download a sizeable file – a 5.72-GByte Apple operating system file – to the Mac-Mini client at the branch office, and the extent to which the Cisco solution and Riverbed WAN-optimization products reduce subsequent download times. The download times are measured using a stop watch, in order to minimize cached information.

How we did it: With all Cisco solution and Riverbed nodes disabled. The Apple OS X file is downloaded to a Mac-Mini client and this "baseline" download time is recorded. With no WAN optimization applied, the operating system file – over 5.7 Gbytes – takes over an hour to download. The Cisco solution branch office or edge node, the vWAAS-2500, is then enabled, and the file and cache of the OS-X on the Mac-Mini is cleared. The download is then repeated and the time noted. For any retries of the first pass, the Cisco solution caches have to be cleared.

The second pass is then conducted –with removing the OS-X on the Mac-Mini, but not the Cisco solution node. This is repeated at least once, and the average time calculated.

The Cisco solution node is then disabled and the Riverbed branch office appliance is enabled. The process is then repeated as for the Cisco solution tests. All caches are cleared for every re-run of the first pass.



Cisco and Riverbed each show equivalent download times for their "first pass" – that is, the first time the OS X file is transferred across the WAN to the Mac-Mini. There is very little benefit from either product's WAN optimization for the first pass, and both "first pass" times are essentially the same as the baseline.

The "second pass" results, and subsequent test runs, clearly show that the Cisco solution caches the 5.72-Gbyte OS X file. The Riverbed CX770, however, does not cache this file, and all subsequent runs take as long as the first. It turns out that Riverbed does not cache large files – of about 2 GB and more.

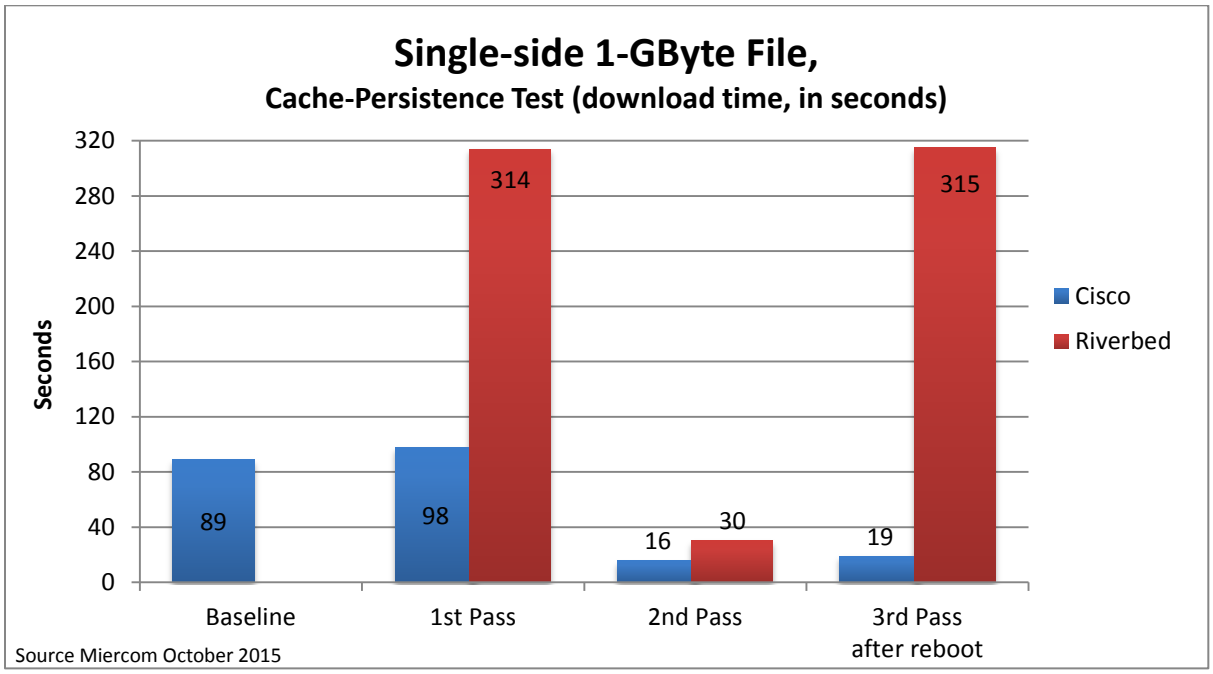
Single-side Tests: Persistent vs non-persistent cache

What's measured: Whether or not the cached content of the WAN-optimization device survives a power reboot or a service restart.

How we did it: With Cisco solution and Riverbed devices disabled, we download a 1-GByte file and note the time it takes to transfer to the client. The file is then deleted from the client.

The Cisco solution node, the vWAAS-2500, is enabled. The same 1-Gbyte file is downloaded to the client and the time to download the first time with the Cisco solution, vWAAS-2500 enabled is noted. The service on vWAAS-2500 is then restarted and the file is deleted from the client. The same 1-GB file is again downloaded to the client and the download time recorded second pass.

The file is again deleted from the client, the Cisco solution node is disabled, and the Riverbed CX770 appliance is enabled. The same 1-Gbyte file is downloaded to the client and the time to download the first time with the Riverbed CX770 enabled is noted. The service on CX770 is then restarted and the file is deleted from the client. The same 1-GB file is again downloaded and the download time recorded.



In the first pass, Cisco solution transfers the file at the baseline rate, while the Riverbed first-pass download time is substantial. The Cisco and Riverbed products both deliver the file from cache in the second pass, at approximately the same speed.

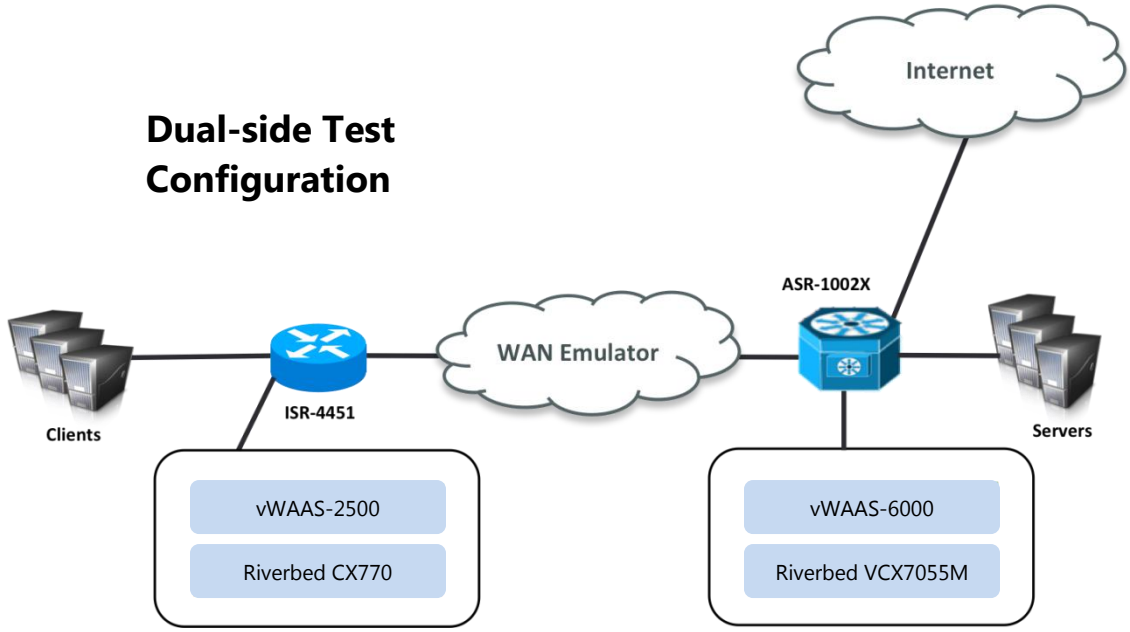
Before the third pass, both the Cisco and the Riverbed services were restarted. The result shows that Cisco solution's cache persists even across a system failure, while Riverbed's cache does not.

The results clearly show that the 1-GB file in the Cisco solution node is persistent, surviving a service restart or reboot, while the same cached file is lost with a service restart or reboot of the Riverbed appliance.

Dual-side Tests and Test Results

Dual-side deployment of application-acceleration/WAN-optimization devices – at both core/server and remote edge/client sites – maximizes the effectiveness of these devices. Dual-side deployment supports transparent caching of customer-owned, Intranet web resources and also achieves TCP optimizations.

The same devices deployed at the client or edge site for the single-side tests were also used in the same role in the dual-side tests. A second device was added, at the core or server site, in the dual-side testing. For Cisco solution testing, a VMware system running vWAAS-6000 was deployed in the core, which worked closely with the vWAAS-2500 node in the edge. For Riverbed testing, a VMware virtualized system running the VCX7055M Virtual Steelhead software was added at the core, working closely with the Riverbed CX770 appliance at the edge. See below diagram.



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These dual-side test cases are detailed in this section.

- Popular Website loading
- Apple OS X download
- 1-GB Non-cacheable file download
- Simultaneous file downloads
- Live streaming
- YouTube caching, and
- Pre-positioning.

Dual-side Tests: Popular Website loading

What's measured: The time it takes to download a particular, popular Website homepage. Unlike in single-side testing, the edge and core devices work closely together in dual-side testing. So this test case features the key competitive features that Cisco claim to offer, summarized in the acronym THDL, which stands for TCP, HTTP, DRE (Data Redundancy Elimination), and Lempel-Ziv IP data compression.

How we did it: A baseline time to load the particular Website was taken initially – with both the Cisco solution and Riverbed nodes disabled. The Website download is done on a Mac Mini client through the emulated WAN. Several repeat loads are measured, using the load time indicated on the Chrome Incognito browser window. The load time is measured by the Chrome browser.

With everything else being equal, there can still be significant variance in downloading Web home pages, given the fluctuations in Internet performance and congestion. So another baseline download was taken after clearing the cache, before either the Cisco solution or Riverbed was tested. This was to see if there was significant difference between the two readings. We also took multiple readings for both the Cisco solution and Riverbed again, after clearing the cache each time.

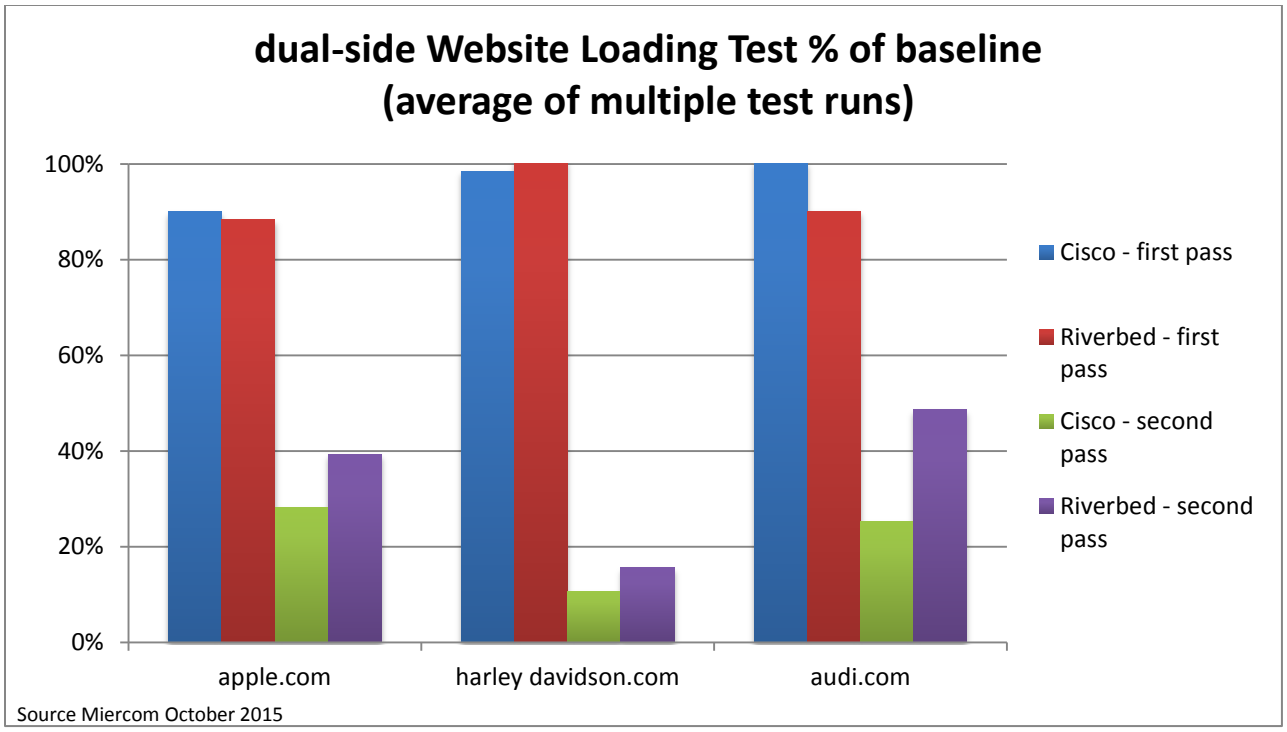
On occasion the repeated load times did vary significantly. We would then record, but disregard such values – for baselines, and for the Cisco solution and Riverbed measurements.

On the first pass – where no real improvement in the baseline load time was expected – all caches were first cleared in the Cisco and Riverbed systems, as well as in the Chrome browser itself. The Cisco and Riverbed systems showed very comparable results for each first pass.

The Chrome browser cache was then cleared and the load test re-run a second time. This result would show the load-time optimizations achieved by Cisco solution and then Riverbed.

Several popular Websites, featuring rich graphics, were tested: Apple (apple.com), Harley-Davidson (harley-davidson.com) and Audi (audi.com). The procedure was the same for each:

- A baseline was obtained (the average of at least two loads, after cache clearing of the client each time).
- The Cisco solution devices were enabled and then tested for the first pass, and then multiple subsequent test runs.
- The Cisco solution nodes were disabled, and the Riverbed devices enabled.
- The Riverbed devices were tested for the first pass, and then multiple subsequent runs. Note: To re-test first pass, the Cisco solution and Riverbed caches also need to be cleared beforehand.



Dual Sided Website Test - Load time Average (seconds)

	Cisco		
	baseline	**first pass**	**2nd pass**
apple.com	7.42	6.69	2.09
harley davidson.com	31.02	30.57	3.32
audi.com	7.42	7.46	1.87

Dual Sided Website Test - Load time Average (seconds)

	Riverbed		
	baseline	**first pass**	**second pass**
apple.com	8.27	7.31	3.25
harley davidson.com	32.51	32.78	5.10
audi.com	7.99	7.21	3.89

The results of the dual-side Website load tests show that both Cisco and Riverbed show that both accelerate subsequent website loads due to caching. The cache acceleration varies depending on the websites being accessed.

Note that the baseline times for the 2 test runs are different. This is due to traffic on the web outside of the Cisco solution test environment. Baselines were taken before each of the runs to provide a normalization of the test website download times. The raw data shows the download times in seconds, the graphs show the downloads as a % of the baseline.

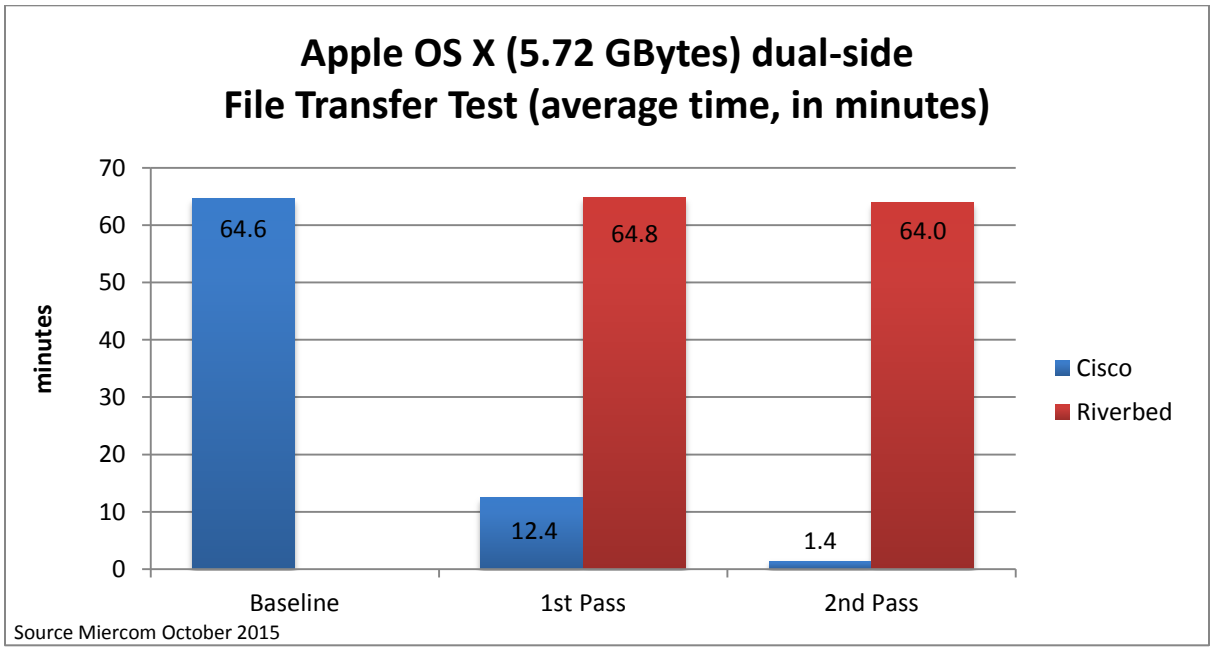
Dual-side Tests: Apple OS X download

What's measured: The time it takes to download a sizeable file – a 5.72-GByte Apple operating system – to the Mac-Mini client at the branch office, and the extent to which the Cisco solution and Riverbed WAN-optimization products reduce download times.

How we did it: With all Cisco solution and Riverbed nodes disabled. The Apple OS X file is downloaded to a Mac-Mini client and this baseline download time is recorded. With no WAN optimization applied, the operating system file – over 5.7 Gbytes – takes over an hour to download. The Cisco solution branch office and data center nodes are both then enabled, and the file and cache of the OS-X on the Mac-Mini is cleared. The download is then repeated and the time noted. For any retries of the first pass, the Cisco solution caches have to be cleared.

The second pass is then conducted – with the OS-X on the Mac-Mini cleared, but not the Cisco solution nodes. This is repeated at least once, and the average time calculated.

The Cisco solution nodes are then disabled and the Riverbed branch office appliance and data center node are enabled. The process is then repeated as for the Cisco solution tests. All caches are cleared for every re-run of the first pass.



The results of the first pass show impressive advantages of dual-sided deployment of Cisco solution nodes – at the data center and at the branch office. The results, where a first pass download the Apple OS X operating system file takes just 12.5 minutes instead of over an hour; validate the Layer-4 techniques and processing that the Cisco solution packages apply. These are summarized by the acronym THDL, which stands for TCP optimization, HTTP caching, Data Redundancy Elimination and Lempel-Ziv IP compression.

The results indicate that Riverbed does not perform comparable processing between the data-center and branch WAN-optimization nodes, since the "first pass" download with dual-side Riverbed deployment show no improvement in download time over the baseline.

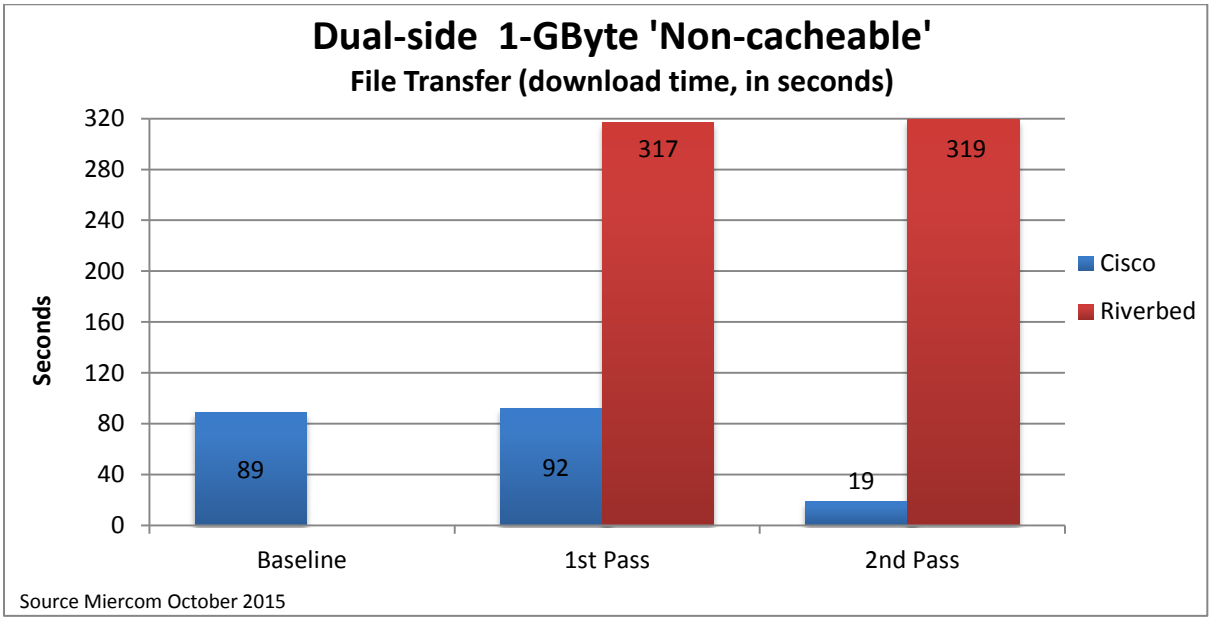
The second pass results, and subsequent test runs, show that the Cisco solution cache the 5.72-Gbyte OS X file. The Riverbed units, however, do not cache this file, and subsequent downloads of this large file take as long with the Riverbed products as without them.

Dual-side Tests: 1-GB Non-cacheable file download

What is measured: The optimization that can be achieved, in a dual-side topology, when a large file, 1 Gbytes with headers set to non-cacheable is downloaded. Features in the Cisco solution are designed to optimize even non-cacheable files.

How we did it: A baseline is measured by a branch client downloading a 1-Gbyte file over the WAN in a dual-side topology. The client cache is then cleared, both Cisco solution nodes are enabled, and the same download is conducted, with the transfer time first pass carefully recorded. The client cache is cleared again and the same download is repeated second pass.

The Cisco solution nodes are disabled, the client cache cleared and the Riverbed nodes are enabled. The same two-step process is repeated: A first-pass download of the same non-cacheable file is done, the client cache is cleared and a second-pass transfer is performed.



In this dual-side configuration, Cisco solution's first pass result is roughly the same as the baseline. However, the second pass result shows significant optimization, even for this large non-cacheable file. This is accomplished largely by transparent caching, supported by Cisco, which offers alternatives to on/off non-cacheable flags.

Besides transparent caching, the Cisco solution provides additional optimization processing with non-cacheable data in the dual-side topology, notably DRE (data redundancy elimination), LZ (Lempel-Ziv) data compression and TFO (transport flow optimization).

Test results indicate that Riverbed treats all http traffic as single-sided with Web-proxy – and as such doesn't provide any caching benefits in those cases.

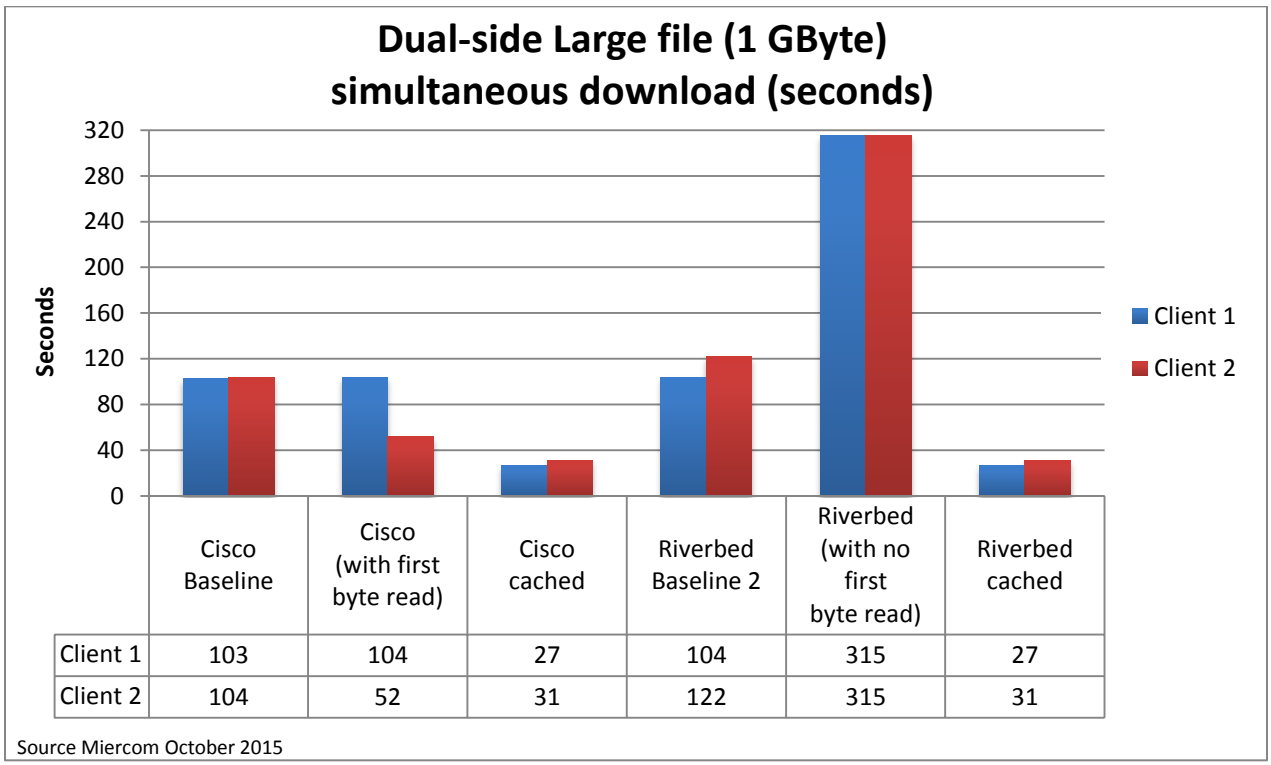
Dual-side Tests: Simultaneous file downloads

What's measured: The effectiveness of First Byte Read, a capability in the Cisco solution– not supported by Riverbed – that is designed to reduce the WAN bandwidth required when multiple clients are simultaneously downloading the same large files. Rather than each client going out over the WAN to retrieve the same large file, only the first client goes over the WAN link and all subsequent clients feed off the first stream.

How we did it: We first ensured that the Cisco solution and Riverbed nodes were all disabled. The first remote branch client then starts downloading a 1-GByte file. Then a second client starts a download of the same file. The time is measured for each down load to complete. We did this once before the Cisco solution test runs and once before the Riverbed test runs to ensure our test runs were comparable.

The Cisco solution branch and data center nodes are then enabled, and all client caches are cleared. The 1-Gbyte file is then retrieved by two branch office clients over the dual-side WAN, one after the other, and the time to download is carefully recorded for each client with a stopwatch.

The whole cycle is then repeated for the Riverbed configuration.



	Cisco Baseline	Cisco (with first byte read)	Cisco cached	Riverbed Baseline 2	Riverbed (with no first byte read)	Riverbed cached
Client 1	103	104	27	104	315	27
Client 2	104	52	31	122	315	31

Source Miercom October 2015

After the clients caches are cleared, the Cisco solution nodes are disabled. A baseline run is then again performed, to confirm the same results, baseline 2. The two Riverbed nodes are enabled, and the two client downloads of the same 1-Gbyte file over the WAN is performed, with the transfer times carefully recorded.

The second client's file transfer is started about half-way through the first client's download. In Cisco's case, the second client transfer is started about 50 seconds after the first client starts. In the Riverbed case, the second client transfer is started about two minutes into the first client's transfer.

The results highlight the first byte read capability of the Cisco solution in this dual-side topology. It turns out that, when the second client transfer starts, the file is read from the growing cached version of the first transfer, so it catches up to the first transfer very quickly. At that point the transfers proceed at a slower, non-cached rate. The first byte read ability means that, as the first file transfer is accumulating in cache, the first byte is immediately available for reading, thus speeding up overlapping transfers across the WAN, through the immediate availability of the data still being cached.

The results show that both client transfers take the same amount of time with Riverbed, due to no first byte read capability. Even though it is a dual-side test, the Riverbed products are operating in this test case essentially in just single-side mode: Only its object cache is in play.

In this test case, highlighting first byte read, the Riverbed environment uses more than double the WAN bandwidth of Cisco solution. The reduction in WAN bandwidth required by Cisco solution is actually less than half that of Riverbed because the additional benefits of DRE (data redundancy elimination) and LZ (Lempel-Ziv) data compression are also realized.

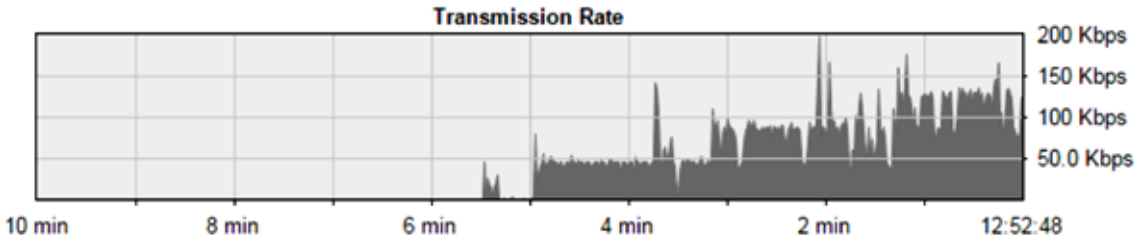
By comparison, the Cisco solution bolsters WAN optimization with its THDL processing (TCP, HTTP, Data redundancy elimination, and Lempel-Ziv data compression) – which achieves substantial WAN optimization in a dual-side topology – plus the caching benefits of Akamai Connect.

In the last set of transfers, the cache of both the Cisco and the Riverbed systems is used, and the corresponding optimization of both is apparent.

Dual-side Tests: Live streaming

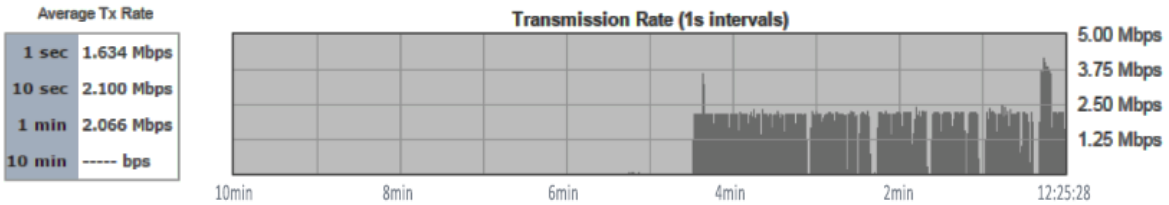
What's measured: Optimization of WAN bandwidth when multiple clients download the same streaming-video presentation, a Cisco live video stream was used in the dual-side test environment. This test case exercises the first byte read and Web-proxy features of the Cisco and Riverbed products.

How we did it: All Cisco solution and Riverbed nodes are initially disabled. First one, then two, and then three clients begin downloading the same live video stream. The Linktropy WAN simulator tool is used to monitor WAN bandwidth utilization. With client starts about two minutes apart, baseline WAN bandwidth use is shown in the below figure:



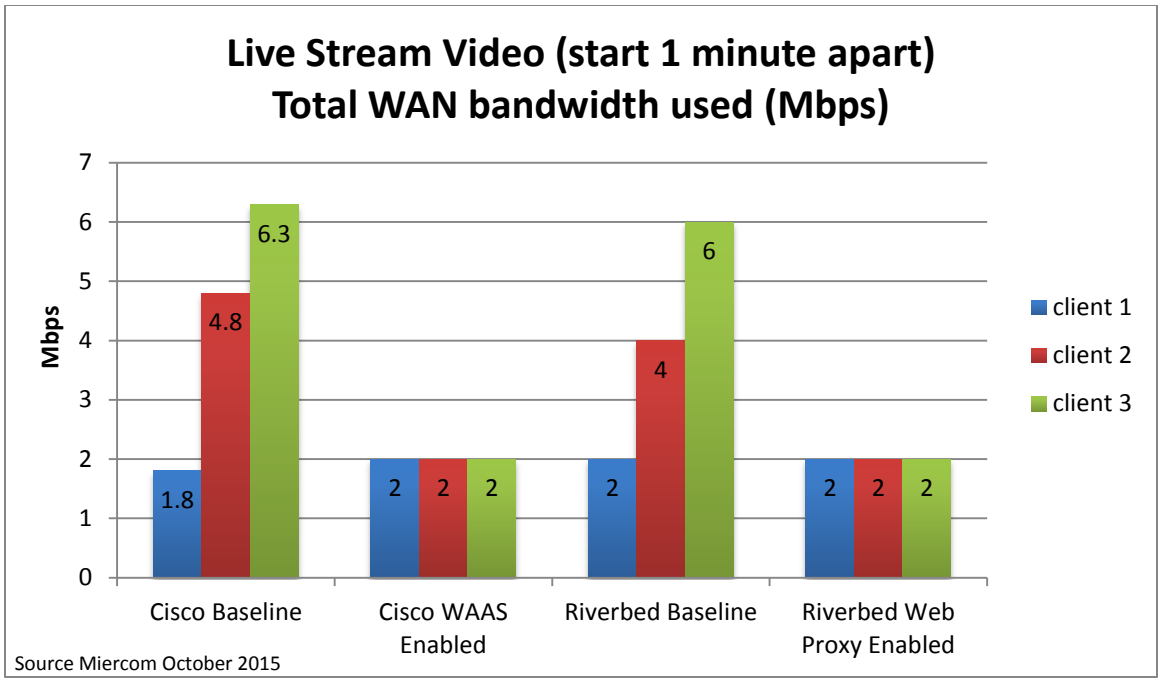
There is no caching of the stream and the individual download streams consume over 6 Mbps of collective WAN bandwidth.

The client downloads are stopped, and the branch and data center Cisco solution nodes are enabled. Then the three clients again start downloading the same live video stream, starting at one-minute intervals. This presents the opportunity for features such as first byte read and Web-proxy to be applied for WAN optimization. The result is shown in the below WAN-bandwidth-monitoring screen:



The graph shows that, instead of three separate streams over the WAN, just one stream is using WAN bandwidth, about 2 Mbps.

The client downloads are stopped, the Cisco solution nodes are disabled, and the Riverbed nodes are enabled. Again, the monitor shows that WAN bandwidth is used by just one client, and the other clients are being fed a cached version of the live video stream.



The above chart shows WAN Bandwidth benefit of the Cisco solution and Riverbed environments. A baseline measurement of the WAN bandwidth was taken with both Cisco solution and Riverbed disabled. Note that each client gets its own stream of data across the WAN. So the WAN bandwidth increases with each new client accessing the same streaming data.

With the Cisco solution and Riverbed systems enabled, as each new client accesses the streaming video, the first byte read capabilities allow subsequent clients to stream from the same stream of data cached for all subsequent clients by these systems. No additional data streams are required greatly lightening the bandwidth load on the WAN.

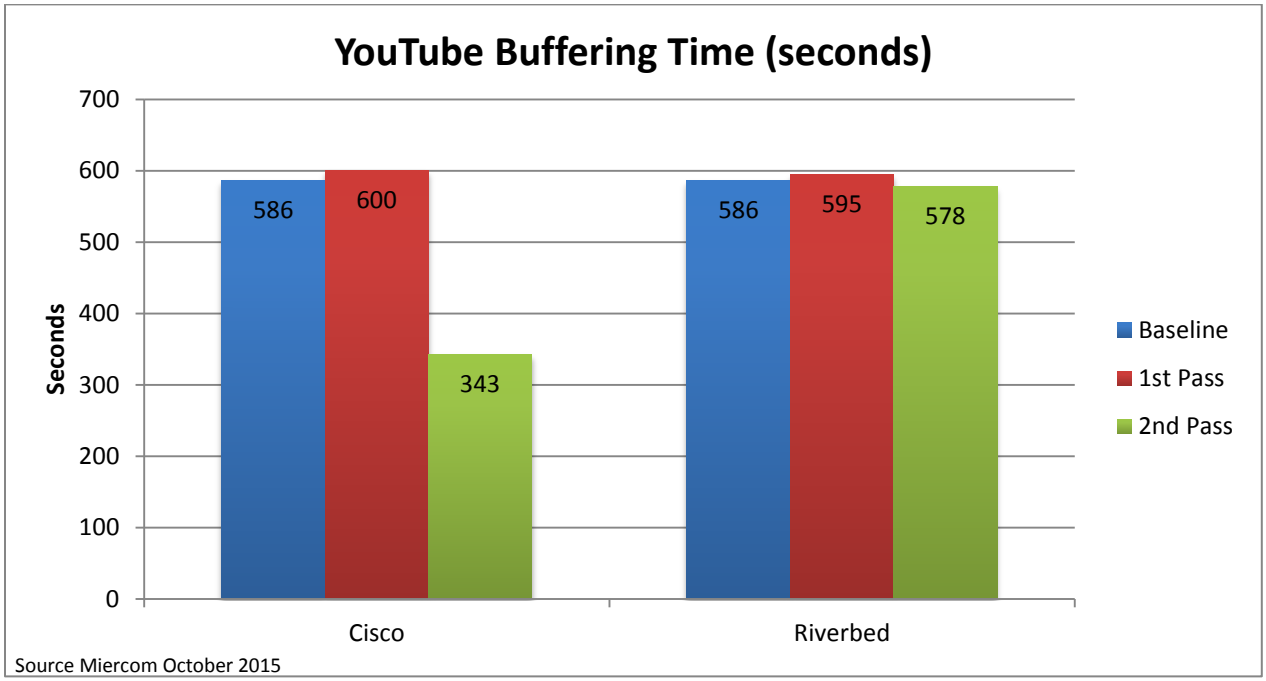
Dual-side Tests: YouTube caching

What's measured: The ability of the WAN-optimization equipment, in a dual-side topology, to cache YouTube content, which uses dynamic links.

How we did it: Ensure Cisco solution and Riverbed nodes are all disabled. In a client Chrome browser, using Incognito, open YouTube and play a video (Video A): The video needs to be buffered and will be slow. Right click on the video and note dropped frames and the connection data rate. Speed at this time will be slow. This is the baseline test run. The Riverbed YouTube configuration procedure was followed according to Riverbed documentation but no optimization was seen.

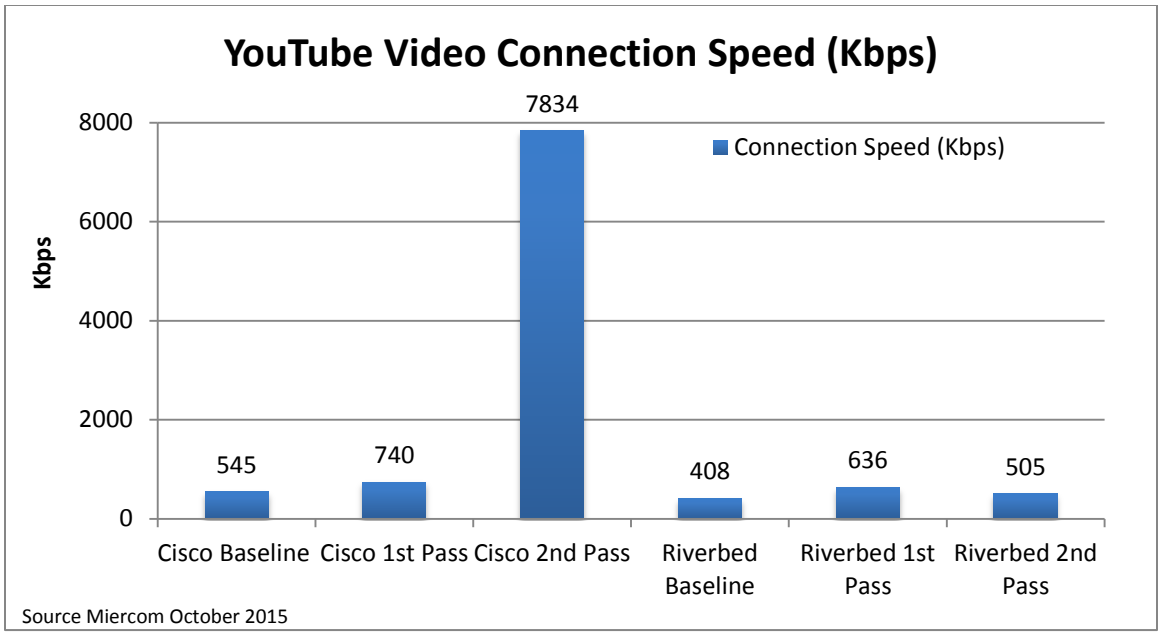
Clear the browsing data and open a new Incognito Chrome browser (Incognito minimizes caching and offers good connection-monitoring statistics). Enable the branch and data center Cisco solution nodes. From the same client open a YouTube video (Video B). Right click and record the connection stats; they should be very similar to the baseline (dropped frames and connection data rate). This is the first pass.

Stop the video, clear the browser data. Re-open the same YouTube video (Video B). The content will be rendered from cache and should buffer much faster. This is the second pass. Check the stats; there should be no dropped frames and the connection speed should be must faster, close to the LAN speed. Record the stats. This is the second pass.



Stop the video and clear the browser cache. Disable the Cisco solution nodes, and enable both of the Riverbed nodes, for the dual-side test configuration.

Open a video session and note dropped frames and connection data rate. These should be similar to the baseline. Stop the video and clear the browser cache. Then open the video session again and note the connection stats.



The graph on the previous page shows the results of the buffer times for these YouTube connections. On the first pass for both vendors' systems, the first pass connection speed hovered in the range of 600-750 kbps, slightly more than the baseline. On the second pass, however, the Riverbed buffer time stayed about the same, since it had not cached the YouTube video stream.

The Cisco solution nodes were able to cache the YouTube video stream. The result: The time to buffer the video was appreciably shortened because the data did not go across the WAN and was instead cached on the branch Cisco solution node.

The following table summarizes the test results. It shows that the best customer experience – that is, high connection speed and least dropped frames – is achieved on the Cisco solution second pass, because the video was rendered from the branch Cisco solution node. The YouTube video data only passes over the WAN once.

The Riverbed YouTube configuration procedure was followed according to Riverbed documentation. Riverbed does not cache YouTube videos, so successive passes see no WAN optimization or bandwidth reduction.

	Connection Speed (Kbps)	# Frames Dropped	Frames	% Frames dropped
Cisco Baseline	545	72	13819	0.52%
Cisco 1st Pass	740	107	14288	0.75%
Cisco 2nd Pass	7834	31	8811	0.35%
Riverbed 1st Pass	408	84	13798	0.61%
Riverbed 2nd Pass	636	93	13799	0.67%
Riverbed Baseline	505	93	13799	0.67%

Dual-side Tests: Pre-positioning

What's measured: The ability to pre-position data – that is, schedule and earmark files and data for transmission and caching, such as during off-hours, to reduce network load during peak-load periods.

How we did it: Pre-positioning of data into cache is not supported by Riverbed.

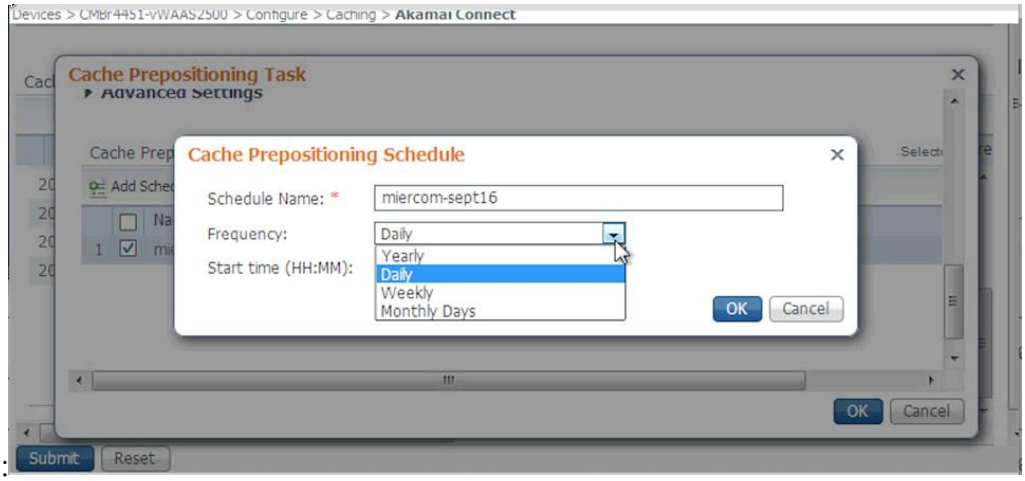
On the Cisco solution Central Manager (WCM), a Web interface, navigate to Device / Akamai Connect and select cache preposition.

Add a pre-position task: Enter the URL and other identifying specifications for the pre-position job. Click on Enable task. Submit and schedule the job.

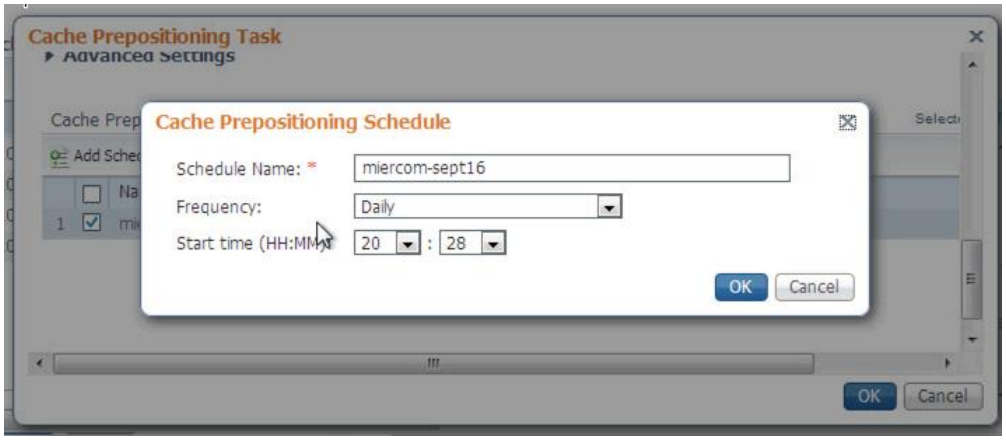
On the Cisco solution "branch" node (the vWAAS-2500), verify the task is in the running configuration: run '**show statistics accelerator http preposition'** to monitor pre-position task status. Once task is completed, verify the task details on the WCM interface.

Verify at the designated time that the data was pre-positioned as expected.

The WAAS Central Manager screen below is used to schedule a daily pre-position task and the frequency of the pre-positioning task is specified:



And the time to move the data into local cache is specified.



The test team confirmed that the specified data was in fact downloaded and pre-positioned in the Cisco solution cache as expected, and this local copy was rendered transparently to branch clients seeking the data, without having to remotely retrieve it over the WAN.

Independent Evaluation

This report was sponsored by Cisco Systems, Inc. The data was obtained completely and independently as part of Miercom's competitive analyses.

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