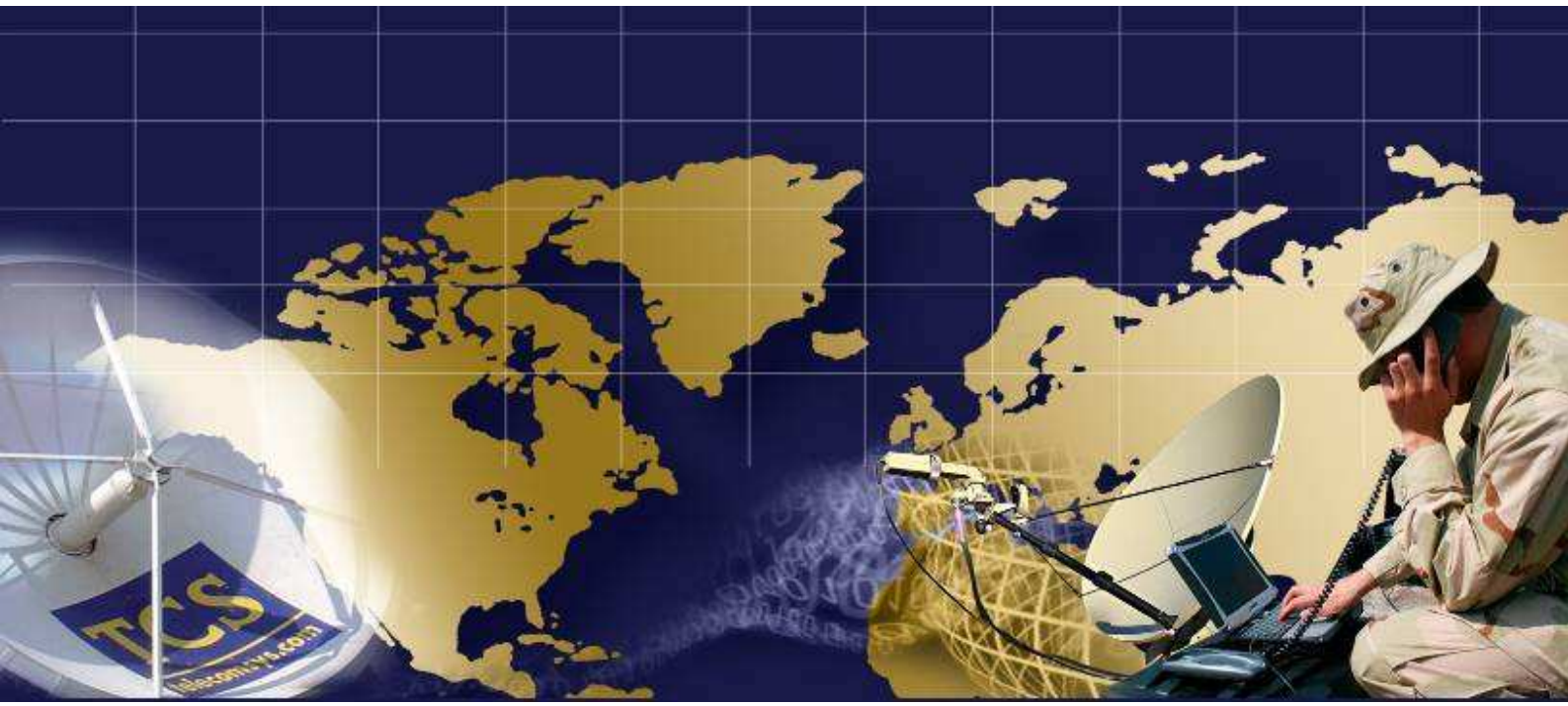

TCS WAN Acceleration Test and Verification Results

Conducted to assist DynCorp International

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Table of Contents

List of Figures

1 Scope

TeleCommunication Systems conducted a through evaluation of various vendors WAN acceleration products to determine which products are the best fit for the types of VSAT networks that TCS typically deploys. We contacted several vendors and asked them to provide equipment and engineers to configure the devices for our test. All the vendors that we contacted participated and provided a variety of equipment. The devices tested ranged from software based clients to hard drive based network appliances. The vendors were each given one day to configure their equipment and witness the test. A few vendors had slight issues that required them to return with engineers, or to email additional support/software. However this did not impact all the vendors completing the tests.

The test bed that was utilized is shown in Figure 1, Test Bed Used. The network consists of a Cisco 2811 router forming an IPSec (AES-256 VTI) WAN link to a Cisco 3845 router. The WAN link was created by a PacketStorm WAN emulator and was configured for the following parameters:

- Bandwidth: 2,048Kbps
- Delay: 400ms each way (800ms total)
- Packet Loss: 1%
- Packet reorder: 1%

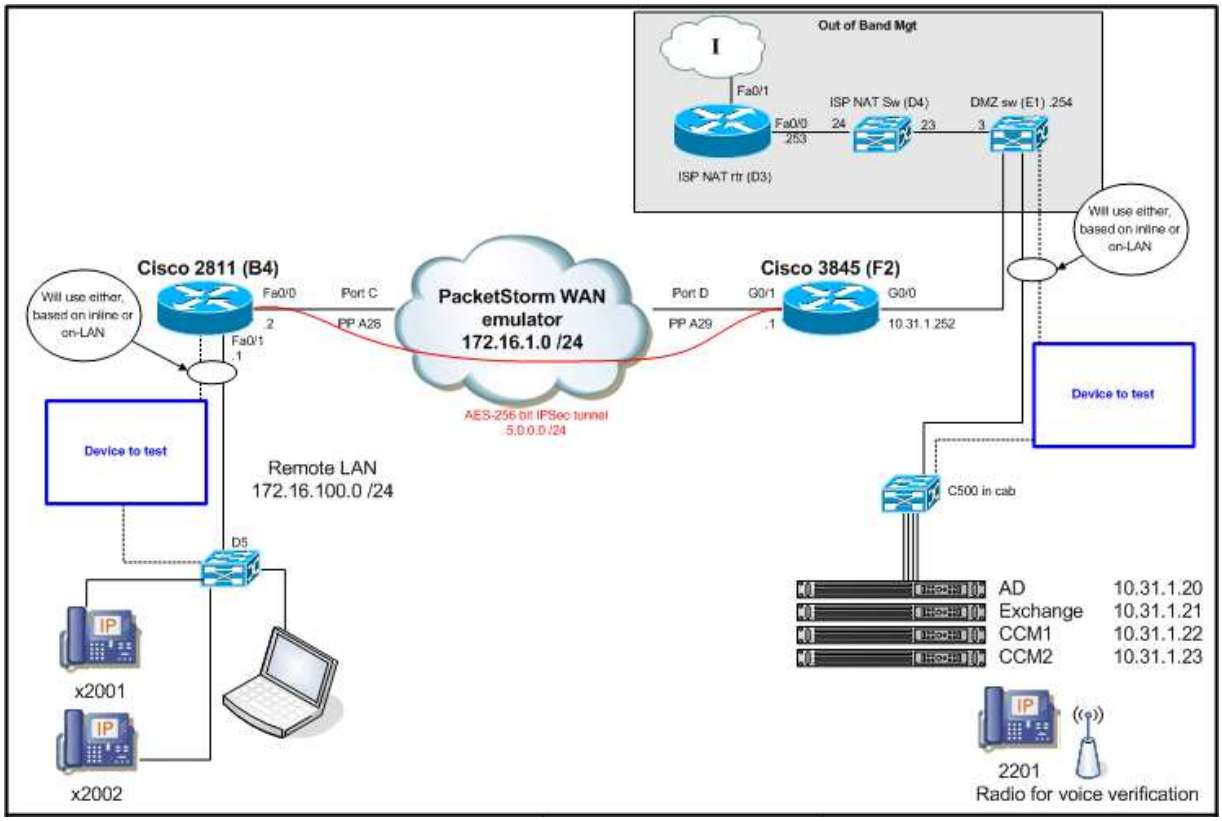


Figure 1, Test Bed Used

All tests were conducted at least two times and in various conditions; cold, warm and modified. The "cold" run was done with empty caches on the devices, a "warm" run was done once the data is cached on the device and a "modified" run was conducted after a warm run with 10% of the data changed on the server side.

2 Equipment tested

For this test a variety of vendors' equipment was tested, ranging from software based clients to network appliances with hard drive caching. Here is a listing of the various equipment tested.

Cisco
- WAE 500 appliance
- WAE 600 appliance
- NME-WAE-520-K9

Level421 PEH-GW type TT-2400
- 6930 model
- 6940 model

iDirect
- Skycelerator 1150

Riverbed
- Steelhead 520
- Steelhead 3520

Silver Peak
- 2600
- 5620

Stampeded networks
- Client software
- IBM server

3 Testing methodology

The tests were all conducted from a Dell ATG laptop running Windows XP with a Core2 Duo 2GHz CPU. The laptop was connected to the remote side of the network and ran all the tests against the Exchange/file server on the home side of the network.

To keep a record of the test results we used "timethis.exe" from the Microsoft Windows 2000 resource kit. As a way to further capture results and to also display the output on the screen the application "tee.com" with the /A switch was used. A variety of different file access methods were used to test the different ways that users access files in the real world. To simulate accessing files across the WAN via a mapped drive the Windows resource kit application "robocopy" was used. The Cisco "WAFS Benchmark Tool" was used to measure response times for basic file operations (open, save, close) when using a Microsoft Office application (such as Word, PowerPoint, or Excel). For HTTP, HTTPS and FTP transfers "Wget" was used.

The "baseline" results are the test results with no acceleration at all on the link. All times listed are in seconds.

4 Summary of the results:

	CIFS	HTTP	HTTPS	FTP	WAFS
Silver Peak	2	4	3	4	4
Level 9 2 1 Satellite Communications	1	1	1	1	1
Riverbed	4	3	5	2	3
Cisco	3	5	6	6	2
Stampede		6	4	5	
iDirect		2	2	3	

Figure 2, Test Results Summary

This is a ranking of each of the vendors on a 1 to 6 scale, with 1 being the best. In the case where the tests did not complete, or were not run for whatever reason, the ranking is omitted.

5 Results

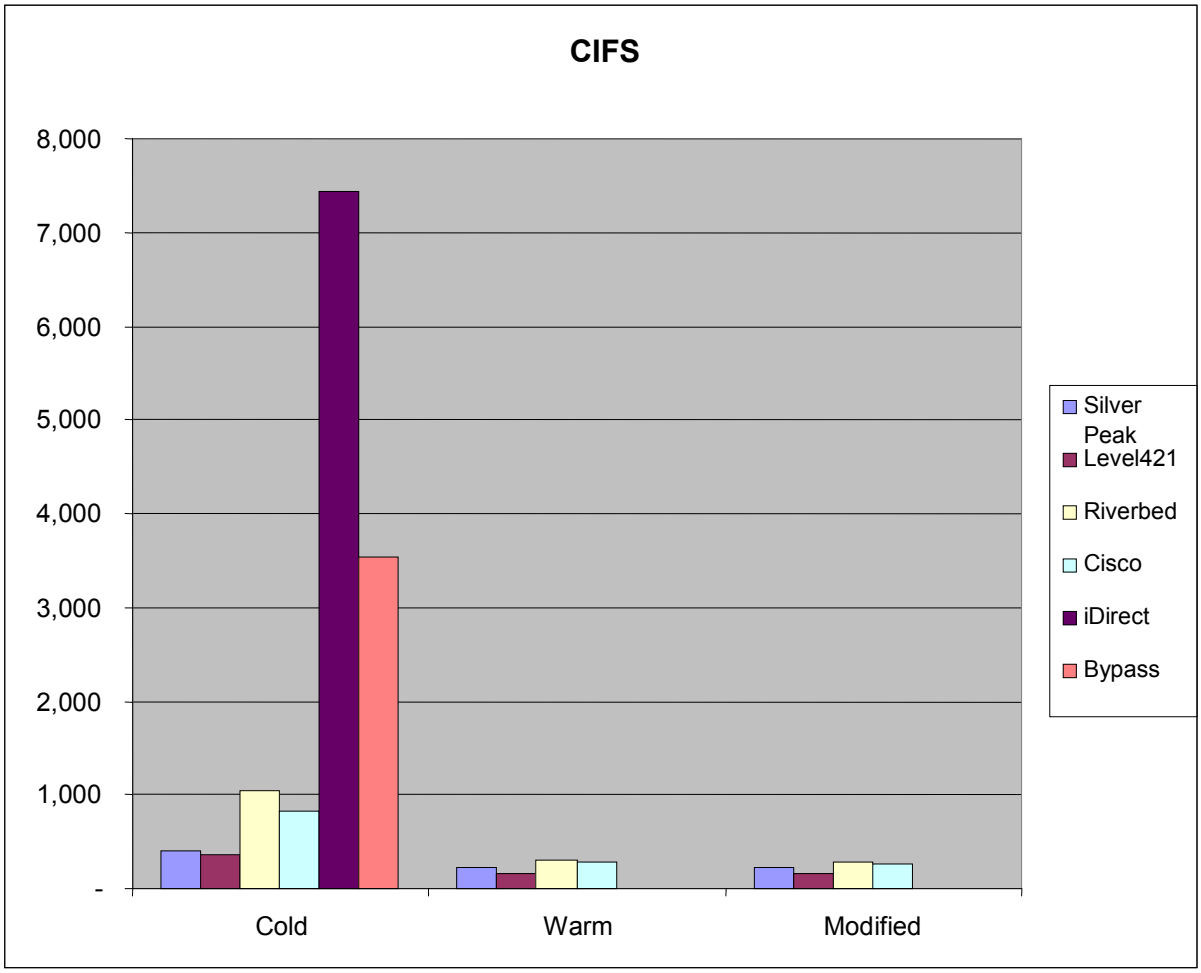


Figure 3, CIFS Results

CIFS	Cold	Warm	Modified	Sum	Rank
Silver Peak	407.03	229.14	218.29	854.46	2
Level 3 Satellite Communications	359.63	158.24	152.03	669.90	1
Riverbed	1,035.74	302.07	271.69	1,609.50	4
Cisco	833.42	284.79	255.18	1,373.39	3
Stampede	2,745.43	-	-		
iDirect	7,440.44	-	-		
Bypass	3,540.00				

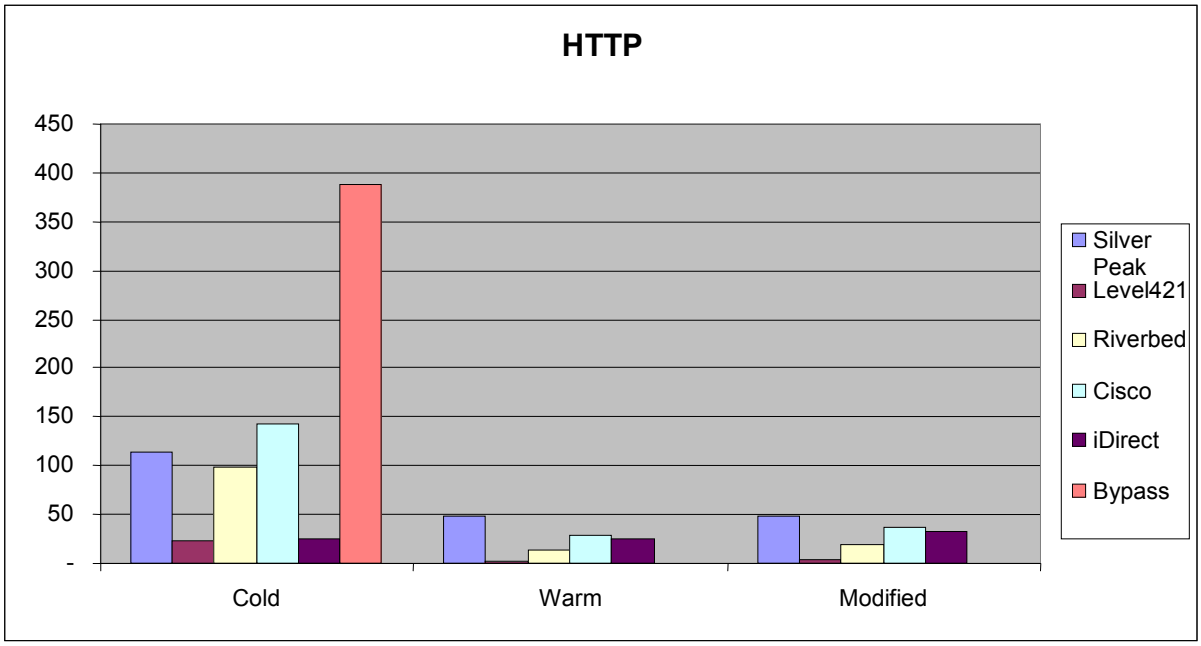


Figure 4, HTTP Results

HTTP	Cold	Warm	Modified	Sum	Rank
Silver Peak	113.02	48.88	48.27	161.89	4
Level 421	23.25	1.60	4.10	24.85	1
Riverbed	98.50	13.46	20.24	111.96	3
Cisco	143.56	29.36	36.35	172.91	5
Stampede	70.18	84.89	106.21	388.84	6
iDirect	24.47	25.91	33.53	50.38	2
Bypass	388.84				

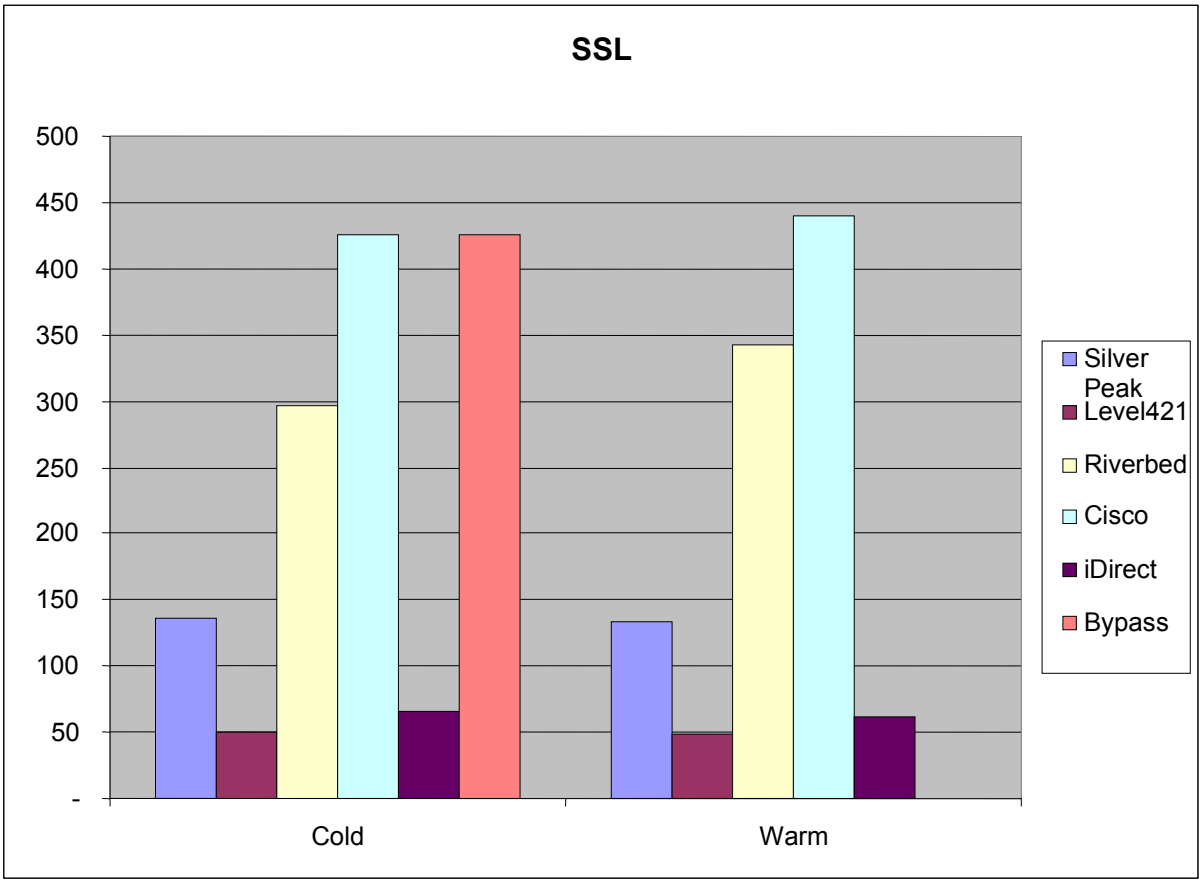


Figure 5, SSL Results

SSL/HTTPS	Cold	Warm	Modified	Sum	Rank
Silver Peak	135.51	133.86	-	269.37	3
Level 421 Satellite Communications	49.95	49.36	-	99.31	1
Riverbed	296.79	342.80	-	639.58	5
Cisco	425.70	440.31	-	866.01	6
Stampede	82.10	86.60	-	425.25	4
iDirect	65.45	62.20	-	127.66	2
Bypass	425.25				

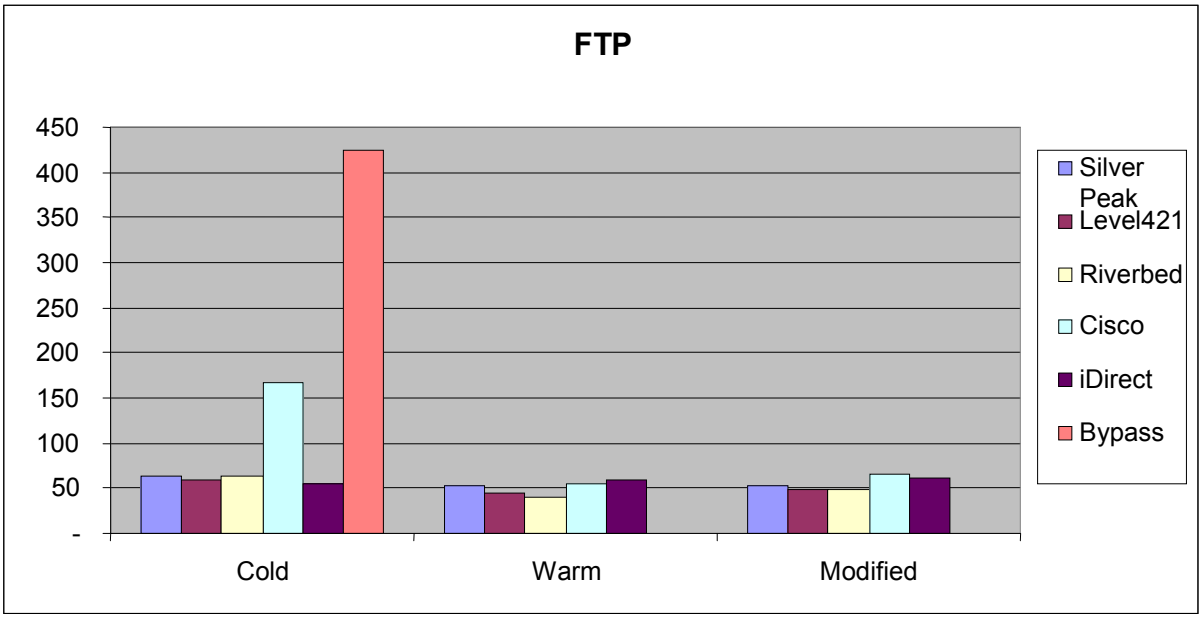


Figure 6, FTP Results

FTP	Cold	Warm	Modified	Sum	Rank
Silver Peak	62.56	52.02	52.81	114.58	4
Level 9 2 1 Satellite Communications	59.09	44.23	47.97	103.32	1
Riverbed	63.80	40.05	47.58	103.85	2
Cisco	166.57	55.12	66.45	221.69	6
Stampede	97.49	93.79	106.61	191.28	5
iDirect	55.61	58.40	61.91	114.01	3
Bypass	425.18				

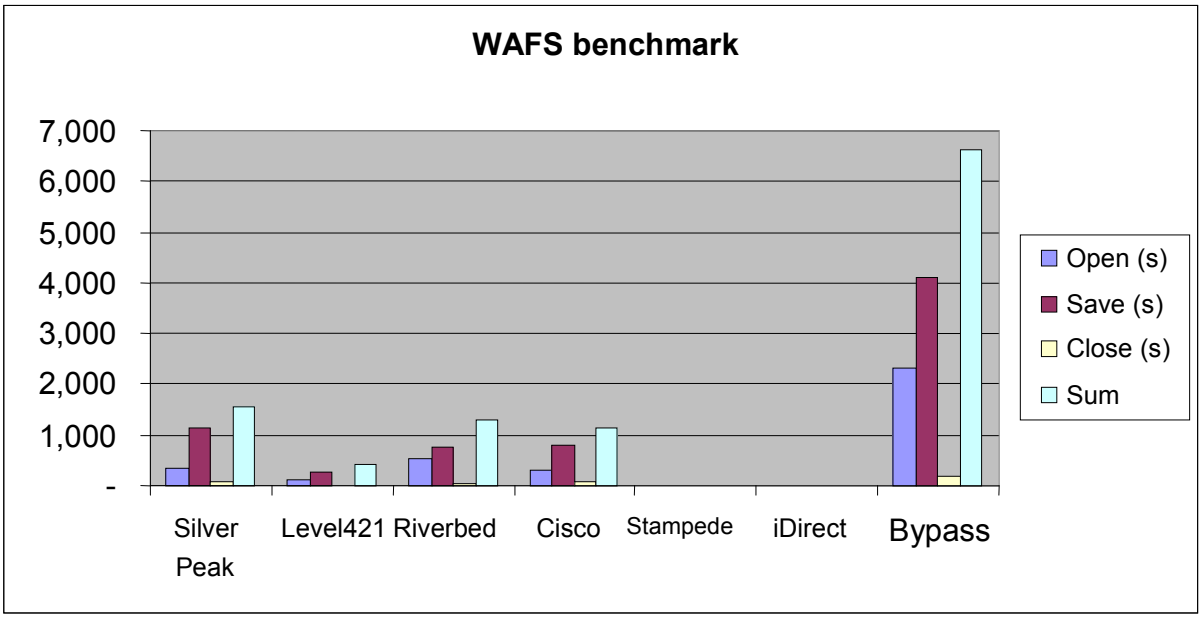


Figure 7, WAFS Results

WAFS benchmark					Rank
	Open (s)	Save (s)	Close (s)	Sum	
Silver Peak	335.79	1,127.19	78.84	1,541.82	4
Level 421	105.33	281.20	18.53	405.07	1
Riverbed	514.96	750.33	39.74	1,305.03	3
Cisco	295.10	789.17	67.90	1,152.17	2
Stampede					
iDirect	-	-	-		
Bypass	2,337.85	4,099.41	192.77	6,630.03	

6 Test Scripts

6.1 CIFS

Purpose: To simulate remote users accessing files from a location across the WAN, using mapped drives.

Setup: The remote maps a drive to the server at home (net use x: \\x.x.x.x\shared) and then copies files to and from the server via robocopy.

Test script:
timethis 1.CIFS.cmd | tee C:\temp1\[vendor]\[vendor_CIFS.txt]

1.CIFS.cmd
```
del /Q c:\temp
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP Final.doc
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP v7.doc
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP E.coli.txt
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP Router.ppt
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP Semester3-CCNA.doc
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP setup.exe
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP SKU_list.xls
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP UnityUninstall30.exe
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP VoIP.ppt
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP world192.txt
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP world192.txt
::
del /Q z:\back\*.*
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP Final.doc
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP v7.doc
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP E.coli.txt
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP Router.ppt
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP Semester3-CCNA.doc
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP setup.exe
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP SKU_list.xls
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP UnityUninstall30.exe
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP VoIP.ppt
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP world192.txt
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP world192.txt
```

Modified files:
timethis 1.CIFS-mod.cmd | tee C:\temp1\[vendor]\[vendor_CIFSmod.txt]

1.CIFS-mod.cmd
```
del /Q c:\temp
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP Final.doc
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP v7.doc
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP E.coli.txt
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP Router.ppt
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP Semester3-CCNA.doc
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP setup.exe
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP SKU_list.xls
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP UnityUninstall30.exe
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP VoIP.ppt
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP world192.txt
robocopy z:\ C:\temp /R:10 /W:30 /IS /NP world192.txt
::
del /Q z:\back\*.*
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP Final.doc
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP v7.doc
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP E.coli.txt
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP Router.ppt
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP Semester3-CCNA.doc
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP setup.exe
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP SKU_list.xls
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP UnityUninstall30.exe
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP VoIP.ppt
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP world192.txt
robocopy C:\temp z:\back /R:10 /W:30 /IS /NP world192.txt
```

6.2 HTTP

Purpose: To simulate remote users accessing files from a location across the WAN, using the web (HTTP).
Setup: The remote will download files from the home server web page using wget

Test script:
timethis 2.http.cmd | tee C:\temp1\[vendor]\[vendor_HTTP.txt]

2.http.cmd
wget 10.31.1.20/Final.doc -P http
wget 10.31.1.20/Router.ppt -P http
wget 10.31.1.20/SKU_list.xls -P http
wget 10.31.1.20/world192.txt -P http

Modified files:
timethis 2.mod-http.cmd | tee C:\temp1\[vendor]\[vendor_HTTP.txt]

2mod-http.cmd
wget 10.31.1.20/Final.doc -P http
wget 10.31.1.20/Router.ppt -P http
wget 10.31.1.20/SKU-mod.xls -P http
wget 10.31.1.20/world192.txt -P http

6.3 HTTPS (SSL)

Purpose: To simulate remote users accessing files from a location across the WAN, using the secure web (HTTPS/SSL).
Setup: The remote will download files from the home server web page

Test script:
timethis 3.ssl.cmd | tee C:\temp1\[vendor]\[vendor_ssl.txt]

3.ssl.cmd
wget https://10.31.1.20/Final.doc --no-check-certificate -P http
wget https://10.31.1.20/Router.ppt --no-check-certificate -P http
wget https://10.31.1.20/SKU_list.xls --no-check-certificate -P http
wget https://10.31.1.20/world192.txt --no-check-certificate -P http

6.4 FTP

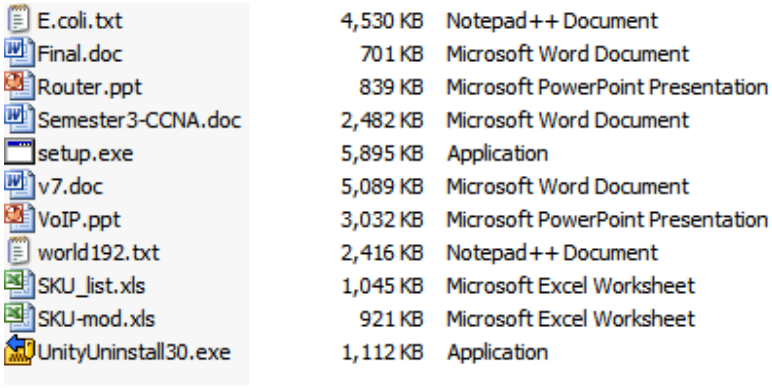
Purpose: To simulate remote users accessing files from a location across the WAN, using FTP.

Setup: The remote will download files from the home server via FTP page

Test script:
timethis 4.ftp.cmd | tee C:\temp1\[vendor]\[vendor_ftp.txt]

4.FTP.cmd
wget ftp://10.31.1.20/Final.doc t -P ftp_test
wget ftp://10.31.1.20/Router.ppt -P ftp_test
wget ftp://10.31.1.20/SKU_list.xls -P ftp_test
wget ftp://10.31.1.20/world192.txt -P ftp_test

6.5 Listing of the files and their sizes:



E.coli.txt	4,530 KB	Notepad++ Document
Final.doc	701 KB	Microsoft Word Document
Router.ppt	839 KB	Microsoft PowerPoint Presentation
Semester3-CCNA.doc	2,482 KB	Microsoft Word Document
setup.exe	5,895 KB	Application
v7.doc	5,089 KB	Microsoft Word Document
VoIP.ppt	3,032 KB	Microsoft PowerPoint Presentation
world192.txt	2,416 KB	Notepad++ Document
SKU_list.xls	1,045 KB	Microsoft Excel Worksheet
SKU-mod.xls	921 KB	Microsoft Excel Worksheet
UnityUninstall30.exe	1,112 KB	Application