Microsoft SharePoint and Citrix Application Optimization Deployment Best Practices and Performance Validation

Citrix Systems, Inc.

Notice

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Executive Summary

Corporations of all sizes and in various vertical segments are looking to provide an infrastructure that allows employees and teams to collaborate and exchange data and documents in all functional areas such as Human Resources, Finance, Engineering, Sales and others. Microsoft has been a market leader in productivity software for the desktop with the established suite of Office products. With the latest release of the 2007 Microsoft Office system, Microsoft SharePoint Server 2007 is allowing users to work on deliverables collaboratively and increasing productivity across the enterprise.

As many industries follow global trends like outsourcing and employ geographically dispersed workforces, the deployment of a centralized knowledge and document repository proves to be more and more challenging. All users, regardless of their physical location, expect reasonable application response times to actively participate in the knowledge exchange process within their organizations.

As complex and diverse data are being accessed and processed, sizeable amounts of traffic traverse the network between the user and the data center, or have to be processed by the application components causing workflow execution times to lengthen undesirably and affecting worker productivity. Thus, it is critical that solutions are implemented to overcome these challenges – not meeting them can have adverse effects on worker productivity and the financial bottom line. The Citrix Application Optimization products, NetScaler and WANScaler, provide a seamless and transparent solution to these challenges. NetScaler accelerates the delivery of Web components and greatly contributes to the scalability of the Web servers in a SharePoint deployment, while WANScaler is specifically tailored to optimize the utilization of high latency wide area network (WAN) links while simultaneously providing advanced data compression and protocol optimization.

This document outlines the best way to optimize the Microsoft Office 2007 SharePoint Server applications for all access scenarios, allowing organizations to streamline operations and dramatically reduce network costs between data centers, remote sites, and branch offices. The tests detailed in this document show that download times of commonly accessed documents across a WAN can be reduced from over 4 minutes to less than 1 second. In extreme network scenarios where user response times showed to be in excess of 10 minutes, Citrix NetScaler and WANScaler were able to reduce the workflow wait down to 15 seconds, making a previously impossible access scenario feasible again.

The following graph highlights the improvement in application download times provided by WANScaler over several network conditions, providing 500x acceleration for a common WAN link scenario:
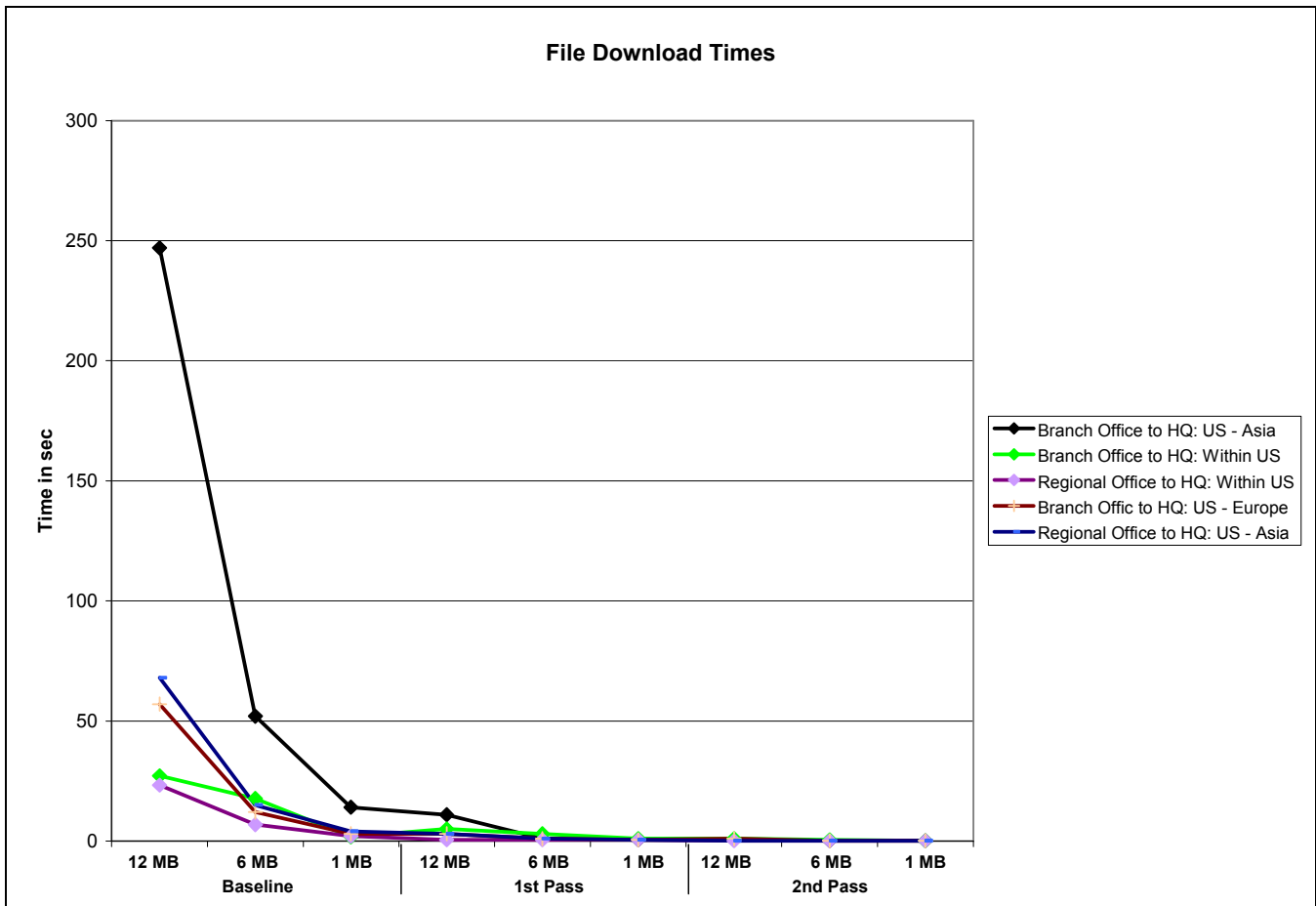
Figure 1 - File Download Acceleration with Citrix WANScaler

In summary, the tests detailed in this white paper show that any SharePoint Server 2007 environment can benefit greatly from being deployed with Citrix NetScaler, WANScaler, and Citrix Best Practices. Without exception, user response times and the access experiences are dramatically improved in the most commonly used workflows as determined by Microsoft's production SharePoint team. In addition, file download and data transfers across WANs provide a LAN-like experience through the use of Citrix WANScaler.

Product Overview

Microsoft SharePoint Server 2007

SharePoint Server 2007 connects people, processes, and information. More and more corporate users, from small and medium sized businesses to large, globally dispersed enterprises, leverage Microsoft SharePoint to facilitate the sharing of information and collaboration within teams as well as across functional areas.

SharePoint Server 2007 is an integrated suite of server capabilities that can help improve organizational effectiveness by providing comprehensive content management and enterprise search, accelerating shared business processes, and facilitating information-sharing across boundaries for better business insight. Office SharePoint Server 2007 supports all intranet, extranet, and Web applications across an enterprise within one integrated platform, instead of relying on separate fragmented systems. Additionally, this collaboration and content management server provides IT professionals and developers with the platform and tools they need for server administration, application extensibility, and interoperability.

Citrix NetScaler Application Switch

The Citrix NetScaler Application Switch combines the features and functions of traditional data center point products - load balancing, caching, compression, SSL acceleration, attack defense, SSL VPN - into a single network appliance, built from the ground up to maximize the performance of applications. Citrix NetScaler products deliver maximized application performance, end-to-end application security, continuous application availability, and reduced cost of operations.

Citrix WANScaler

Citrix WANScaler solutions provide high-performance application delivery to branch office users. WANScalers accelerate application performance across WANs by an average of 5x to 30x, and up to 300x at peak compression efficiency. With WANScalers in the network, end users in the branch office will experience LAN-like application performance over the WAN, meaning less time waiting for slow applications and more time using them.

Citrix WANScaler is a symmetric solution where an appliance is deployed both in the central data center as well as the branch office. Mobile and at-home users can benefit from WANScaler optimization by leveraging the Windows-based WANScaler client software.

Citrix WANScaler provides benefits by using more suitable TCP parameters on the WAN side as well as an extensive compression history on disk and in memory, which allows for small tokens to traverse the WAN in place of the full length payload. In addition, layer 7 protocol optimization helps reduce the number of round trips on chatty protocols such as CIFS over the WAN.

Microsoft Office SharePoint Server Deployment Considerations

The Microsoft Office SharePoint Server infrastructure consists of one or more Web servers on the front-end as well as at least one Application server and a backend database. The database in larger deployments is typically implemented as an SQL Server database server cluster.

Typical Challenges

As businesses become progressively more real-time and employees collaborate with each other on various initiatives, users are increasingly looking to share up-to-date information and expect almost instant responses from their systems. As multiple users are requesting similar or the same information in the same timeframe, backend database and application servers are often taxed to generate or deliver the same data over and over again. Businesses need to account for this by scaling the backend resources accordingly or accelerating application delivery.

Application response times and the sizing of the Web server farms are affected by Web servers performing multiple tasks that are not directly related to serving the content to the users. Oftentimes, hardware resources are consumed for non-core tasks such as the management of TCP connections and handshakes, encrypting and decrypting content, exchanging SSL crypto keys with clients, and managing surges in user requests.

As businesses become more globally dispersed, remote users may additionally be affected by accessing the applications over high latency and/or low bandwidth connections. Businesses often attempt to overcome slow application response times by resorting to costly WAN link upgrades, only to find that the bandwidth cannot be fully utilized if networks span long distances and are thus subjected to high network latency. Additionally, users working from the same regional or branch office are often accessing the same documents and shared resources from the central data center in HQ, resulting in multiple, repetitive downloads of large amounts of data over a limited network connection.

Who is Affected by These Challenges?

An increasing number of businesses deploy Microsoft SharePoint Server to provide individual employees and teams the infrastructure to work productively and collaborate and share information, documents and resources with each other. Global trends such as outsourcing, a geographically dispersed workforce, and traveling users result in increased complexities in the deployment of and access to the work environment.

How are Solutions Implemented to Meet These Challenges?

After evaluating the challenges faced by many organizations, Citrix Application Optimization solutions provided an attractive and effective alternative to costly network upgrades and specific point products.

The Citrix NetScaler Application Switch accelerates application delivery and improves application availability by providing load balancing, TCP offloading, SSL offloading and acceleration, HTTP and TCP compression, as well as caching of static and dynamic Web content. This solution dramatically improves application response time to users and reduces the number of required Web and application servers by off-loading non-core tasks. In addition, Citrix NetScaler provides protection against Denial of Service attacks, and aids the scalability of any back-end server farm by providing server load balancing, monitoring, and centralized Web server logging.

Citrix WANScaler enables organizations to use the full bandwidth of a WAN link and fill the link by utilizing TCP parameters between WANScalers that allow for smarter congestion control and larger packets. Unlike typical TCP implementations, WANScalers know the bandwidth of the WAN link, allowing them to avoid using the TCP slow start mechanism and sending data at the maximum speed immediately after establishing a connection. The AutoOptimizer technology allows WANScaler to adapt to changing network conditions to keep sending data at the optimum rate. WANScaler's sophisticated compression engine allows the units to build a history of transmitted bit streams, allowing users to download data at LAN speed from the local WANScaler if the data has been seen by that WANScaler based on another user's previous request.

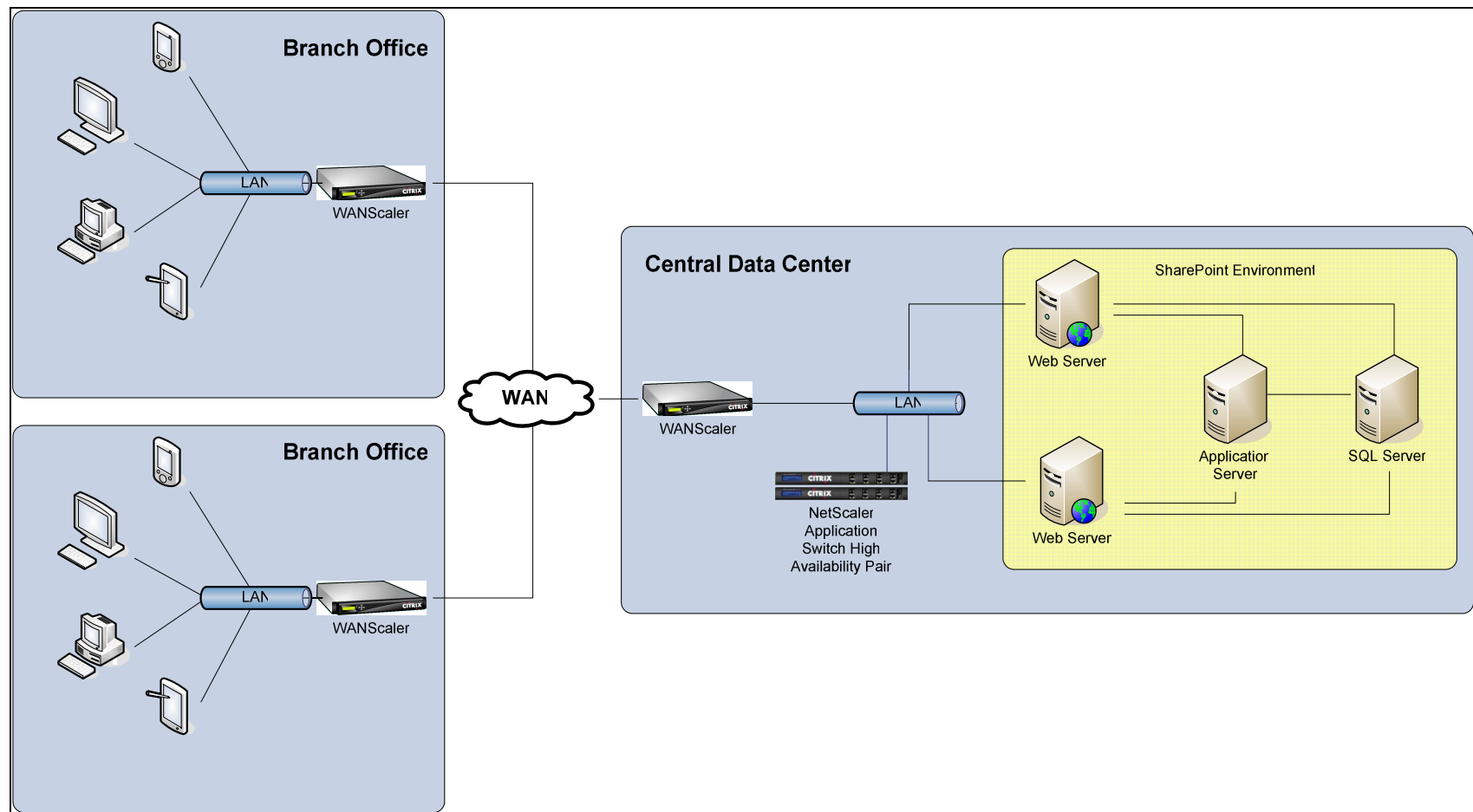# Microsoft Office SharePoint Server and Citrix Infrastructure Optimization Solution

Figure 2 - SharePoint and Citrix Infrastructure Optimization

Central Data Center Network

The Citrix components in the central data center consist of a pair of Citrix NetScaler Application Switches to provide server load balancing, compression, caching, SSL offloading, TCP multiplexing and defenses against common attacks such as Denial of Service. The high availability pair constitutes an active/passive redundant deployment, where the NetScaler terminates incoming traffic and proxies it on behalf of the requestor to the Web servers. Citrix NetScalers are most commonly deployed in a simple one-arm configuration on the LAN segment of the data center network.

Citrix WANScaler appliances are typically deployed in in-line mode on the edge of the data center network and just on the inside of the WAN router. A physical fail-to-wire card ensures that connectivity remains possible even in the event of a power failure or failure of the appliance. Should in-line mode be impossible to achieve, WANScalers can also be deployed in virtual in-line mode, where router policies or WCCP direct WAN-bound traffic to the WANScaler for processing and optimization. WANScalers do not proxy or tunnel any traffic and are fully transparent to other network devices such as firewalls, QoS implementations or traffic monitoring tools. WANScalers support traffic from multiple branch offices in a hub-and-spoke architecture and can divide their resources between connections from all branch offices.

Branch Office

On the branch office side, a Citrix WANScaler is also deployed on the edge of the branch office network in in-line or virtual in-line mode. WANScaler's auto-discovery allows for WANScalers to discover each other during the TCP handshake of an establishing connection and apply acceleration automatically. There is no need to configure the addresses of any peer appliances on any WANScaler, making the deployment and configuration easy to use and seamless.

Configuration Considerations

Microsoft Office SharePoint Server Configuration

The Microsoft Office SharePoint Server 2007 environment has been configured according to Microsoft best practices and reflects a copy of Microsoft's internal production SharePoint deployment, which is accessed by approximately 8,000 users on a daily basis. No configuration changes were required to enable this environment to work with either Citrix NetScaler or WANScaler.

Citrix NetScaler Application Switch configuration

The NetScaler Application Switch has been configured to load balance and optimize the front-end Web servers in this SharePoint environment. The following NetScaler features are being leveraged:

- Server Load Balancing
- HTTP Compression
- SSL Offload
- Integrated Caching
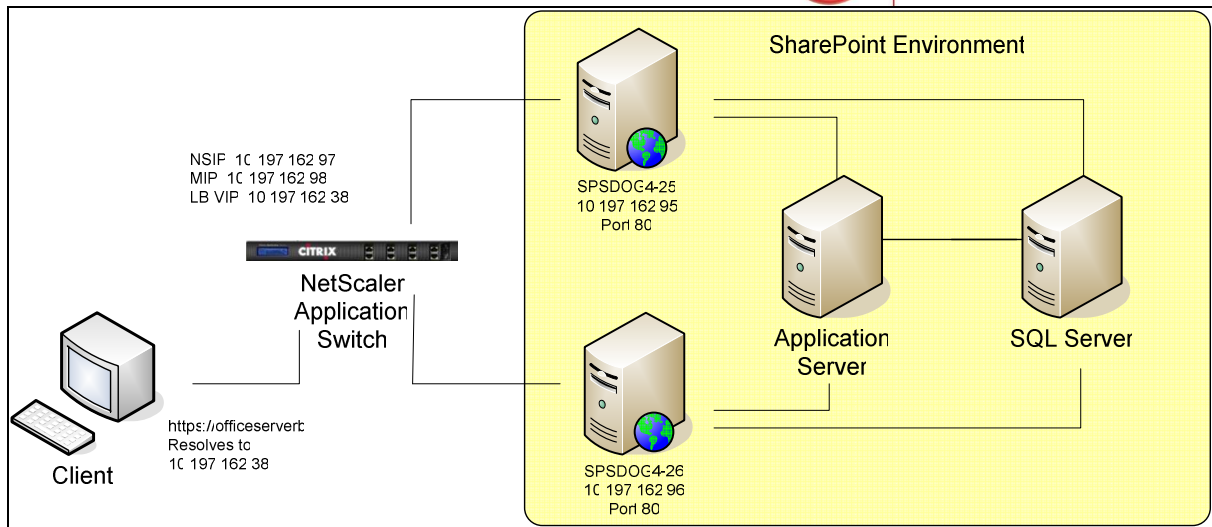
Figure 3 - NetScaler and SharePoint topology

Figure 3 details the IP addresses as ports of the relevant components in this environment. For a complete NetScaler configuration, refer to Appendix A.

Citrix WANScaler configuration

Citrix WANScalers work very well with a simple "out-of-the-box" configuration. Apart from configuring management IP addresses on the WANScaler appliances, it is imperative to configure the bandwidth of the WAN link on the appliance. Setting these values to 96% of the link speed is considered a best practice.

By default, the HTTP and HTTPS service classes are disabled in the WANScaler configuration. In order to apply optimization to Web traffic, administrators are encouraged to create a service class to cover Web servers internal to the organization. As all Web servers in this test environment should be accelerated, the standard service classes have been enabled for disk-based compression. Appendix B details the WANScaler configuration.

Performance Results and Analysis

The environments detailed in this white paper have been built and configured in the Microsoft SharePoint Test Lab on the main Microsoft campus in Redmond, WA. Standard Microsoft performance scalability and response time test scripts and load generation tools have been used throughout the test scenarios to gather the performance metrics of each test scenario.

Test Environment

The test environment for each test corresponds to the testing scenarios outlined below. The following diagrams depict the environment topologies configured during this test:
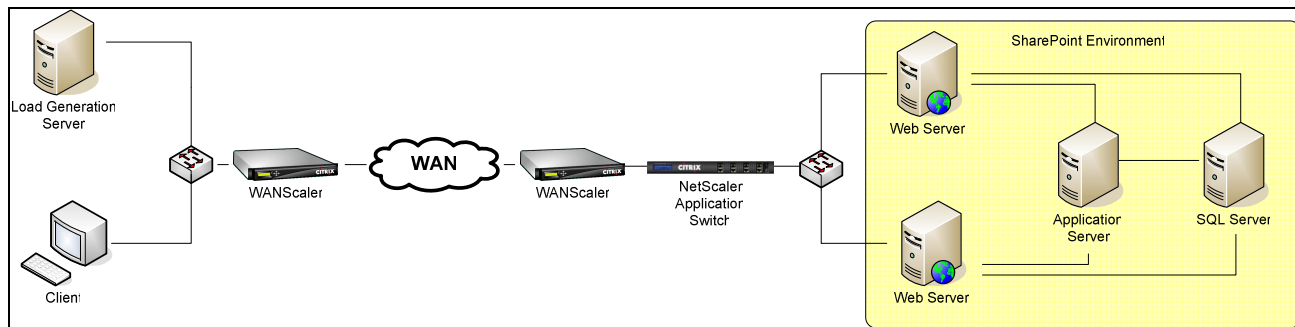
Figure 4 - Test Environment

Hardware Specifications

The following table provides detailed information for the hardware deployed in this test environment:

Device Role	Hardware
Citrix NetScaler Application Switch	Model 9000 series – 2 U appliance with dual processors
Citrix WANScaler	Model 8500
Apposite Technologies WAN Emulator	Linktropy 4500
SharePoint Web Servers	Dell 2850 Dual CPUs 3.4 GHz Hyperthreaded, 146GB 15,000 RPM HDD RAID1 4 GB RAM
SharePoint Application Servers	Dell 6850 Quad CPUs 3.4 GHz Hyperthreaded, 146 GB 15,000 RPM RAID1 HDD 8 GB RAM
SQL Server	Dell 6850 Quad CPUs2.8 GHz Dual Core , 146 GB 15,000 RPM RAID1, 8 TB SAS 15,000 RPM RAID 10 HDD

Table 1 – Hardware Specifications

Software Specifications

The following section provides all the software necessary for the test environment:

Windows 2003 Environment

The servers in this test environment were built with Windows Server 2003, Enterprise Edition, SP1.

SharePoint Environment

The SharePoint components are running the SharePoint 2007 RTM code base.

Citrix NetScaler Environment

The Citrix NetScaler Application Switch is running the 7.0.46.9 code build.

Citrix WANScaler Environment

The Citrix WANScaler appliances are running the 64-bit build of the 3.1.7 software version.

Apposite WAN Emulator Environment

The Apposite Linktropy 4500 WAN Emulator is running the 2.0.1 firmware.

Test Workflows

The Microsoft SharePoint team identified the most commonly accessed sites in the internal production SharePoint deployment and has developed automated scripts based on Microsoft's Application Center Test. During each test, 80 simulated users are accessing the specified sites repeatedly, while various performance metrics are gathered such as download times (time to last Byte) and various other metrics. Appendix C details the specific workflows used in this test.

Test Plan

The tests evaluate the impact of the Citrix solutions to various deployment scenarios and workflows. The following paragraphs provide a detailed overview of these scenarios:

NetScaler and WANScaler accelerate common HTTP-based workflows

- During this test the identified http-based workflows are executed repeatedly by the Microsoft Application Test Center and application response times are recorded. The baseline data reflects the use of Microsoft Network Load Balancing in front of the SharePoint servers and no use of WANScaler or NetScaler.
- During the second phase, NetScaler replaces Microsoft Network Load Balancing and applies additional optimization techniques as outlined in the NetScaler configuration. Citrix WANScalers are disabled during this test and do not provide any acceleration.
- During the third phase, the Citrix WANScalers are enabled. Both WANScalers and NetScalers provide optimization and acceleration.
- All tests are performed over a simulated WAN, where parameters like bandwidth, roundtrip latency and packet loss are established and detailed in the test results.

NetScaler provides SSL offload to common HTTPS-based workflows

During this test, the NetScaler application switch provides SSL offloading to the SharePoint environment in addition to the previously configured acceleration methods.

WANScaler accelerates file downloads

During this test, files of various sizes and file types are downloaded and download times were recorded for each scenario. The emulated WAN parameters are changed to reflect the following scenarios:

Scenario	Network Parameters
Branch Office to HQ between US and Asia	1.5 Mbps, 300ms latency, 1% packet loss
Regional Office to HQ within US	44 Mbps, 90ms latency, 0.1% packet loss
Branch Office to HQ within US	6 Mbps, 90ms latency, 0.1% packet loss
Branch Office to HQ between US and Europe	6 Mbps, 200ms latency, 0.1% packet loss
Regional office to HQ between US and Asia	6 Mbps, 300ms latency, 0.1% packet loss

Each WAN Scenario is conducted without WANScaler to establish a baseline, followed by two consecutive file downloads with WANScaler to determine first and second pass acceleration benefits.

Test Results

NetScaler and WANScaler accelerate common HTTP-based workflows

The following table details the performance improvements obtained during this test:

Workflow	Test	Response Time	Improvement	Response Time	Improvement	Response Time	Improvement
WAN Parameters		**5 Mbps / 169ms latency**		**512 kbps / 140ms latency**		**32 kbps / 708ms latency**	
MySite	Baseline	3.02s		6.72s		Unusable[1]	
	NetScaler	2.18s	27.91%	2.65s	60.53%	67.98s	9x
	NetScaler WANScaler	1.97s	34.80%	1.78s	73.56%	15.11s	40x
Search Query	Baseline	2.68s		5.27s		Unusable	
	NetScaler	2.19s	18.19%	2.78s	47.22%	65.90s	9x
	NetScaler WANScaler	2.15s	19.82%	1.93s	63.37%	12.41s	50x
Document	Baseline	2.96s		6.36s		Unusable	

[1] Page load in excess of 10 minutes (600s) are deemed unusable. Improvement figures are based on a baseline of 10 minutes.

Workflow	Test	Response Time	Improvement	Response Time	Improvement	Response Time	Improvement
WAN Parameters		**5 Mbps / 169ms latency**		**512 kbps / 140ms latency**		**32 kbps / 708ms latency**	
Library	NetScaler	2.14s	27.90%	2.66s	58.27%	63.70s	9x
	NetScaler WANScaler	2.09s	29.44%	1.87s	70.64%	10.03s	60x
Team Site	Baseline	2.91s		5.68s		Unusable	
	NetScaler	2.13s	26.93%	2.73s	51.97%	62.82s	9x
	NetScaler WANScaler	2.08s	28.58%	1.97s	65.38%	10.19s	60x

The following charts depict the performance results for various WAN parameters:
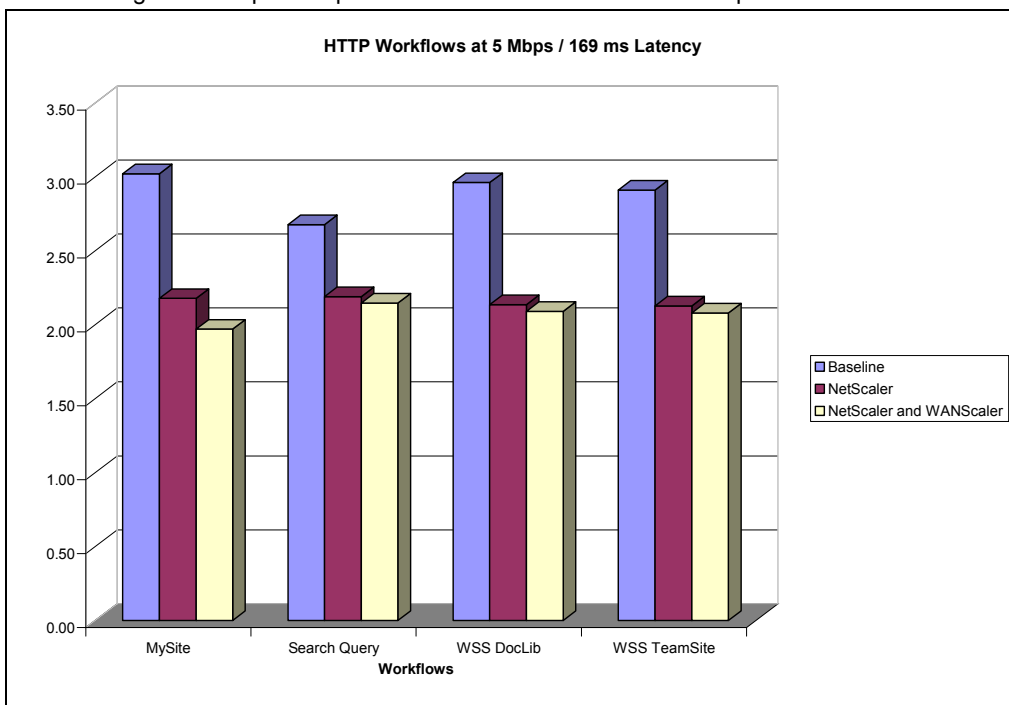
Figure 5 - HTTP workflows at 5 Mbps and 169ms latency
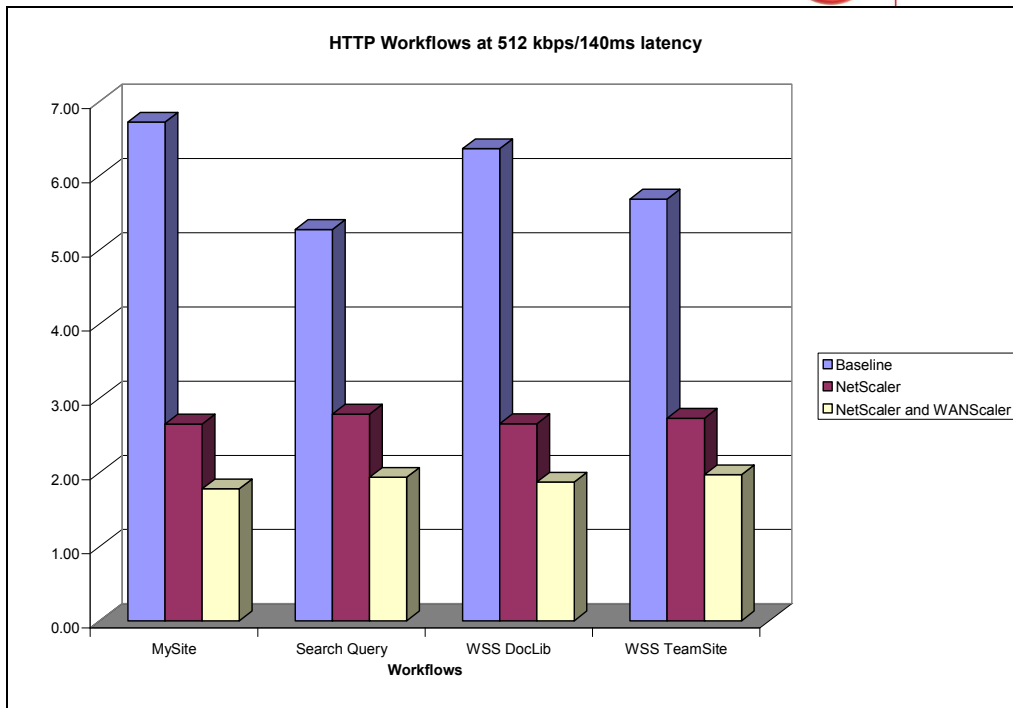
Figure 6 - HTTP Workflows at 512 kbps and 140ms latency
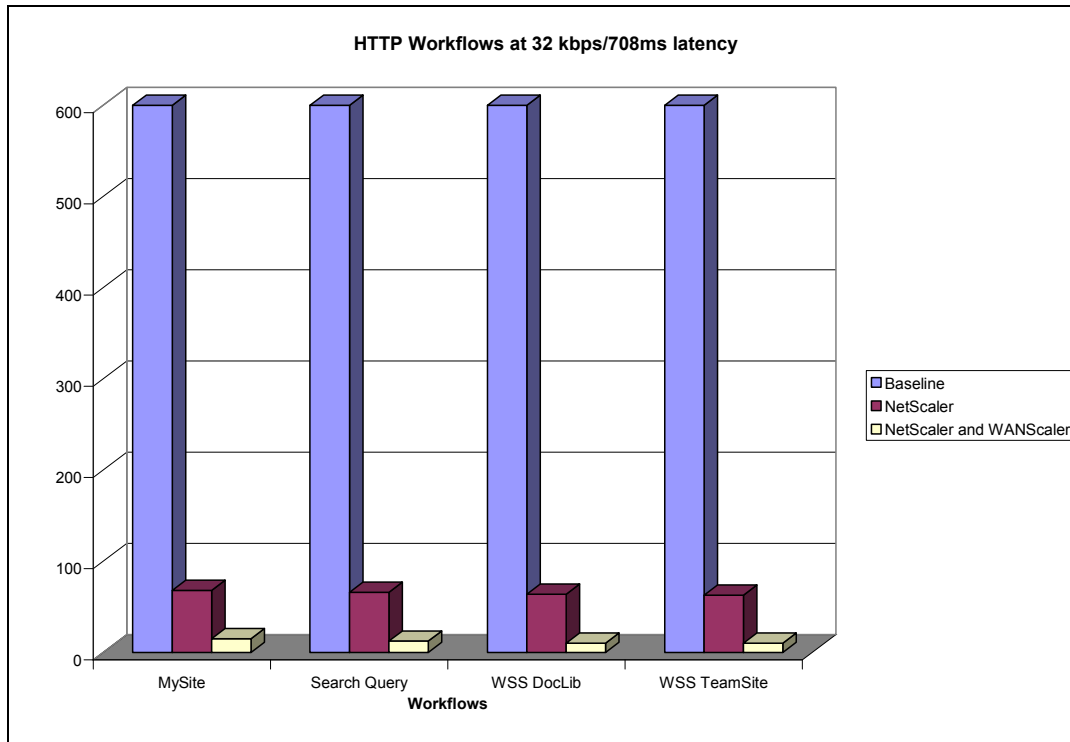
Figure 7 - 32 kbps and 708ms latency

The results show that the combination of Citrix NetScaler and WANScaler accelerate the application response time for http-based workflows by up to 35% in a high bandwidth scenario. As the available bandwidth of the link is reduced, the benefits of NetScaler and WANScaler become more and more accentuated, as figures 5 and 6 depict. In a 512 kbps bandwidth access scenario, NetScaler and WANScaler accelerate the performance of these http workflows by up to 87% compared to the baseline.

Figure 7 depicts a scenario low bandwidth, high latency scenario similar to a narrow band, satellite based access scenario. The baseline response times of these workflows are in excess of 10 minutes and are thus deemed unusable. Citrix NetScaler consistently showed 9x acceleration to all workflows in this scenario, while the combination of NetScaler and WANScaler improves user response time by up to 60x, resulting in response times of a few seconds. This shows that Citrix can provide user access with reasonably fast response times to extreme access scenarios which were previously deemed unusable.

NetScaler provides SSL offload to common HTTPS-based workflows

The following table details the performance improvements obtained during this test:

Workflow	Test	Response Time	Improvement
		512 kbps / 140ms latency	
MySite	Baseline	6.65s	
	NetScaler	3.48s	47.61%
Search Query	Baseline	5.24s	
	NetScaler	3.84s	26.81%
Document Library	Baseline	6.49s	
	NetScaler	3.36s	48.26%
Team Site	Baseline	6.29s	
	NetScaler	1.13s	82.03%

This test demonstrates that Citrix NetScaler's SSL offloading capabilities allow for the Web servers to save resources and focus their work on delivering content. This results in user response time improvements of up to 82%.

WANScaler Accelerates File Downloads

The detailed test results for this scenario can be found in Appendix D. The following chart details a selection of the tests and shows the dramatic performance improvements:

File Download Times

Legend:
- Branch Office to HQ: US - Asia
- Branch Office to HQ: Within US
- Regional Office to HQ: Within US
- Branch Offic to HQ: US - Europe
- Regional Office to HQ: US - Asia

Figure 8 - File Download Times

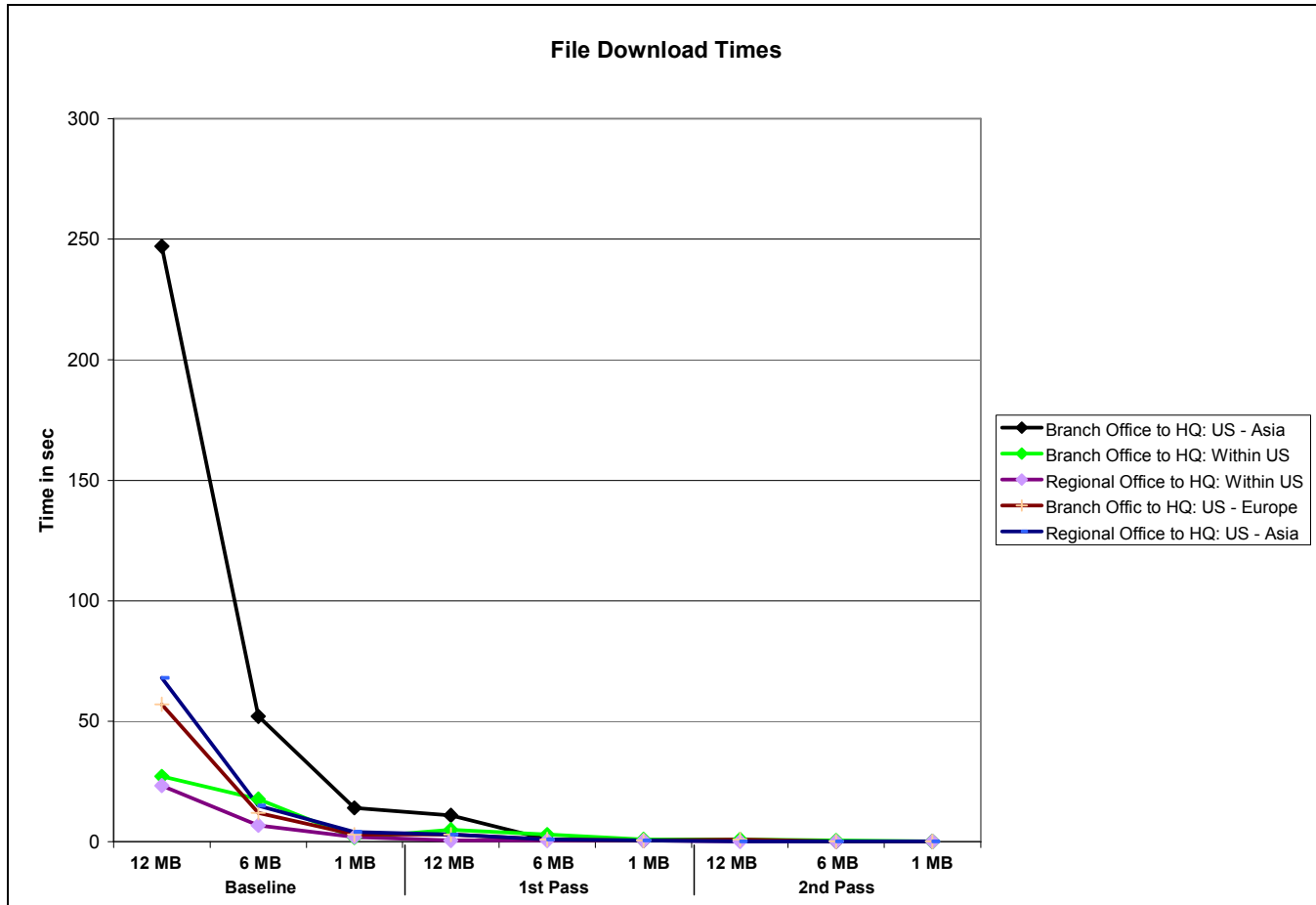As Figure 8 and the detailed data in Appendix D show, the file download times are improved significantly by WANScaler, even on the first pass. For a typical access scenario between Asia and the United States, the download time of a 12 MB file was reduced from over 4 minutes to 0.5 seconds, which corresponds to 500x acceleration.

Appendix A – NetScaler Application Switch Configuration

```
#NS7.0 Build 49.5
# Last modified by `save config`, Wed Mar 21 05:55:19 2007
set ns config -IPAddress 10.197.251.120 -netmask 255.255.255.240
enable ns feature WL LB CS cmp SSL IC
enable ns mode FR L3 CKA TCPB MBF Edge USNIP
set lacp -sysPriority 32768
set interface 0/1 -speed AUTO -duplex AUTO -flowControl RX -autoneg ENABLED -haMonitor
ON -trunk OFF -lacpMode DISABLED
set interface 1/2 -speed AUTO -duplex FULL -flowControl RX -autoneg ENABLED -haMonitor
ON -trunk OFF -lacpMode DISABLED
set interface 1/3 -speed AUTO -duplex AUTO -flowControl RX -autoneg ENABLED -haMonitor
ON -trunk OFF -lacpMode DISABLED
set interface 1/4 -speed AUTO -duplex AUTO -flowControl RX -autoneg ENABLED -haMonitor
ON -trunk OFF -lacpMode DISABLED
add ns ip 10.197.251.121 255.255.255.240 -type MIP -vServer DISABLED
add ns ip 10.197.251.122 255.255.255.240 -type VIP -telnet DISABLED -ftp DISABLED -gui
DISABLED -ssh DISABLED -snmp DISABLED
add vlan 361
bind vlan 361 -ifnum 1/4
add route 0.0.0.0 0.0.0.0 10.197.251.113 65535
set locationParameter -context geographic -q1label Continent -q2label Country -q3label
Region -q4label City -q5label ISP -q6label Organization
add policy expression jpg "URL == /*.jpg || URL == /*.JPG"
add policy expression jpeg "URL == /*.jpeg || URL == /*.JPEG"
add policy expression gif "URL == /*.gif || URL == /*.GIF"
add policy expression pdf "URL == /*.pdf || URL == /*.PDF"
add policy expression css "URL == /*.css || URL == /*.CSS"
add policy expression js "URL == /*.js"
add policy expression js_content_type "RES.HTTP.HEADER Content-Type CONTAINS
application/x-javascript"
add policy expression cache_jpeg "REQ.HTTP.URL == /*.jpeg"
add policy expression cache_javascript "REQ.HTTP.URL == /*.js"
add policy expression cache_gif "REQ.HTTP.URL == /*.gif"
add policy expression cache_pdf "REQ.HTTP.URL == /*.pdf"
add policy expression cache_css "REQ.HTTP.URL == /*.css"
add server 10.197.163.95 10.197.163.95
add server 10.197.163.96 10.197.163.96
add server 10.197.162.95 10.197.162.95
add server 10.197.162.96 10.197.162.96
add cr policy bypass-non-get -rule NS_NON_GET
add cr policy bypass-dynamic-url -rule "(NS_EXT_CGI || NS_EXT_ASP || NS_EXT_EXE ||
NS_EXT_CFM || NS_EXT_EX || NS_EXT_SHTML || NS_EXT_HTX) || (NS_URL_PATH_CGIBIN ||
NS_URL_PATH_EXEC || NS_URL_PATH_BIN)"
add cr policy bypass-cookie -rule "(NS_HEADER_COOKIE && NS_EXT_NOT_GIF &&
NS_EXT_NOT_JPEG)"
add cs policy mysite -rule "REQ.HTTP.URL CONTAINS /_layouts/MySite.aspx"
add service spsdog4-26 10.197.162.96 HTTP 80 -gslb NONE -maxClient 0 -maxReq 0 -cip
DISABLED -usip NO -sp OFF -cltTimeout 180 -svrTimeout 360 -CKA YES -TCPB YES -CMP YES
```

```
add service spsdog4-25 10.197.162.95 HTTP 80 -gslb NONE -maxClient 0 -maxReq 0 -cip
DISABLED -usip NO -sp OFF -cltTimeout 180 -svrTimeout 360 -CKA YES -TCPB YES -CMP YES
add service spsdog4-25-8080 10.197.162.95 HTTP 8080 -gslb NONE -maxClient 0 -maxReq 0 -
cip DISABLED -usip NO -sp OFF -cltTimeout 180 -svrTimeout 360 -CKA YES -TCPB YES -CMP
YES
add service spsdog4-26-8080 10.197.162.96 HTTP 8080 -gslb NONE -maxClient 0 -maxReq 0 -
cip DISABLED -usip NO -sp OFF -cltTimeout 180 -svrTimeout 360 -CKA YES -TCPB YES -CMP
YES
add cmp action Delta_per_policy delta -deltaType PERPOLICY
add vpn intranetApplication route_migrate_1 ANY 192.168.0.0 -netmask 255.255.0.0 -
destPort 1-65535 -interception TRANSPARENT
add cmp policy compress_javascript -rule "js || js_content_type" -resAction COMPRESS
add lb vserver Sharepoint_http_80 HTTP 10.197.251.122 80 -persistenceType COOKIEINSERT -
timeout 0 -cltTimeout 180
add lb vserver Sharepoint_http_8080 HTTP 10.197.251.122 8080 -persistenceType
COOKIEINSERT -timeout 0 -cltTimeout 180
set lb vserver Sharepoint_http_80 -IPAddress 10.197.251.122 -persistenceType
COOKIEINSERT -lbMethod LEASTCONNECTION -persistMask 255.255.255.255 -m IP -cltTimeout
180
set lb vserver Sharepoint_http_8080 -IPAddress 10.197.251.122 -persistenceType
COOKIEINSERT -lbMethod LEASTCONNECTION -persistMask 255.255.255.255 -m IP -cltTimeout
180
add cs vserver Sharepoint_SSL_VIP SSL 10.197.251.122 443 -soPersistenceTimeOut 2
set cs vserver Sharepoint_SSL_VIP -IPAddress 10.197.251.122 -cltTimeout 180
set ns rpcNode 10.197.251.120 -password
..8a7b474124957776a0cd31b862cbe4d72b5cbd59868a136d4bdeb56cf03b28 -srcIP 0.0.0.0
bind lb vserver Sharepoint_http_80 spsdog4-26
bind lb vserver Sharepoint_http_80 spsdog4-25
bind lb vserver Sharepoint_http_8080 spsdog4-25-8080
bind lb vserver Sharepoint_http_8080 spsdog4-26-8080
bind cs vserver Sharepoint_SSL_VIP Sharepoint_http_80
bind cs vserver Sharepoint_SSL_VIP Sharepoint_http_8080 -policyName mysite
set ns tcpbufParam -size 128 -memLimit 256
bind lb monitor tcp spsdog4-26
add ssl certKey ns-server-certificate -cert ns-server.cert -key ns-server.key
add ssl certKey NSTestCert -cert /nsconfig/ssl/NSTestCert.cert -key
/nsconfig/ssl/NSTestCert.key
add ssl certKey ms_pair_new -cert /nsconfig/ssl/ms_certkey.pem -key
/nsconfig/ssl/ms_certkey.pem
bind ssl certKey Sharepoint_SSL_VIP -vServer ms_pair_new
set ssl service nshttps-10.197.251.121-443 -sessReuse ENABLED -sessTimeout 120
set ssl service nsrpcs-10.197.251.121-3008 -sessReuse ENABLED -sessTimeout 120 -
cipherRedirect DISABLED -sslv2Redirect DISABLED
set ssl service nskrpcs-127.0.0.1-3009 -sessReuse ENABLED -sessTimeout 120 -
cipherRedirect DISABLED -sslv2Redirect DISABLED
set ssl service nshttps-127.0.0.1-443 -sessReuse ENABLED -sessTimeout 120
set ssl service nsrpcs-127.0.0.1-3008 -sessReuse ENABLED -sessTimeout 120 -
cipherRedirect DISABLED -sslv2Redirect DISABLED
```

```
set cache parameter -memLimit 200 -via "NS-CACHE-6.1:  37" -verifyUsing HOSTNAME_AND_IP
-maxPostLen 32768 -prefetchMaxPending 4294967294 -enableBypass NO
add cache contentGroup images -cacheControl "max-age=86400     " -maxResSize 500 -
memLimit 256
add cache contentGroup javascript -cacheControl "max-age=86400     " -maxResSize 500 -
memLimit 256
add cache contentGroup css -cacheControl "max-age=86400     " -maxResSize 500 -memLimit
256
add cache contentGroup ppt -prefetchMaxPending 0 -cacheControl "max-age=86400     " -
maxResSize 10000 -memLimit 256
add cache contentGroup jpg -prefetchMaxPending 0 -cacheControl "max-age=86400     " -
maxResSize 500 -memLimit 256
add cache contentGroup search -heurExpiryParam 10 -removeCookies NO -prefetchMaxPending
0 -maxResSize 5000 -memLimit 100 -ignoreReqCachingHdrs NO
add cache contentGroup Home_page -heurExpiryParam 10 -removeCookies NO -
prefetchMaxPending 0 -maxResSize 10000 -memLimit 100 -ignoreReqCachingHdrs NO
set cache contentGroup DEFAULT -weakPosRelExpiry 3600 -heurExpiryParam 0 -
weakNegRelExpiry 600 -ignoreReloadReq YES -removeCookies YES -prefetch YES -
prefetchMaxPending 4294967294 -insertVia YES -insertAge YES -insertETag YES -
quickAbortSize 4194303 -maxResSize 80 -memLimit 4095 -ignoreReqCachingHdrs YES -
lazyDnsResolve YES
set cache contentGroup BASEFILE -relExpiry 86000 -weakNegRelExpiry 600 -ignoreReloadReq
YES -removeCookies YES -prefetch YES -prefetchMaxPending 4294967294 -insertVia YES -
insertAge YES -insertETag YES -quickAbortSize 4194303 -maxResSize 256 -memLimit 2 -
ignoreReqCachingHdrs YES -lazyDnsResolve YES
set cache contentGroup DELTAJS -relExpiry 86000 -weakNegRelExpiry 600 -ignoreReloadReq
YES -removeCookies YES -prefetch YES -prefetchMaxPending 4294967294 -insertVia YES -
insertETag YES -quickAbortSize 4194303 -maxResSize 256 -memLimit 1 -ignoreReqCachingHdrs
YES -pinned YES -lazyDnsResolve YES
add cache policy cache_ppt_new -rule "REQ.HTTP.URL == /*.pptx" -action CACHE -
storeInGroup ppt
add cache policy cache_search_page -rule "REQ.HTTP.URL ==
/searchcenter/Pages/default.aspx" -action CACHE -storeInGroup search
add cache policy cache_jpg_new -rule jpg -action CACHE -storeInGroup jpg
add cache policy cache_homepage -rule "REQ.HTTP.URL == /Pages/default.aspx" -action
CACHE -storeInGroup Home_page
add cache policy cache_jpeg -rule jpeg -action CACHE -storeInGroup images
add cache policy cache_gif -rule gif -action CACHE -storeInGroup images
add cache policy cache_css -rule css -action CACHE -storeInGroup css
add cache policy cache_js -rule js -action CACHE -storeInGroup javascript
add cache policy cache_js_content_type -rule js_content_type -action CACHE -storeInGroup
javascript
set vpn parameter -splitDns BOTH -proxyLocalBypass DISABLED -forceCleanup none -
clientOptions all -clientConfiguration all -SSO OFF -clientDebug OFF
bind cache global cache_ppt_new -priority 1 -precedeDefRules YES
bind cache global cache_search_page -priority 2 -precedeDefRules YES
bind cache global cache_jpg_new -priority 3 -precedeDefRules YES
bind cache global cache_homepage -priority 4 -precedeDefRules YES
bind cache global cache_jpeg -priority 20 -precedeDefRules YES
bind cache global cache_gif -priority 30 -precedeDefRules YES
bind cache global cache_css -priority 50 -precedeDefRules YES
bind cache global cache_js -priority 60 -precedeDefRules YES
bind cache global cache_js_content_type -priority 120 -precedeDefRules YES
bind vpn global -intranetApplication route_migrate_1
set lb sipParameters -retryDur 120 -addRportVip ENABLED
set responder param -undefAction NOOP
set rewrite param -undefAction NOREWRITE
set ns hostName ns
```

Appendix B – Citrix WANScaler Configuration

Both WANScaler appliances were fitted with management IP addresses and VLAN information appropriate to the test lab in Redmond.

Citrix WANScaler requires relatively little configuration apart from the default configuration. This section focuses only on the configuration changes made in preparation for the tests detailed in this document.

Service Class	Flow Control	Compression
HTTP/S	Checked	Disk
Unclassified TCP	Checked	Disk

Appendix C – Microsoft Application Center Test Workflows

Microsoft SharePoint utilizes various pages and sites that are accessed via HTTP or HTTPS. The following four pages reflect the most commonly accessed pages in the Microsoft production SharePoint environment:

Workflow	Description
MySite	Personalized home page for a user
Search Query	Page to submit search queries against the SharePoint environment
WSS Document Library	Page enumerates and lists shared documents
WSS Team Site	Home Page for a specific team

As users commonly upload or download shared documents in a SharePoint document library, the tests included the following file download scenarios:

File Size	File Type
1.24 MByte	PDF
4.33 MByte	PDF
17.344 MByte	PDF
1 MByte	Microsoft Word Document
3 MByte	Microsoft Word Document
12.14 MByte	Microsoft Word Document

Sharepoint File Transfer Time Comparison 90 millisecond Delay

File Size	Bandwidth	WANScaler Disabled Download Time in Seconds, 0% Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 0 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, 0 % Packet Loss	WANScaler Disabled Download Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, .1 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, .1 % Packet Loss	WANScaler Disabled Download Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, 1 % Packet Loss	WANScaler Disabled Download Time in Seconds, 5 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 5 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, 5 % Packet Loss
1.24 MB .pdf	1.5 Mbps	6.85	1	1	6.9	1	0.1	10.49	1	0.1	22	2	0.1
4.33 MB .pdf	1.5 Mbps	24.17	20	1	25	17	1	30	18	1	81	21	0.1
17.344 MB .pdf	1.5 Mbps	99.08	38	2	102	35	2	129	37	2	312	40	2
1 MB .doc	1.5 Mbps	5.4	1	0.5	5.6	0.5	0.1	6.7	2	0.1	12	2	0.1
3 MB .doc	1.5 Mbps	17.04	2	0.5	17.6	1	0.1	22	2	0.1	54	4	0.5
12.14 MB .doc	1.5 Mbps	69.84	10	1	71	11	1	88	7	1	222	10	1
1.24 MB .pdf	6 Mbps	2	0.5	0.1	3.4	2	0.5	7	1	0.1	18	1	0.1
4.33 MB .pdf	6 Mbps	8.3	4	1	9	8	1	28	6	1	68	1	0.1
17.344 MB .pdf	6 Mbps	35.4	12	2	37	12	2	110	14	2	290	5	1
1 MB .doc	6 Mbps	1.29	0.5	0.1	1.7	1	0.1	6	1	0.1	8	2	0.1
3 MB .doc	6 Mbps	5.73	0.5	0.1	7.7	3	0.5	18	1	0.1	41	12	1
12.14 MB .doc	6 Mbps	24.89	2	1	27.1	5	1	61	4	1	194	17	1
1.24 MB .pdf	44 Mbps	1.4	0.5	0.1	1.9	0.5	0.1	4	0.1	0.1	18	0.5	0.1
4.33 MB .pdf	44 Mbps	6.5	1	1	6.4	1	0.1	33	1	0.5	64	1	1
17.344 MB .pdf	44 Mbps	28	2	2	37.5	2	1.5	95	3	2	273	2	2

File Size	Bandwidth	WANScaler Disabled Download Time in Seconds, 0% Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 0 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, 0 % Packet Loss	WANScaler Disabled Download Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, .1 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, .1 % Packet Loss	WANScaler Disabled Download Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, 1 % Packet Loss	WANScaler Disabled Download Time in Seconds, 5 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 5 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, 5 % Packet Loss
1 MB .doc	44 Mbps	1.3	0.5	0.1	2	0.5	0.1	7	0.1	0.1	13	0.1	0.1
3 MB .doc	44 Mbps	4.6	0.5	0.1	6.8	0.5	0.1	17	0.5	0.5	50	1	1
12.14 MB .doc	44 Mbps	19.6	1	0.5	23.3	0.5	0.1	66	2	2	200	1	0.5

Sharepoint File Transfer Time Comparison 200 millisecond Delay RTT

File Size	Bandwidth	Download Time in Seconds, 0% Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 0 % Packet Loss	Download 2nd pass Time in Seconds, 0 % Packet Loss	WANScaler Disabled Download Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, .1 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, .1 % Packet Loss	WANScaler Disabled Download Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, 1 % Packet Loss	WANScaler Disabled Download Time in Seconds, 5 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 5 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, 5 % Packet Loss
1.24 MB .pdf	1.5 Mbps	7	1	0.1	9	2	0.1	16	1	0.1	43	1	0.1
4.33 MB .pdf	1.5 Mbps	26	18	1	27	19	1	57	18	1	147	20	1
17.344 MB .pdf	1.5 Mbps	98	33	2	124	38	2	198	33	2	520	38	2
1 MB .doc	1.5 Mbps	7	1	0.1	8	0.5	0.1	7	0.5	0.1	34	1	0.1
3 MB .doc	1.5 Mbps	17	1	0.1	17	1	0.1	31	5	1	106	2	0.1
12.14 MB .doc	1.5 Mbps	75	11	1	81	11	1	158	12	1	425	12	1
1.24 MB .pdf	6 Mbps	4	1	0.1	4	0.5	0.1	8	0.5	0.1	32	1	0.1
4.33 MB .pdf	6 Mbps	17	5	0.1	17	5	1	51	5	1	138	4	1
17.344 MB .pdf	6 Mbps	65	13	2	92	13	2	193	13	2	602	12	2
1 MB .doc	6 Mbps	3	0.5	0.1	3	0.5	0.1	14	1	0.1	26	0.5	0.1
3 MB .doc	6 Mbps	11	1	0.1	12	1	0.1	35	1	0.1	93	1	0.1
12.14 MB .doc	6 Mbps	46	3	1	57	3	1	24	3	1	367	4	1
1.24 MB .pdf	44 Mbps	4	0.5	0.1	4	1	0.1	14	1	0.1	36	1	0.1
4.33 MB .pdf	44 Mbps	14	1	0.1	17	1	0.1	47	1	0.5	126	3	1
17.344 MB .pdf	44 Mbps	57	2	0.1	88	4	2	108	5	2	510	6	2
1 MB .doc	44 Mbps	3	0.1	0.1	3	0.5	0.1	9	1	0.1	30	1	0.1
3 MB .doc	44 Mbps	12	1	0.1	12	1	0.1	49	1	0.1	103	2	0.5
12.14 MB .doc	44 Mbps	40	1	0.1	55	1	0.1	143	1	0.5	375	4	2

Sharepoint File Transfer Time Comparison 300 millisecond delay RTT

File Size	Bandwidth	Download Time in Seconds, 0% Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 0 % Packet Loss	Download 2nd pass Time in Seconds, 0 % Packet Loss	WANScaler Disabled Download Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, .1 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, .1 % Packet Loss	WANScaler Disabled Download Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 1 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, 1 % Packet Loss	WANScaler Disabled Download Time in Seconds, 5 % Packet Loss	WANScaler Enabled Download 1st pass Time in Seconds, 5 % Packet Loss	WANScaler Enabled Download 2nd pass Time in Seconds, 5 % Packet Loss
1.24 MB .pdf	1.5 Mbps	9	1	0.1	10	2	0.1	23	1	0.1	56	1	0.1
4.33 MB .pdf	1.5 Mbps	35	21	1	45	19	0.5	62	19	1	204	18	1
17.344 MB .pdf	1.5 Mbps	158	37	2	157	36	2	355	37	2	849	38	3
1 MB .doc	1.5 Mbps	11	0.5	0.1	13	1	0.1	14	0.5	0.1	37	1	0.1
3 MB .doc	1.5 Mbps	26	1	0.1	29	2	0.5	52	1	0.1	128	2	0.1
12.14 MB .doc	1.5 Mbps	94	8	2	102	11	2	247	11	0.5	596	12	1
1.24 MB .pdf	6 Mbps	6	1	0.1	8	1	0.1	17	1	0.1	48	1	0.1
4.33 MB .pdf	6 Mbps	24	5	0.5	31	5	0.1	73	6	1	221	6	0.5
17.344 MB .pdf	6 Mbps	95	13	2	105	13	1	330	14	3	787	17	3
1 MB .doc	6 Mbps	4	1	0.1	4	0.5	0.1	12	1	0.1	31	1	0.1
3 MB .doc	6 Mbps	15	1	0.1	15	1	0.1	48	1	0.1	151	1	0.1
12.14 MB .doc	6 Mbps	64	3	0.5	68	3	0.1	227	7	2	534	3	1
1.24 MB .pdf	44 Mbps	6	0.1	0.1	6	1	0.1	20	1	0.1	38	1	0.1
4.33 MB .pdf	44 Mbps	21	1	0.1	31	2	0.1	83	2	0.1	186	4	0.5
17.344 MB .pdf	44 Mbps	85	2	0.1	133	5	0.5	285	4	0.1	760	10	3
1 MB .doc	44 Mbps	4	1	0.1	4	1	0.1	13	0.1	0.1	34	1	0.1
3 MB .doc	44 Mbps	14	1	0.1	20	1	0.1	41	2	0.1	108	2	0.1
12.14 MB .doc	44 Mbps	59	1	0.1	70	2	0.1	208	4	1	548	4	0.1