

CITRIX XENDESKTOP 5.5 VS. VMWARE VIEW 5: USER EXPERIENCE AND BANDWIDTH CONSUMPTION

Citrix® XenDesktop® 5.5

Provided a better remote user experience via WAN

vs. VMware® View™ 5



Organizations with remote offices that operate a virtual desktop infrastructure (VDI) over the wide area network (WAN), have discovered that bandwidth constraints can severely affect the experience remote users have running their virtual desktops. The ideal remote virtual desktop experience delivers just what a local PC would: responsiveness, crisp audio, sharp graphics, and smooth Flash video.

The virtual desktop solution (and associated protocol) you choose for your infrastructure can make all the difference in getting the high definition end-user experience and the performance you need over the WAN in a situation where bandwidth is constrained. But which virtual desktop solution makes the best use of your limited bandwidth and provides the best user experience? To find out, we compared the user experience with two VDI products – Citrix XenDesktop 5.5 and VMware View 5 – delivered over the WAN to remote users in both small and medium-sized branch office scenarios. (Note: View 5.1 was not yet available at the time of testing.) We modeled our small and medium-sized branch office scenarios on real-world data provided by Enterprise Strategy Group (ESG).¹ Using out-of-the-box default configurations, Citrix XenDesktop 5.5 provided a significantly better user experience than VMware View 5 while using up to 37.1 percent less bandwidth. When we tuned VMware View 5 using some of VMware’s suggested settings, XenDesktop still provided the better experience, while using up to 33.8 percent less bandwidth.

¹ Research Report: Remote Office/Branch Office Network Trends, April 2012, <http://www.esg-global.com/research-reports/research-report-remote-officebranch-office-network-trends/>. (Please note that you must have an ESG subscription to view this report.)

Enabling Citrix Branch Repeater, a feature of Citrix XenDesktop 5.5 Platinum Edition, in the Citrix XenDesktop 5.5 configuration provided a seamless user experience and maximized bandwidth over VMware View 5 by as much as 121.9 percent. Those bandwidth savings lets you further increase the number of concurrent VDI sessions without having to upgrade the network's bandwidth, use that bandwidth to improve user experience, or share any available bandwidth with other background traffic such as VoIP or HTTP traffic. Regardless of the size of your remote offices, selecting a top-performing VDI solution can deliver better experiences for remote users and maximize your bandwidth usage.

A BETTER VIRTUAL DESKTOP SESSION FOR REMOTE OFFICES

Wide area networks, or WANs, are vital when your organization has multiple branch offices. It's over the WAN that remote workers can connect to applications, servers, and services to retrieve and store data, and the WAN delivers virtual desktops to branches from the home office. In such a constrained bandwidth situation, virtual desktop performance can sometimes suffer, so it's important to choose a VDI solution capable of providing an excellent remote user experience that at the same time maximizes your network usage.

To evaluate Citrix XenDesktop 5.5 and VMware View 5, we set up tests simulating a small branch office (10 users, T1 connection) and a medium-sized branch office (100 users, T3 connection). Because virtual desktop traffic isn't the only traffic over the WAN, we allocated 50 percent of the network resources for VDI traffic and created background traffic to test user experience with a congested network. (You can find detailed information about the ESG report and the background traffic characteristics in the What We Tested section of this report.) We monitored end-users' virtual desktop experience, as the desktop completed office tasks and ran a Flash video while recording the bandwidth the VDI session consumed. Each virtual desktop ran a Medium workload from the Login VSI benchmark tool.

We found that Citrix XenDesktop 5.5 provided a better remote user experience than VMware View 5 across the board. This remained true even when we used some of the VMware-suggested settings for View 5 sessions from their optimization guide² and matched Citrix XenDesktop 5.5's frame rate. Note that we did not use all of the settings in the VMware optimization guide. We did not use QoS because the ESG data indicated that half of the bandwidth was used for things other than VDI. Citrix XenDesktop 5.5 provided this improved user experience both with and without HDX MediaStream Flash Redirection (MFR), which effectively redirects processing of Adobe® Flash® content to WAN-connected users' local devices to avoid using valuable server and network resources. When we enabled the Citrix Branch Repeater WAN optimization feature with a default installation of Citrix XenDesktop 5.5, remote user experience improved even further, delivering local-like virtual desktop sessions in both the small and medium-sized branch office scenarios.

² VMware View 5 with PCoIP: Network Optimization Guide
<http://www.vmware.com/files/pdf/view/VMware-View-5-PCoIP-Network-Optimization-Guide.pdf>

Figure 1 presents a look at overall user experience for the VDI solutions as the sessions completed the Login VSI medium workload. (Note – We recorded these sessions and have made them available for viewing online. For more information, see [Appendix D.](#))

	Default settings			Tuned	Branch Repeater	
	XD MFR on	XD MFR off	View	View	XD MFR on	XD MFR off
Small branch office scenario						
Editing in Microsoft® Word	●	●	●	●	●	●
Opening messages on Microsoft Outlook®	●	●	●	●	●	●
Navigating on Internet Explorer®	●	●	●	●	●	●
Viewing PDF file	●	●	●	●	●	●
Editing PowerPoint® slides (full screen)	●	●	●	●	●	●
Editing Excel® worksheet	●	●	●	●	●	●
Viewing Flash video	●	●	●	●	●	●
Medium-sized branch office scenario						
Editing in Microsoft Word	●	●	●	●	●	●
Opening messages on Microsoft Outlook	●	●	●	●	●	●
Navigating on Internet Explorer	●	●	●	●	●	●
Viewing PDF file	●	●	●	●	●	●
Editing PowerPoint slides (full screen)	●	●	●	●	●	●
Editing Excel worksheet	●	●	●	●	●	●
Viewing Flash video	●	●	●	●	●	●
Key to user experience assessment						
●	●	●	●	●	●	●
Excellent	Very good	Good	Adequate	Poor		

Figure 1: experience for the VDI solutions (XD = XenDesktop and MFR = Media Flash redirection).

Comparing default configurations of Citrix XenDesktop 5.5 and VMware View 5

Small branch office scenario

When we compared the two out-of-the box VDI solutions in our 10-user, small branch office scenario, we found that Citrix XenDesktop 5.5 provided a significantly better remote user experience than VMware View 5 did. Citrix XenDesktop 5.5, with media Flash redirection both on and off, had no difficulty hosting all 10 virtual desktops simultaneously. With media Flash redirection off, the Flash video and full screen updates were slow to respond. With media Flash redirection on, a few full-screen applications were somewhat delayed in updating, but the Flash video was flawless. In contrast, VMware View 5 struggled to keep all 10 sessions running, and thus had difficulty completing the workload’s tasks. With the video, View lost image quality and dropped frames at such a high rate that the session became unusable.

Figures 2 and 3 show the average VDI traffic, in Mbps, that the two solutions used to complete the 10-user workload in the small branch office scenario. Supporting 10 users on a T1 WAN connection, Citrix XenDesktop 5.5 with media Flash redirection off used 5.6 percent less bandwidth than VMware View 5, and Citrix XenDesktop 5.5 with media Flash redirection on used 16.3 percent less bandwidth.

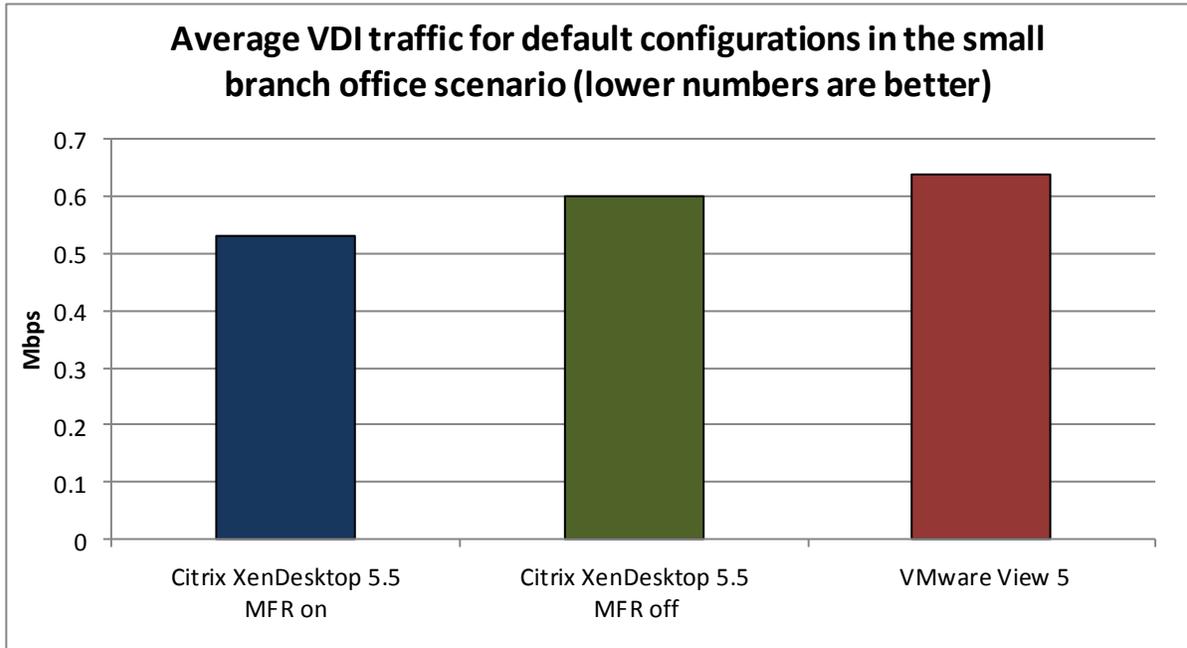


Figure 2: Average VDI traffic for the default configurations in the small branch office scenario. Less bandwidth consumption is better.

	Average VDI traffic (Mbps)	Percentage bandwidth savings over VMware View 5
Citrix XenDesktop 5.5 MFR on	0.53	16.3%
Citrix XenDesktop 5.5 MFR off	0.60	5.6%
VMware View 5	0.64	

Figure 3: The average bandwidth consumption of VDI traffic, in Mbps, for the solutions using default configurations in the small branch office scenario.

Medium-sized branch office scenario

When we compared the two out-of-the box VDI solutions in our 100-user, medium-sized branch office scenario, we found that Citrix XenDesktop 5.5 once again provided a better end-user experience than VMware View 5. With media Flash redirection off, the XenDesktop session completed the tasks adequately, with the exception of Flash video, which struggled to begin, losing frames in the process. With media Flash redirection on, the Citrix XenDesktop 5.5 session mirrored a local desktop session in quality, with most screen updates fast and uniform. With media Flash redirection on, the Flash video was flawless. As in the small branch office scenario, the VMware View 5 session displayed several

problems, including difficulties with screen updates, choppy Flash video with a large number of lost frames, and difficulties using PowerPoint in full-screen mode.

Figures 4 and 5 show the average VDI traffic, in Mbps, that the VDI solutions used to complete the 100-user workload in the medium-sized branch office scenario. Supporting 100 users on a T3 WAN connection, Citrix XenDesktop 5.5 with media Flash redirection off used 12.0 percent less bandwidth than VMware View 5, and Citrix XenDesktop 5.5 with media Flash redirection reduced bandwidth usage by 37.1 percent.

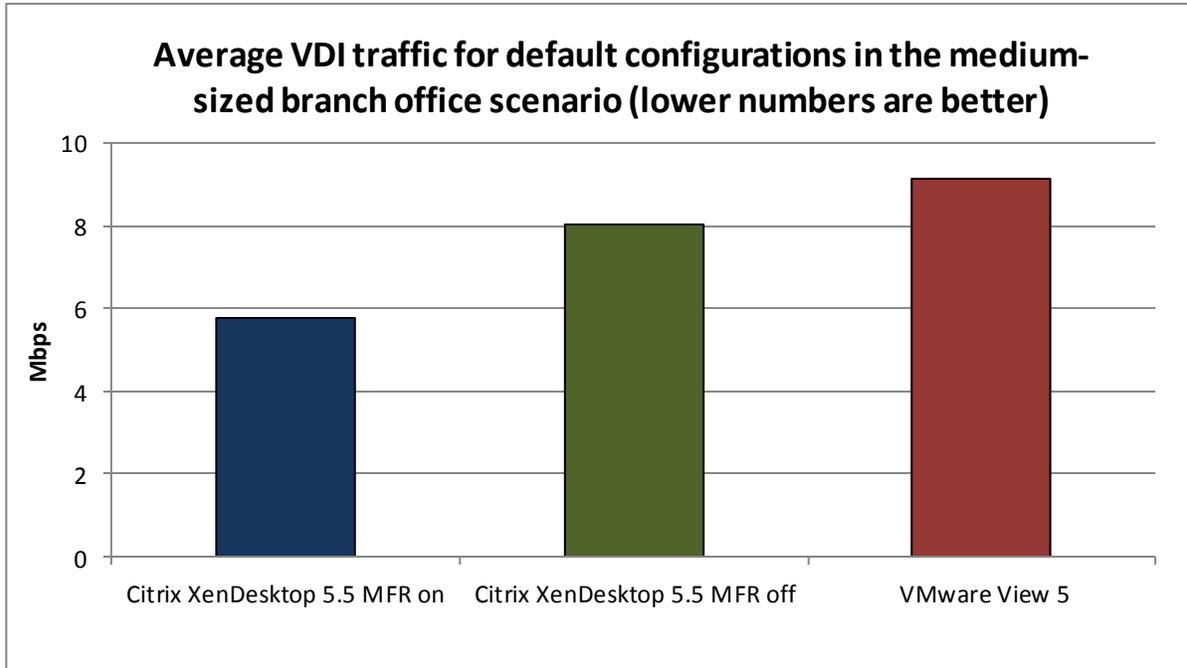


Figure 4: Average VDI traffic for the default configurations in the small branch office scenario. Less bandwidth consumption is better.

	Average VDI traffic (Mbps)	Percentage bandwidth savings over VMware View 5
Citrix XenDesktop 5.5 MFR on	5.76	37.1%
Citrix XenDesktop 5.5 MFR off	8.05	12.0%
VMware View 5	9.15	

Figure 5: The average bandwidth consumption of VDI traffic, in Mbps, for the solutions using default configurations in the medium-sized branch office scenario.

Comparing Citrix XenDesktop 5.5 and tuned VMware View 5 Small branch office scenario

Out-of-the-box, Citrix XenDesktop 5.5 provided a better user experience than VMware View 5. What would happen if we tuned View to maximize its performance, and how would user experience and bandwidth consumption compare to XenDesktop with default setting? To find out, we tuned VMware

View 5 following VMware recommendations,³ disabling the build-to-lossless setting, changing the quality image to 40min-70max, and dropping the frames per second from 30 to 24. With 10 users, the tuned View 5 desktop session was still slow to respond, and had numerous pixilation issues on nearly all screen updates. The Flash video was unwatchable.

Figures 6 and 7 show the average VDI traffic, in Mbps, that the VDI solutions used to complete the 10-user workload in the small branch office scenario. Supporting 10 users on a T1 WAN connection, Citrix XenDesktop 5.5 with media Flash redirection off used 2.6 percent less bandwidth than the tuned VMware View 5 configuration, and Citrix XenDesktop 5.5 with media Flash redirection on saved 13.5 percent bandwidth compared to the VMware View 5 with tuning.

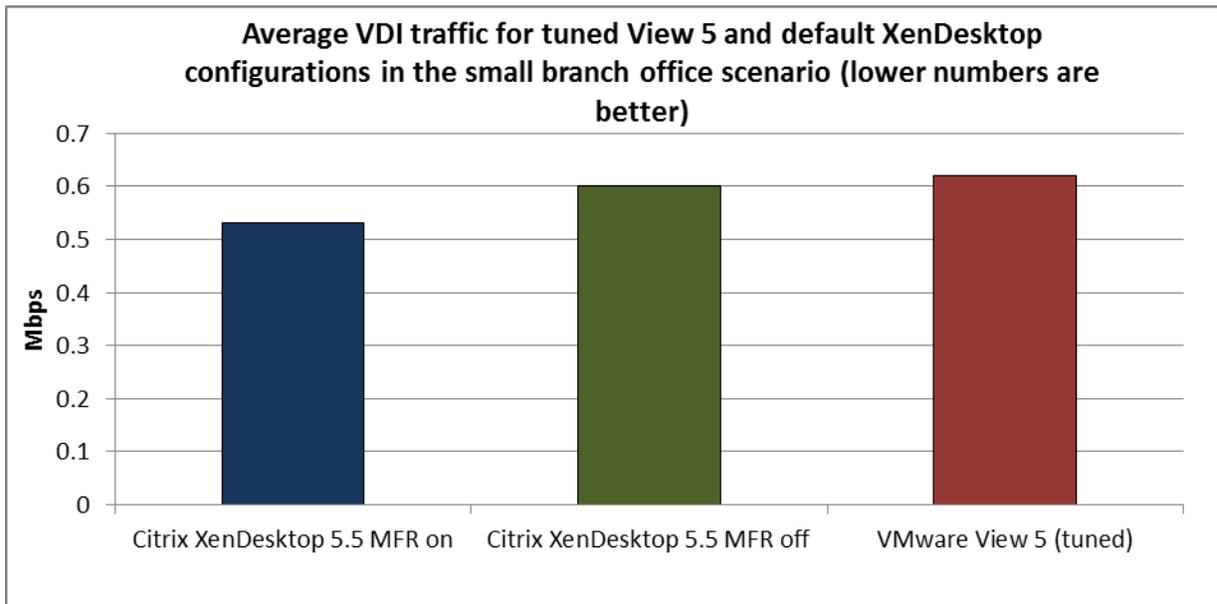


Figure 6: Average VDI traffic for the default Citrix XenDesktop 5.5 configurations and tuned VMware View 5 configuration in the small branch office scenario. Less bandwidth consumption is better.

	Average VDI traffic (Mbps)	Percentage bandwidth savings over VMware View 5 (tuned)
Citrix XenDesktop 5.5 MFR on	0.53	13.5%
Citrix XenDesktop 5.5 MFR off	0.60	2.5%
VMware View 5 (tuned)	0.62	

Figure 7: The average bandwidth consumption of VDI traffic, in Mbps, for the solutions using a tuned VMware View 5 configuration and the default Citrix XenDesktop 5.5 configuration in the small branch office scenario.

³ VMware View 5 with PCoIP: Network Optimization Guide
<http://www.vmware.com/files/pdf/view/VMware-View-5-PCoIP-Network-Optimization-Guide.pdf>

Medium-sized branch office scenario

Compared to the XenDesktop default configurations, the tuned View 5 configuration provided a worse user experience supporting 100 users under restricted bandwidth conditions. While tuning View 5 improved the user experience from the default View configuration, the Flash video was choppy and lost a number of frames, and full screen applications were slow to update.

Figures 8 and 9 show the average VDI traffic, in Mbps, that the VDI solutions used to complete the 100-user workload in the medium-sized branch office scenario. Supporting 100 users on a T3 WAN connection, Citrix XenDesktop 5.5 with media Flash redirection off used 7.5 percent less bandwidth than the tuned VMware View 5 configuration, and Citrix XenDesktop 5.5 with media Flash redirection on used 33.8 percent less bandwidth than to the VMware View 5 with tuned settings.

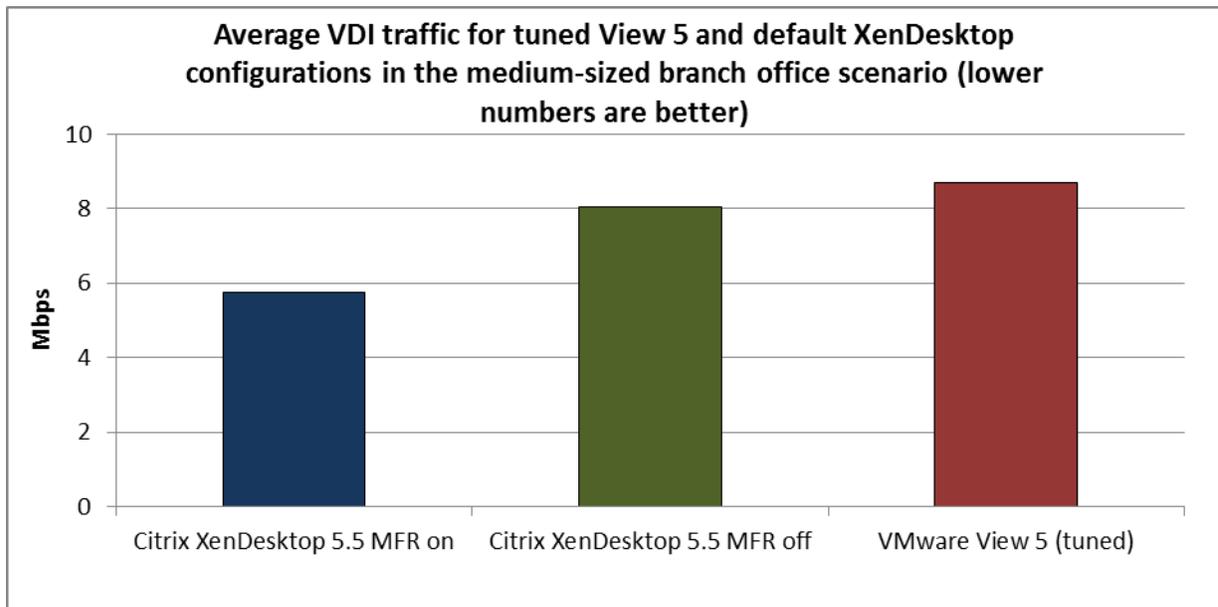


Figure 8: Average VDI traffic for the default Citrix XenDesktop 5.5 configurations and tuned VMware View 5 configuration in the medium-sized branch office scenario. Less bandwidth consumption is better.

	Average VDI traffic (Mbps)	Percentage bandwidth savings over VMware View 5 (tuned)
Citrix XenDesktop 5.5 MFR on	5.76	33.8%
Citrix XenDesktop 5.5 MFR off	8.05	7.5%
VMware View 5 (tuned)	8.70	

Figure 9: The average bandwidth consumption of VDI traffic, in Mbps, for the solutions using a tuned VMware View 5 configuration and the default Citrix XenDesktop 5.5 configuration in the medium-sized branch office scenario.

Comparing Citrix XenDesktop 5.5 with Branch Repeater and tuned VMware View 5

Unlike VMware View 5 Premier, which doesn't provide customers with a WAN optimization tool, XenDesktop Platinum includes Branch Repeater VPX a WAN optimization solution designed to accelerate HDX traffic and improve the quality of remote virtual desktop sessions at no additional cost. Branch Repeater seamlessly integrates with XenDesktop 5.5 and allows you to control traffic flow, improve desktop quality, and manage network resources more efficiently. With multiple deployment options, the ability to plug and play into any network, and technologies for data compression, fair queuing, QoS, and protocol optimization, all while maintaining end-to-end high levels of security, Citrix Branch Repeater can help you get the most out of your WAN. For more information, visit <http://www.citrix.com/branchrepeater>.

Note: In tests using Citrix Branch Repeater, higher bandwidth numbers are better, as they indicate the Branch Repeater increased overall network throughput using a mix of optimization technologies such as data compression, protocol optimization, and QoS. Such efficient use of network resources is highly desirable where VDI traffic must be prioritized in the presence of other traffic sharing the same link.

Small branch office scenario

Citrix XenDesktop 5.5 with Branch Repeater VPX WAN optimization improved the user experience of virtual desktop sessions in our 10-user test. With media Flash redirection off, the screen updates had minimal delays and the Flash video lost only a few frames. Using Branch Repeater with media Flash redirection improved the experience even more: screen updates were fast and uniform, and the session had the look and feel of a local VDI session. Compared to the tuned VMware View 5 configuration, Citrix XenDesktop 5.5 with Branch Repeater provided a significantly better user experience.

Figures 10 and 11 show the average VDI traffic, in Mbps, that the VDI solutions used to complete the 10-user workload in the small branch office scenario. Supporting 10 users on a T1 WAN connection, Citrix XenDesktop 5.5 with media Flash redirection on and Branch Repeater increased available bandwidth by 89.9 percent more than the tuned VMware View 5 configuration, and Citrix XenDesktop 5.5 with media Flash redirection off and Branch Repeater increased network throughput by 121.9 percent compared to the VMware View 5 with tuned settings.

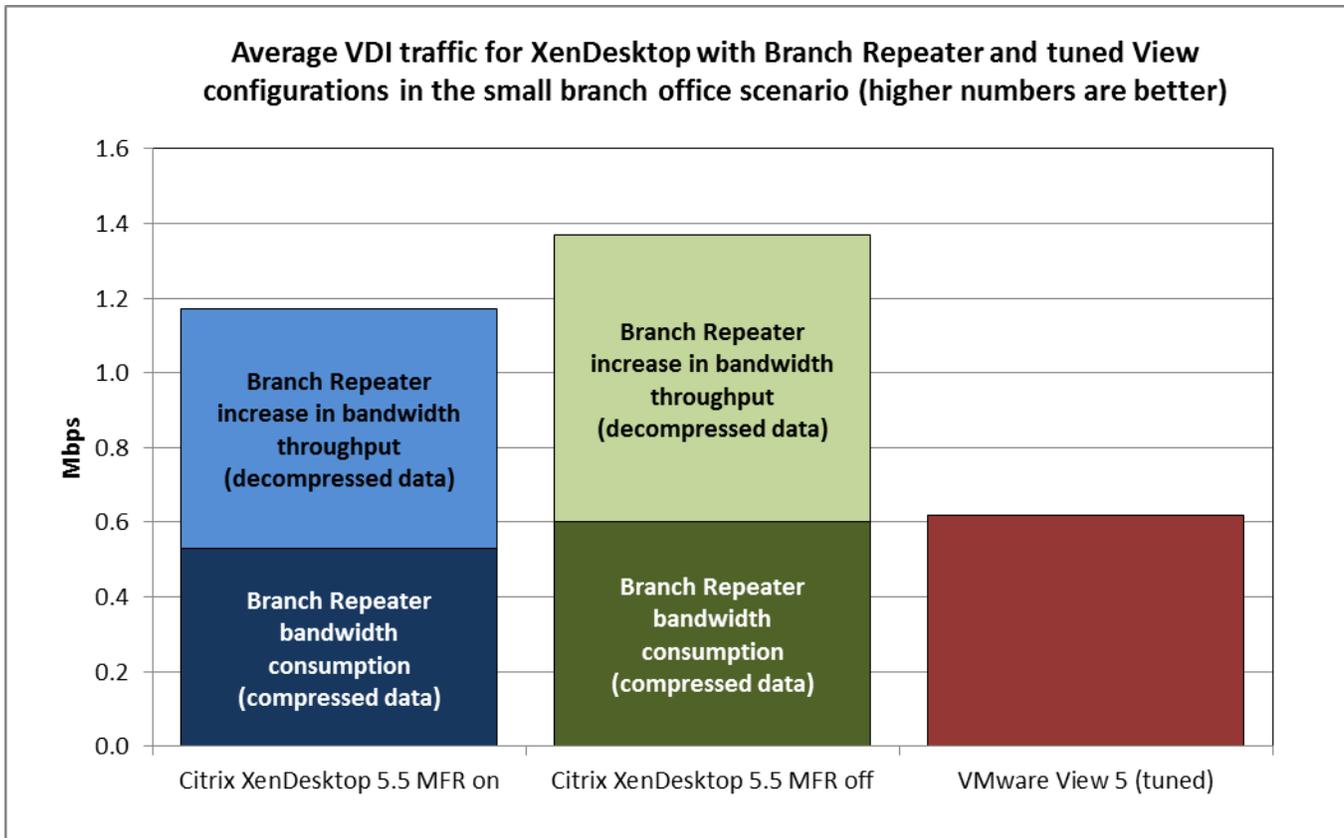


Figure 10: Average VDI traffic for Citrix XenDesktop 5.5 and Branch Repeater configurations and tuned VMware View 5 configuration in the small branch office scenario. More bandwidth is better.

	Branch Repeater bandwidth consumption (compressed data)	Branch Repeater increase in bandwidth throughput (decompressed data)	Total data
Citrix XenDesktop 5.5 MFR on	0.53	0.64	1.17
Citrix XenDesktop 5.5 MFR off	0.60	0.77	1.37
VMware View 5 (tuned)			0.62

Figure 11: The average bandwidth consumption of VDI traffic, in Mbps, for the solutions using a tuned VMware View 5 configuration and Citrix XenDesktop 5.5 configuration with Branch Repeater in the small branch office scenario.

Medium-sized branch office scenario

In our 100-desktop test, Citrix XenDesktop with Branch Repeater provided an excellent user experience, with media Flash redirection both on and off. Screen updates were fast and uniform, with minimal delays and a few lost frames with media Flash redirection off, and both sessions had the look and feel of a local VDI session. Compared to the tuned VMware View 5 configuration, Citrix XenDesktop 5.5 with Branch Repeater provided a significantly better user experience.

Figures 12 and 13 show the average VDI traffic, in Mbps, that the VDI solutions used to complete the 100-user workload in the medium-sized branch office scenario. Supporting 100 users on a T3 WAN connection, Citrix XenDesktop 5.5 with media Flash redirection on and Branch Repeater increased

available bandwidth by 17.2 percent more than the tuned VMware View 5 configuration, and Citrix XenDesktop 5.5 with media Flash redirection off and Branch Repeater increased bandwidth availability by 56.5 percent compared to VMware View 5 with tuning.

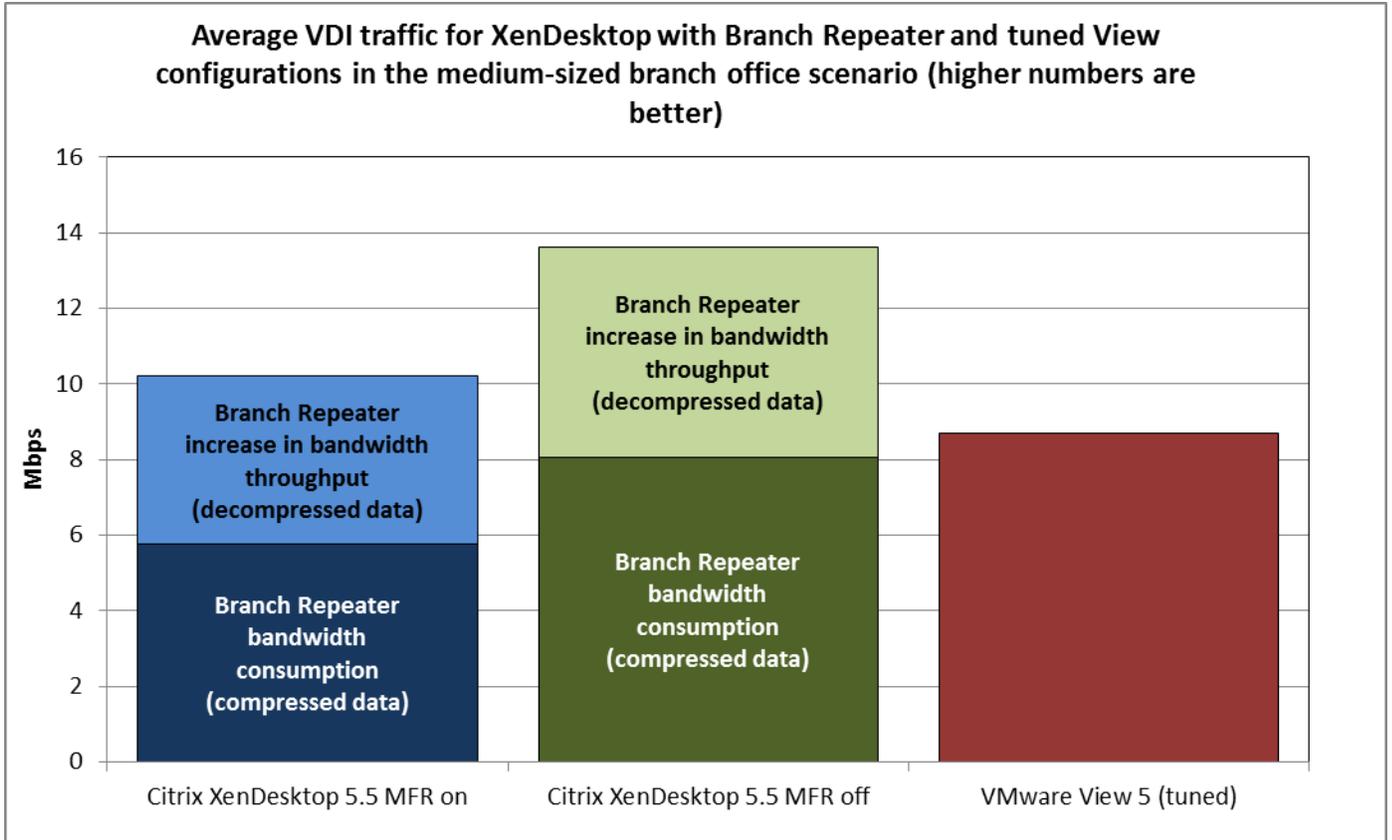


Figure 12: Average VDI traffic for Citrix XenDesktop 5.5 and Branch Repeater configurations and tuned VMware View 5 configuration in the medium-sized branch office scenario. More bandwidth is better.

	Branch Repeater bandwidth consumption (compressed data)	Branch Repeater increase in bandwidth throughput (decompressed data)	Total data
Citrix XenDesktop 5.5 MFR on	5.76	4.44	10.20
Citrix XenDesktop 5.5 MFR off	8.05	5.57	13.62
VMware View 5 (tuned)			8.70

Figure 13: The average bandwidth consumption of VDI traffic, in Mbps, for the solutions using a tuned VMware View 5 configuration and Citrix XenDesktop 5.5 configuration with Branch Repeater in the medium-sized branch office scenario.

WHAT WE TESTED

We used data from an ESG network study to determine typical network settings for both small and medium branch offices. Based on this data, we chose to set up our branch office scenarios with the settings in Figure 14.

	Number of users	Connection	Delay (ms)	Package loss
Small branch office	10	T1 (1.544 Mbps)	75	2%
Medium-sized branch office	100	T3 (43.232 Mbps)	75	1%

Figure 14: Network settings for the scenarios we tested.

We applied network caps and emulated network conditions using a Linktropy® Mini2 WAN emulator.

Since VDI traffic is generally not the only traffic sharing these remote office connections, we created a stream of random background traffic to take about 50 percent of total available bandwidth. The remaining 50 percent was available for VDI traffic.

We created random background traffic using publicly available sample captures⁴ containing equal percentages of Server Message Block (SMB)/Common Internet File System (CIFS), HyperText Transport Protocol (HTTP) and MAPI traffic. We used Tcpreplay to replay the background stream onto the network.

We captured video of the sessions using a full-size workstation to ensure that we were viewing the real end user experience of a user logging in into an already congested network.

During the small branch office scenario, the first nine sessions log into a virtual host and session 10 logs into the full-size workstation. During the medium-sized branch office scenario, the first 99 sessions log into virtual hosts and session 100 logs into the full-size workstation.

Sessions launch individually every 30 seconds, and once all sessions are active, they stay logged in for about 12 minutes. After 12 minutes, sessions begin logging off.

For information about the servers we used in our testing, see [Appendix A](#). For detailed bandwidth consumption data for our tests, see [Appendix B](#). For our detailed test methodology, see [Appendix C](#).

Login VSI 3.5 medium workload

The Login VSI 3.5 medium workload (with Flash) simulates a medium-level knowledge worker using Microsoft Office, Internet Explorer, and PDFs. This workload completes the following tasks in different applications:

- Microsoft Outlook: Browsing a message
- Microsoft Word (TimerDoc): Initiate response timer to see how the program responds throughout the workload

⁴ <http://wiki.wireshark.org/SampleCaptures>

- Microsoft Internet Explorer instance one: Maximizing, scrolling, and minimizing
- Microsoft Internet Explorer instance two: Navigating a Web site, maximizing, and scrolling
- Adobe® Flash®: Viewing a movie trailer
- Microsoft Word (UserRead): Reading and typing text, and printing to PDF
- Bullzip: Generating a PDF
- Adobe Reader®: Reading a PDF
- Microsoft PowerPoint: Watching a presentation and adding a slide
- Microsoft Excel: Reading and minimizing
- 7-Zip: Saving a ZIP file

IN CONCLUSION

The experience that virtual desktops provide for workers is critical. If a user's desktop is sluggish, or worse, choppy and difficult to navigate, working becomes difficult. Choosing a virtual desktop solution that provides sluggish, choppy desktops to remote end-users in branch offices defeats the purpose of implementing such a solution in the first place.

In both the small and medium-sized branch office scenarios we tested, we found that Citrix XenDesktop 5.5 provided a better desktop experience for remote users than VMware View 5, and used as much as 37.1 percent less bandwidth delivering it. Using Citrix XenDesktop 5.5 with Citrix Branch Repeater provided an even better experience for remote users by optimizing bandwidth over the WAN and delivering local-like virtual desktop sessions in both our 10- and 100-user tests. When selecting a VDI solution to deploy virtual desktops over the WAN to users in remote offices, determining the type of user experience the solution provides is paramount.

APPENDIX A – SERVER CONFIGURATION INFORMATION

Figure 15 provides detailed configuration information for the test servers.

System	Dell™ PowerEdge™ R710 server
Power supplies	
Total number	2
Vendor and model number	Dell N870P-S0
Wattage of each (W)	870
Cooling fans	
Total number	5
Dimensions (h x w) of each	2.5" x 2.5"
Volts	12
Amps	1.60
General	
Number of processor packages	2
Number of cores per processor	6
Number of hardware threads per core	2
System power management policy	Balanced
CPU	
Vendor	Intel®
Name	Xeon®
Model number	X5680
Stepping	B1
Socket type	LGA 1366
Core frequency (GHz)	3.33
Bus frequency (MHz)	6.4 GT/s
L1 cache	32 KB + 32 KB per core
L2 cache	6 x 256 KB
L3 cache (MB)	12
Platform	
Vendor and model number	PowerEdge R710
Motherboard model number	0N047H
BIOS name and version	6.1.0
BIOS settings	Default
Memory module(s)	
Total RAM in system (GB)	160
Vendor and model number	Kingston KTH-PL310Q/16G
Type	PC3-8500
Speed (MHz)	1066
Speed running in the system (MHz)	1067
Timing/Latency (tCL-tRCD-tRP-tRASmin)	7-7-7-34.7
Size (GB)	16
Number of RAM module(s)	10
Chip organization	Dual
Rank	

System	Dell™ PowerEdge™ R710 server
Operating system	
Name	ESXi 5.0.0 (515841)
File system	VMFS
Kernel	5.0.0
Language	English
RAID controller	
Vendor and model number	Dell PERC 6/i
Firmware version	1.22.32-1371
Hard drives	
Vendor and model number	Seagate® ST973452SS
Number of drives	4
Size (GB)	73
RPM	15,000
Type	SAS
Network card/subsystem	
Vendor and model number	Broadcom® NetXtreme®II gigE 7509C Quad-Port Ethernet
Type	Integrated
Optical drive(s)	
Vendor and model number	TEAC DV-28SV
Type	SATA
USB ports	
Number	4
Type	2.0

Figure 15: Detailed configuration information for the server.

APPENDIX B – BANDWIDTH CONSUMPTION DETAILS

Default configurations in the small branch office scenario

Figures 16 through 18 show the bandwidth consumption for the solutions with default configurations over the duration of the small branch office scenario test.

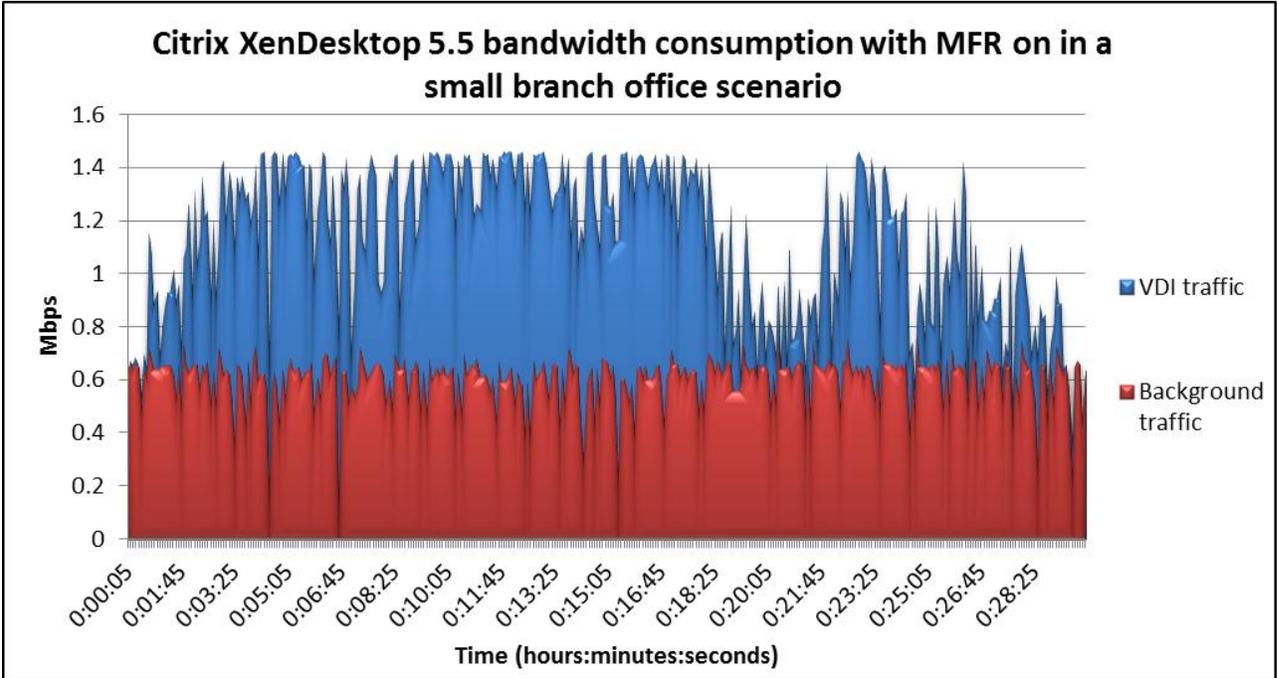


Figure 16: Bandwidth consumption in our small branch office scenario for Citrix XenDesktop 5.5 with MFR on.

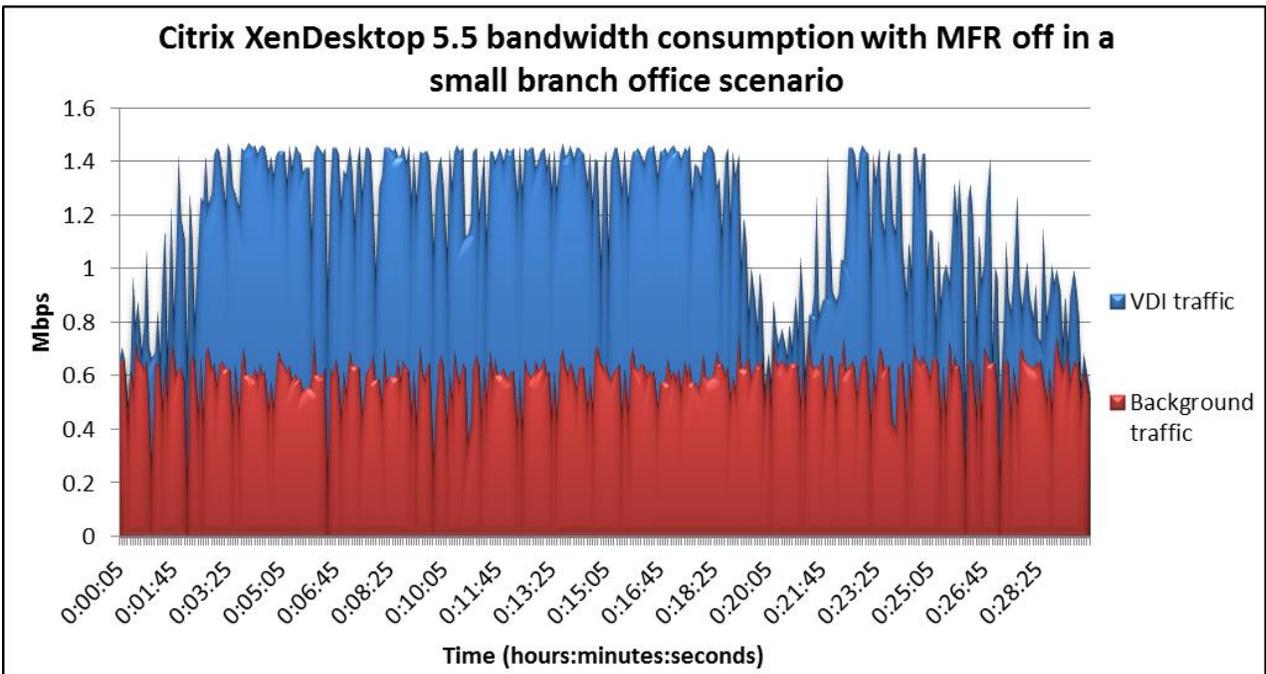


Figure 17: Bandwidth consumption in our small branch office scenario for Citrix XenDesktop 5.5 with MFR off.

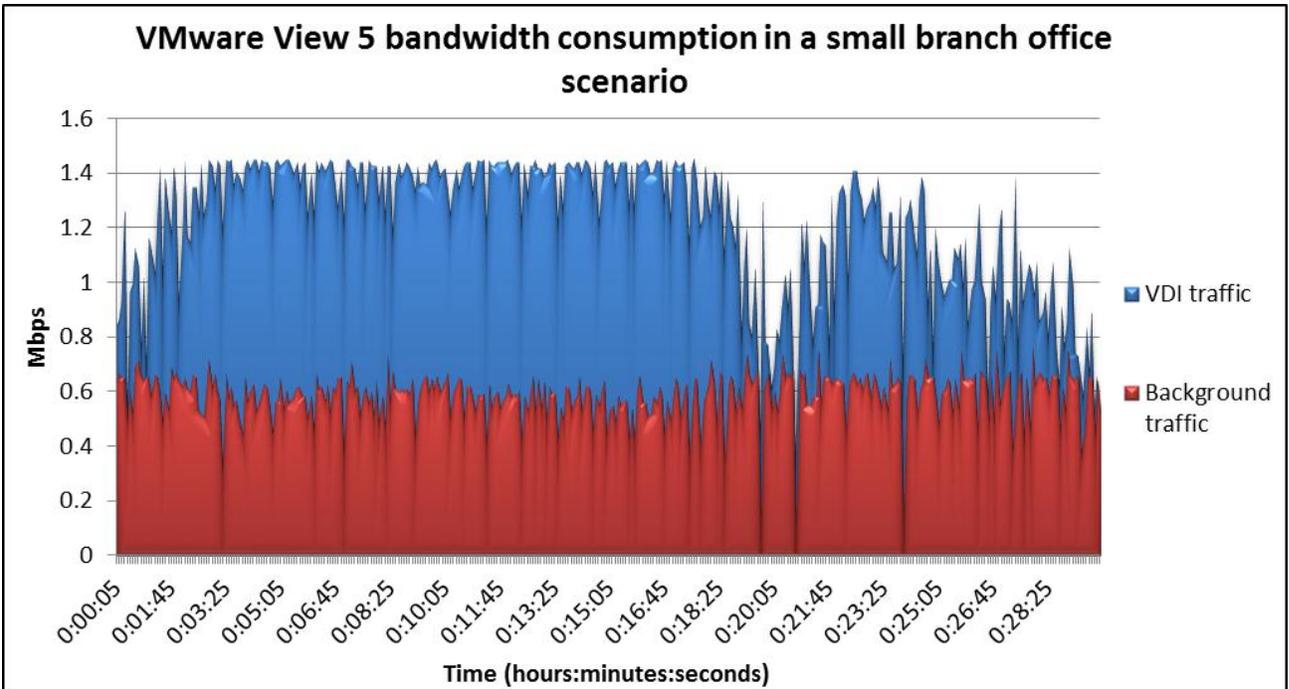


Figure 18: Bandwidth consumption in our small branch office scenario for VMware View 5.

Default configurations in the medium-sized branch office scenario

Figures 19 through 21 show the bandwidth consumption for the solutions with default configurations over the duration of the medium-sized branch office scenario test.

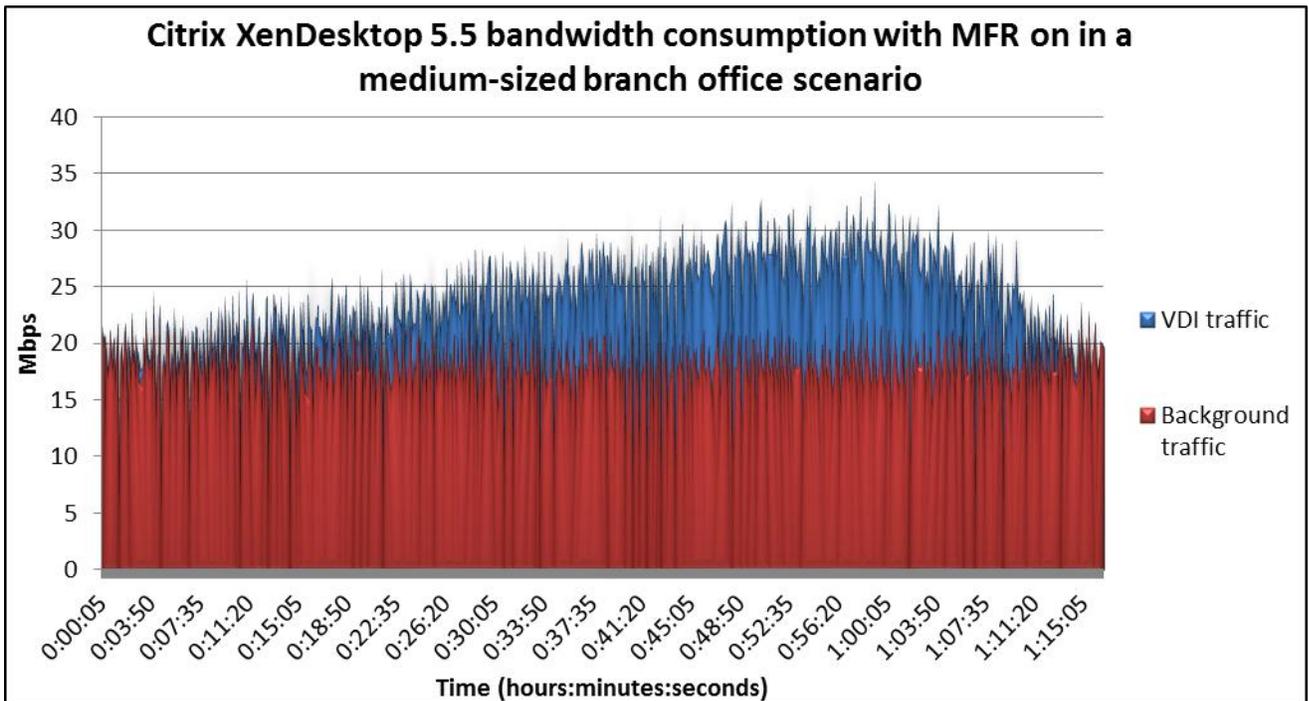


Figure 19: Bandwidth consumption in our medium-sized branch office scenario for Citrix XenDesktop 5.5 with MFR on.

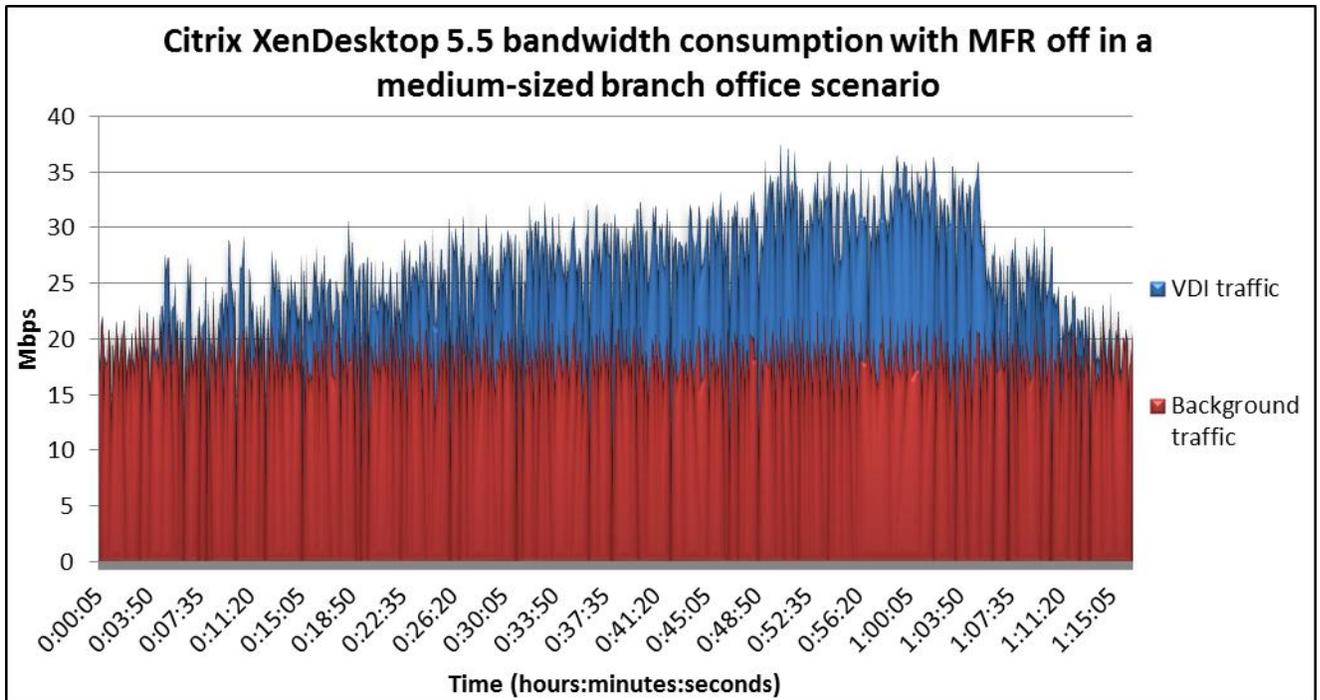


Figure 20: Bandwidth consumption in our medium-sized branch office scenario for Citrix XenDesktop 5.5 with MFR off.

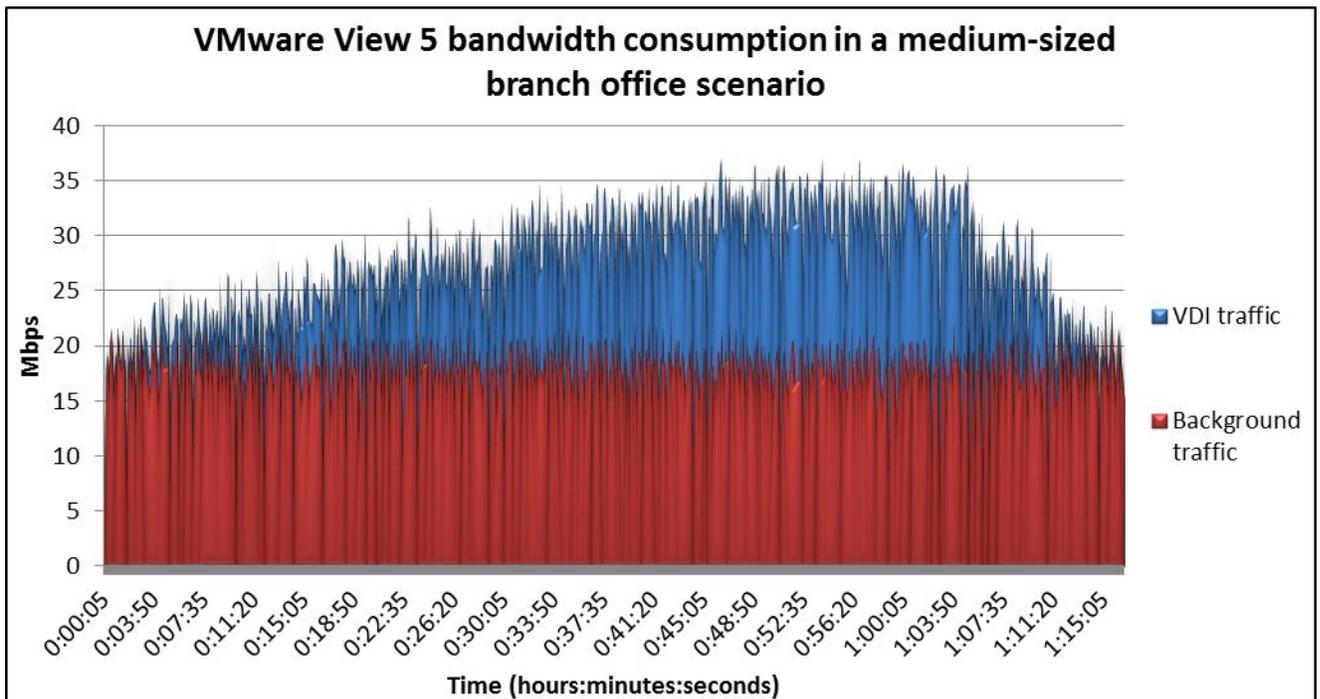


Figure 21: Bandwidth consumption in our medium-sized branch office scenario for VMware View 5.

VMware View 5 (tuned) in the small branch office scenario

Figure 22 shows the bandwidth consumption for VMware View 5 with tuned settings over the duration of the small branch office scenario test.

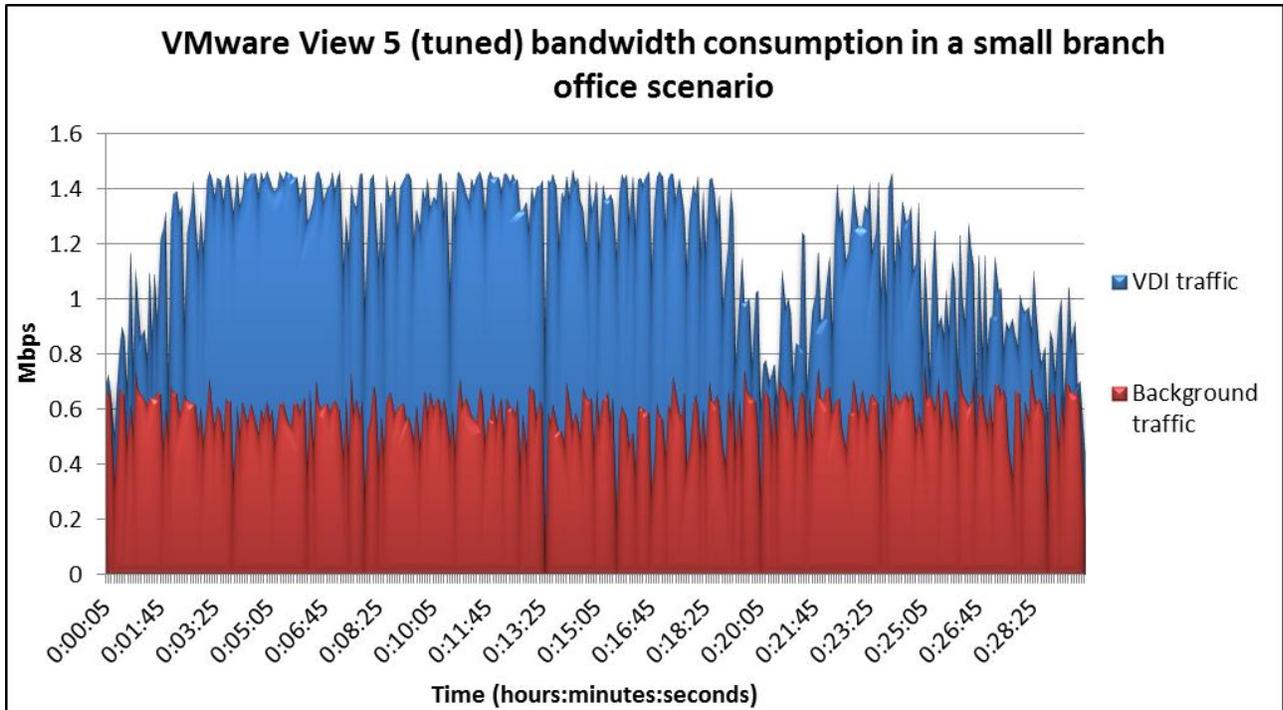


Figure 22: Bandwidth consumption in our small branch office scenario for VMware View 5 with tuning.

VMware View 5 (tuned) in the medium-sized branch office scenario

Figure 23 shows the bandwidth consumption for VMware View 5 with tuned settings over the duration of the medium-sized branch office scenario test.

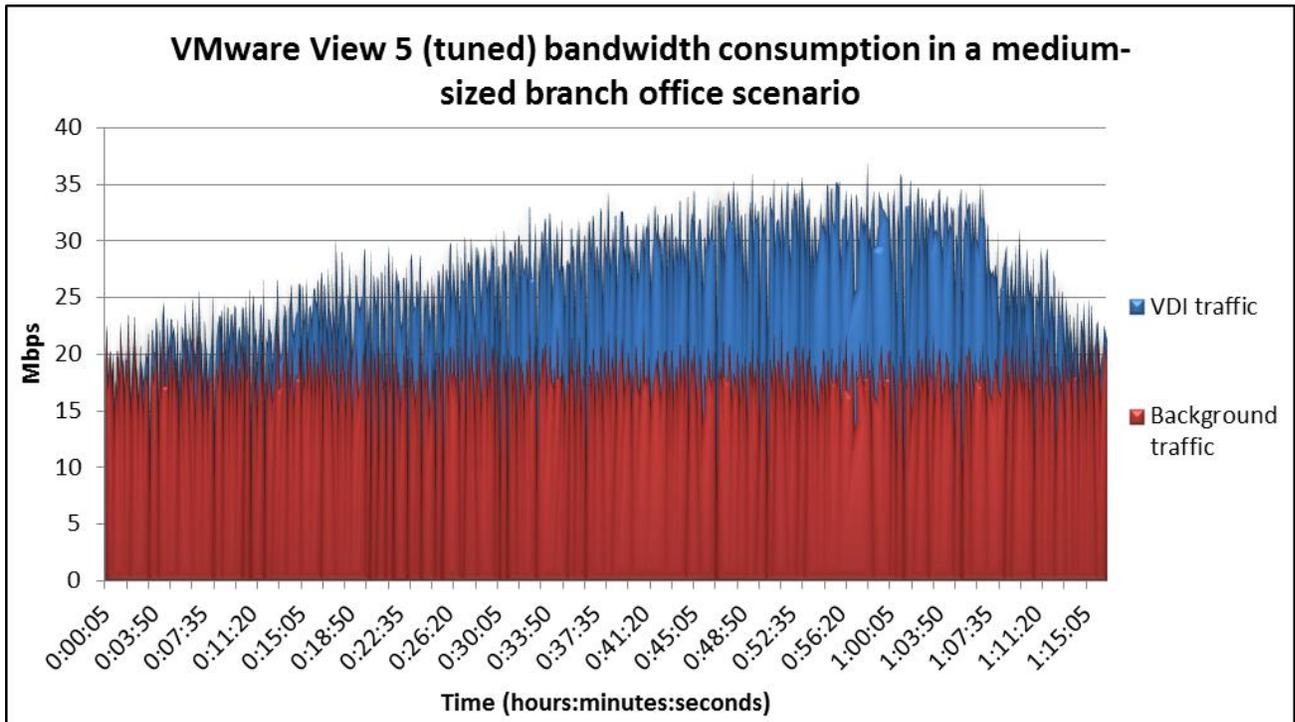


Figure 23: Bandwidth consumption in our medium-sized branch office scenario for VMware View 5 with tuning.

Citrix XenDesktop 5.5 and Branch Repeater in the small branch office scenario

Figures 24 and 25 show the bandwidth consumption for Citrix XenDesktop 5.5 with Branch Repeater over the duration of the small branch office scenario test.

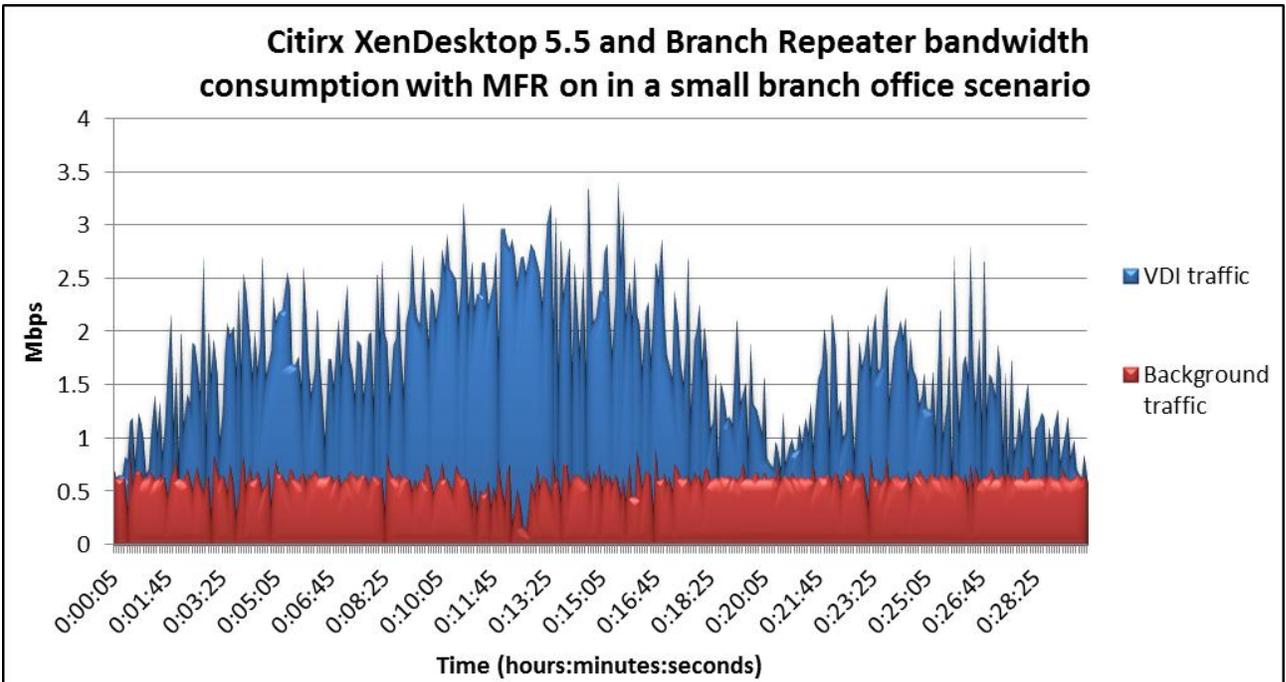


Figure 24: Bandwidth consumption in our small branch office scenario for Citrix XenDesktop 5.5 and Branch Repeater with MFR on.

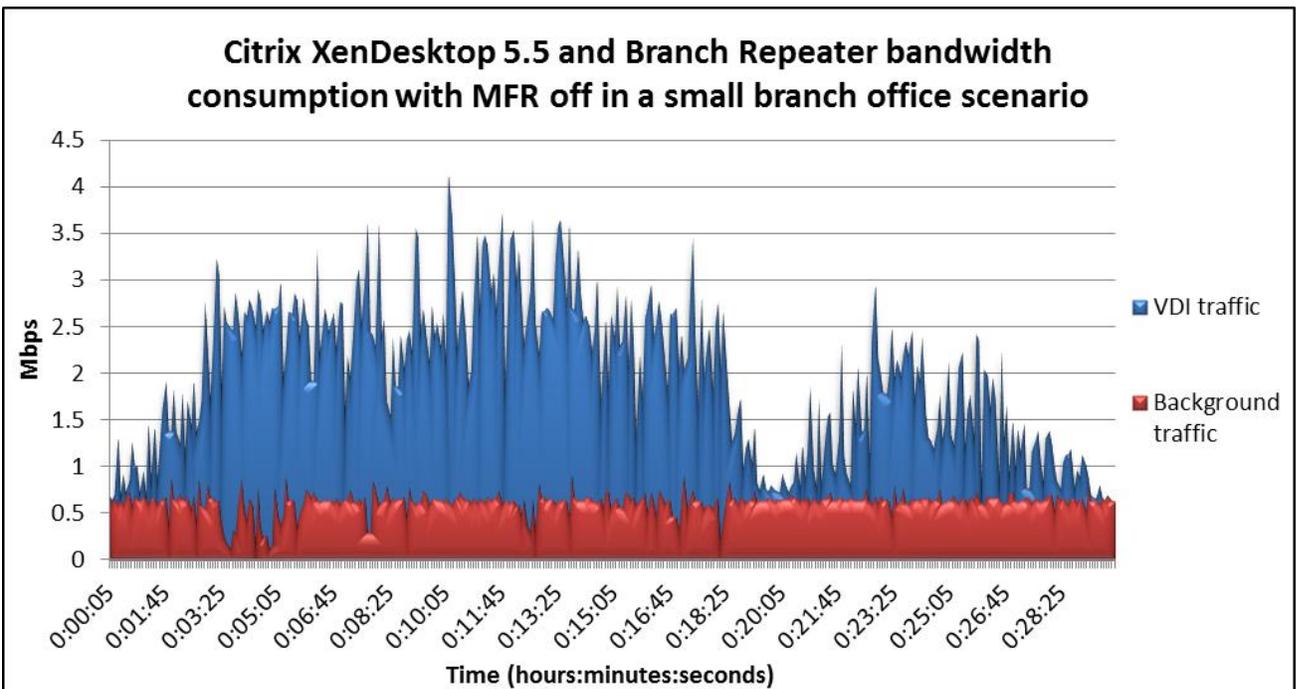


Figure 25: Bandwidth consumption in our small branch office scenario for Citrix XenDesktop 5.5 and Branch Repeater with MFR off.

Citrix XenDesktop 5.5 and Branch Repeater in the medium-sized branch office scenario

Figures 26 and 27 show the bandwidth consumption for Citrix XenDesktop 5.5 with Branch Repeater over the duration of the medium-sized branch office scenario test.

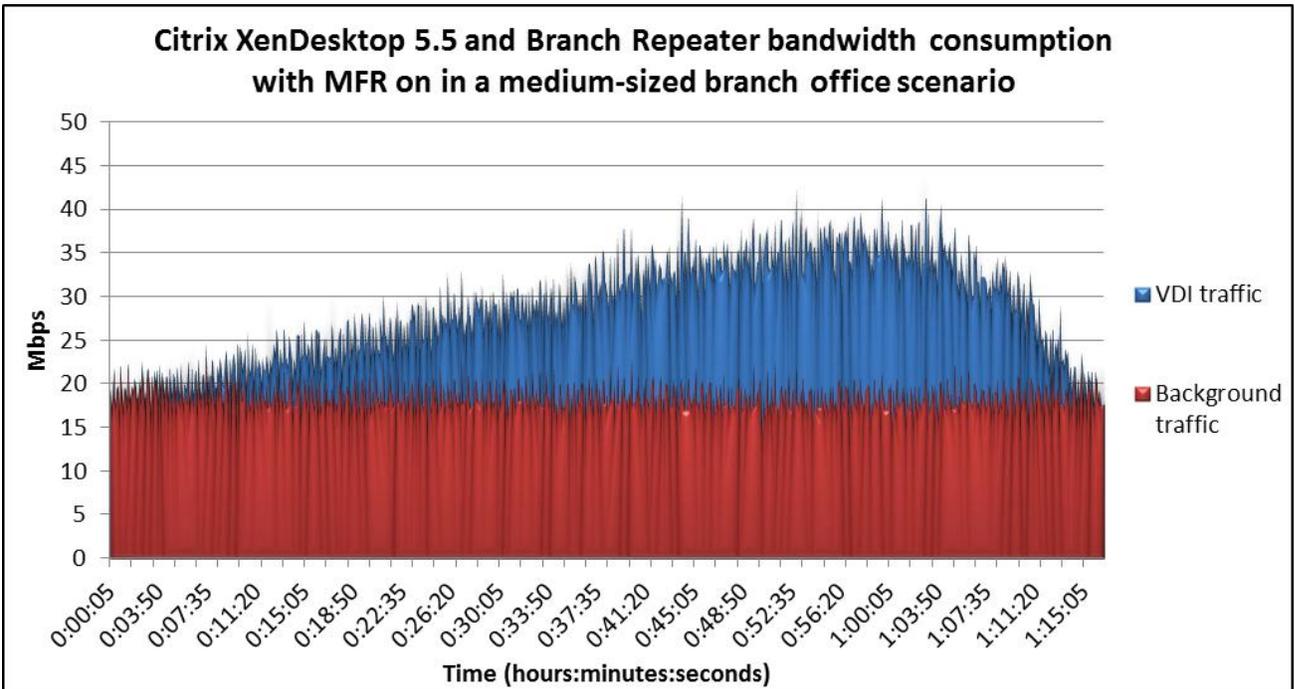


Figure 26: Bandwidth consumption in our medium-sized branch office scenario for Citrix XenDesktop 5.5 and Branch Repeater with MFR on.

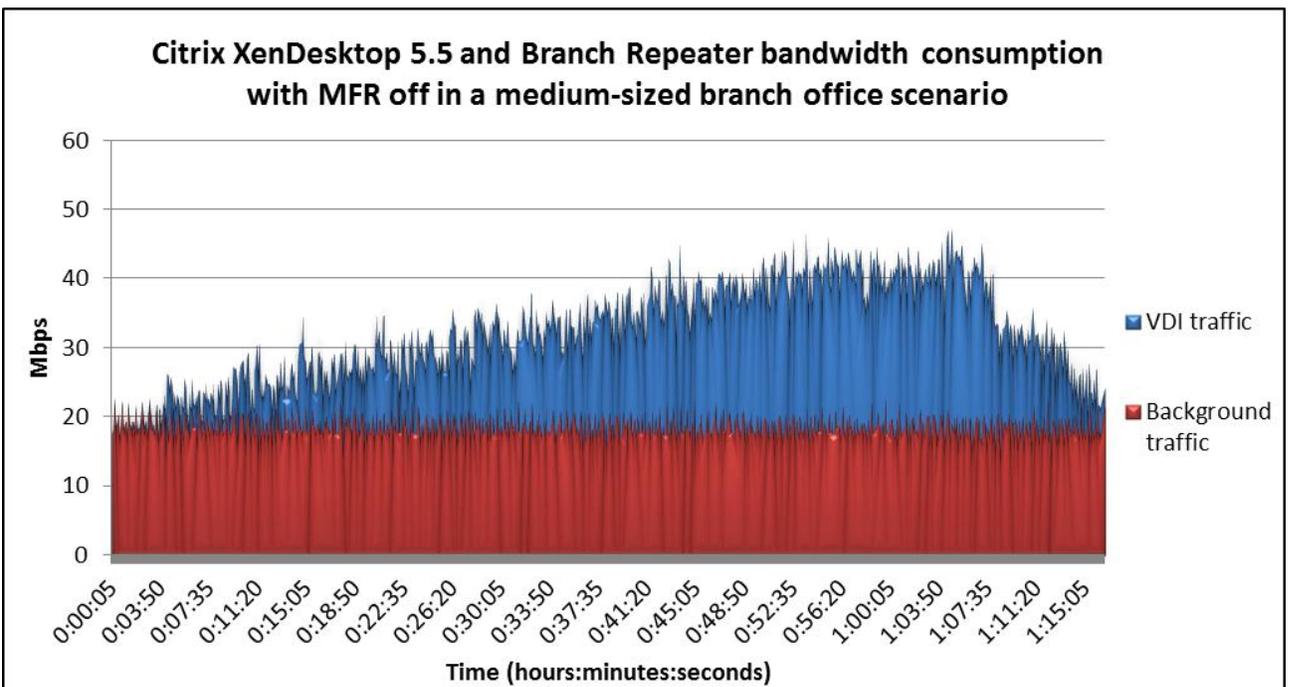


Figure 27: Bandwidth consumption in our medium-sized branch office scenario for Citrix XenDesktop 5.5 and Branch Repeater with MFR off.

APPENDIX C - HOW WE TESTED

Figure 28 shows details for the VMs we used in our testing.

VM name	Hosted OS	Role (s)	Host	Memory	# vCPUs
DC1	Win 2008 R2 x64 Enterprise	AD Domain controller VSI Share, DHCP, DNS, NTP, AD roaming profiles	infra	4 GB	2
XD-DDC	Win 2003 R2 x64 Enterprise	XenDesktop Delivery Controller, License Server	infra	4 GB	4
VMW-View	Win 2008 R2 x64 Enterprise	VMware View Connection server	infra	4 GB	4
XD-PVS	Win 2008 R2 x64 Enterprise	XenDesktop Provisioning Services	infra	4 GB	4
vCenter	Win 2008 R2 x64 Enterprise	VMware Virtual Center, Composer	infra	4 GB	4
Tcpreplay	Red Hat Enterprise Linux 6 x64	CIFS, HTTP, MAPI Traffic generator	Infra	2GB	2
WAN-Traffic	Windows 7 x 86 Enterprise	Background Traffic Target	Infra	2GB	2
Launcher	Windows 7 x 86 Enterprise	Login VSI Master launcher	infra	4 GB	2
XD-gold	Windows 7 x 86 Enterprise	XenDesktop master image	vDT-host	1 GB	1
View-gold	Windows 7 x 86 Enterprise	View master image	vDT-host	1 GB	1

Figure 28: Details about the VMs we used in our testing.

We configured a Dell PowerEdge R710 server with VMware vSphere™ (ESXi) 5.0 to host all VDI infrastructure components for VMware View 5.0 and Citrix XenDesktop 5.5. We installed a Dell PowerEdge R710 with VMware vSphere 5.0 to host virtual desktops for both VMware View 5.0 and Citrix XenDesktop 5.5.

We connected both Dell PowerEdge R710s to a NetApp® FAS960 storage appliance. The FAS960 has four DS14 disk shelves with 14 300GB disks in each shelf. We created two RAID groups with 26 disks in each group. We combined the two RAID groups into one aggregate, and created two LUNs on the aggregate.

We installed and configured a Dell PowerConnect™ 5448 switch with one network for data and used a Linktropy Mini2 WAN emulator to emulate the network conditions required by our test.

Our tests also required a background traffic stream composed of CIFS, HTTP, and MAPI traffic to take as much as 50 percent of the total available bandwidth on all tests. These streams were made out of publicly available sample captures from wireshark.org. We used Tcpreplay to replay the streams at the required speeds during testing.

Setting up the storage

Setting up the internal storage on both Dell PowerEdge R710s for host operating system installation

1. Enter the RAID controller BIOS by pressing Ctrl+R at the relevant prompt during boot.
2. Highlight Controller 0, and press F2.
3. Select Create New VD.
4. Select all four drives, select RAID level 1, tab to the OK button, and press Enter. Accept the warning regarding initialization.
5. Select the new virtual drive, press F2, and select Initialization, Start Init.
6. Wait for the initialization operation to complete.
7. Press Escape, and choose to Save and Exit to return to the boot sequence.

Setting up the infrastructure server (infra) and the virtual desktop hosts (vDT-host)

BIOS settings

We used the latest BIOS updates on both Dell PowerEdge R710s. We adjusted the default BIOS settings by enabling Virtualization Technology, disabling C-States, and setting the performance profile to maximum performance.

Installing VMware vSphere 5.0 (ESXi) on both PowerEdge R710s (infra) and (vDT-Host)

1. Insert the ESXi 5.0 disk, and select Boot from disk.
2. On the Welcome screen, press Enter.
3. On the End User License Agreement (EULA) screen, press F11.
4. On the Select a Disk to install or Upgrade Screen, select the relevant volume to install ESXi on, and press Enter.
5. On the Please Select a Keyboard Layout screen, press Enter.
6. On the Enter a Root Password Screen, assign a root password, and confirm it by entering it again. Press Enter to continue.
7. On the Confirm Install Screen, press F11 to install.
8. On the Installation complete screen, press Enter to reboot.

Configuring ESXi after installation

1. On the ESXi 5.0 screen, press F2, enter the root password, and press Enter.
2. On the System Customization screen, select Troubleshooting Options, and press Enter.
3. On the Troubleshooting Mode Options screen, select enable ESXi Shell, and press Enter.
4. Select Enable SSH, press Enter, and press Esc.
5. On the System Customization screen, select Configure Management Network.
6. On the Configure Management Network screen, select IP Configuration.
7. On the IP Configuration screen, select Set static IP; enter an IP address, subnet mask, and default gateway; and press Enter.
8. On the Configure Management Network screen, press Esc. When asked if you want to apply the changes, press Y.
9. Log into infra as `root` with the vSphere client.
10. Select the Configuration tab, and click Networking.
11. Click Add Networking...
12. Create a virtual machine network called `PRIV-NET` and select the appropriate adapters.
13. Click OK.
14. Select the Configuration tab, and click Time configuration.
15. Select Properties, and click Options.
16. In the General settings, select Start automatically if any ports are open, and Stop when all ports are closed.
17. In the NTP settings, add a reliable NTP server, or use `DC1.VDI.com`.
18. Close NTP settings.
19. Select the Configuration tab, and click DNS and routing.
20. Type `infra` for name, and `VDI.com` for domain.
21. Enter `172.0.0.10` for preferred DNS.
22. Close DNS

Creating the ESXi datastore (LUN1, 2)

1. Log into infra as `root` with the vSphere client.
2. Click Configuration tab → Storage → Add Storage.
3. Select LUN1, and click Next.
4. Select Network File System, and click Next.
5. Enter the Server, Folder and Datastore Name.

6. For Datastore name, type `LUN1` and click Next.
7. For Capacity, select Maximum Available Space, and click Next.
8. Click Finish to create the datastore.
9. Repeat steps 1 through 8 to create LUN2.

Setting up a VM to host Microsoft Windows Active Directory® server (DC1) on (infra) server

1. Connect to the infra server via the VMware vSphere client.
2. Log in as `root` to the infra server.
3. In the vSphere client, connect to the vCenter™ Server, and browse to the ESXi host.
4. Click the Virtual Machines tab.
5. Right-click, and choose New Virtual Machine.
6. Choose Custom, and click Next.
7. Assign the name `DC1` to the virtual machine, and click Next.
8. Select `infra` for the host, and click Next.
9. Select SSD for the storage, and click Next.
10. Choose Virtual Machine Version 8, and click Next.
11. Choose Windows, choose Microsoft Windows Server® 2008 R2 (64-bit), and click Next.
12. For CPUs, select one virtual processor socket, and 2 cores per virtual socket, and click Next.
13. Choose 4 GB RAM, and click Next.
14. Click 1 for the number of NICs, select VMXNET3, connect to the PRIV-NET network, and click Next.
15. Leave the default virtual storage controller, and click Next.
16. Choose to create a new virtual disk, and click Next.
17. Make the OS virtual disk size 40 GB, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
18. Keep the default virtual device node (0:0), and click Next.
19. Click Finish.
20. Right-click the VM, and choose Edit Settings.
21. On the Hardware tab, click Add...
22. Click Hard Disk, and click Next.
23. Click Create a new virtual disk, and click Next.
24. Specify 15 GB for the virtual disk size, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
25. Choose SCSI (0:1) for the device node, and click Next.
26. On the Hardware tab, click Add...
27. Click Create a new virtual disk, and click Next.
28. Specify 50 GB for the virtual disk size, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
29. Choose SCSI (0:2) for the device node, and click Next.
30. Click Finish, and click OK.
31. Click the Resources tab, and click Memory.
32. Select Reserve all guest memory, and click OK.
33. Connect the VM virtual CD-ROM to the Microsoft Windows Server 2008 R2 installation disk.
34. Start the VM.

Installing the Microsoft Windows Server 2008 R2 operating system on the VM

1. Choose the language, time and currency, and keyboard input. Click Next.
2. Click Install Now.
3. Choose Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
4. Accept the license terms, and click Next.

5. Click Custom.
6. Click the Disk, and click Drive options (advanced).
7. Click New→Apply→Format, and click Next.
8. After the installation completes, click OK to set the Administrator password.
9. Enter the administrator password twice, and click OK.
10. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
11. Enable remote desktop access.
12. Change the hostname to DC1 and reboot when prompted.
13. Run diskmgmt.msc.
14. Select the 15 GB secondary volume, name it `profiles` format it NTFS, and assign it drive letter E
15. Select the 50 GB secondary volume, name it `share` format it NTFS, and assign it drive letter F
16. Set up networking for the data network:
 - a. Click Start→Control Panel, right-click Network Connections, and choose Open.
 - b. Right-click the VM traffic NIC, and choose Properties.
 - c. Uncheck TCP/IP (v6).
 - d. Select TCP/IP (v4), and choose Properties.
 - e. Set the IP address as `172.0.1.10/255.255.252.0`
17. Install VMware Tools. For more information, see http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340
18. Reboot.

Installing Active Directory and DNS services on DC1

1. Click Start→Run, type `dcpromo` and click OK.
2. At the Active Directory Domain Services Installation Wizard welcome screen, check the Use advanced mode installation option, and click Next.
3. In the Choose a Deployment Configuration dialog box, select Create a new domain in a new forest, and click Next.
4. At the FQDN page, type `VDI.com` and click Next.
5. At the NetBIOS name prompt, leave the name VDI, and click Next.
6. At the Forest Functionality level, select Windows Server 2008 R2, and click Next.
7. At the additional Domain Controller Options, leave DNS server selected, and click Next.
8. At the System Folder Location screen, change to `E:\` leave the default options, and click Next.
9. Assign a Directory Services Restore Mode Administrator account password, and click Next.
10. At the Summary screen, review your selections, and click Next.
11. Once Active Directory Domain Services finishes installing, click Finish, and restart the system.
12. Run `dnsmgmt.msc`.
13. Create a reverse lookup zone for DC1.
14. Create static entries for `infra` and `vDT-host`.
15. Open Windows Explorer, and create a folder called `e:\profiles`
16. Assign permissions of read/write to the `VDI\everyone` group.

Configuring the Windows time service on DC1

To ensure reliable time, we pointed our Active Directory server to a physical NTP server.

1. Open a command prompt.
2. Type the following:


```
W32tm /config /syncfromflags:manual /manualpeerlist:"<ip address of a NTP server>"
W32tm /config /reliable:yes
W32tm /config /update
```

```
W32tm /resync
Net stop w32time
Net start w32time
```

Setting up DHCP services on DC1

1. Click Start→Administrative Tools→Server Manager→Add Roles.
2. Select DHCP Server, and click Next.
3. At the Introduction to DHCP Server screen, click Next.
4. At the Specify IPv4 DNS Settings screen, type `vdi.com` for the parent domain.
5. Type the preferred DNS server IPv4 address, and click Next.
6. At the Specify IPv4 WINS Server Settings screen, select WINS is not required for applications on the network, and click Next.
7. At the Add or Edit DHCP Scopes screen, click Add.
8. At the Add Scope screen, enter the Name DHCP Scope name.
9. In the next box, set the following values, and click OK.
 - Start IP address=`172.0.0.101`
 - End IP address=`172.0.3.200`
 - Subnet mask=`255.255.252.0`
10. Check the Activate This Scope box.
11. At the Add or Edit DHCP Scopes screen, click Next.
12. Click the Enable DHCP v6 Stateless Mode radio button, and click Next.
13. Leave the default IPv6 DNS Settings, and click Next.
14. At the Authorize DHCP server dialog box, select Use current credentials.
15. At the Confirm Installation Selections screen, click Next. If the installation is set up correctly, a screen displays saying that DHCP server install succeeded.
16. Click Close.
17. Click Start→Run and type `DHCPmgmt.msc`
18. Navigate to DHCP→`dc1.vdi.com`→IPv4→Server Options.
19. Right-click Server Options, and select Configure options.
20. Activate option 66 Boot Server Host Name.
 - String value=`<ip of the XenDesktopController>`
21. Activate option 67 Boot file Name.
 - String value= `ARDBP32.BIN`
22. Click OK.

Setting up the Login VSI share and Active Directory users

For Login VSI to work correctly, you must create a CIFS share, Active Directory OU, and Active directory. For more information on Login VSI, see <http://www.loginvsi.com/en/admin-guide/installation.html>. To enable Flash Media Redirection, we also set up a Web share to host the Flash media in the test.

1. Open Windows Explorer, and create a file called `f:\share`
2. Assign permissions of read/write to the VDI/everyone group.
3. Right-click the `f:\share` folder, and select Properties.
4. Click the Sharing tab, and click Share...
5. Add everyone to the Read/Write group, and click Share.
6. From the Login VSI 3.5 media, run the Login VSI AD Setup.
7. Keep the defaults, and click Start.

Creating roaming profiles for users

1. Open Active Directory Users and Computers.
2. Browse to VDI.com→Login_VSI→Users→Target.
3. Select all Login VSI users, and right-click Properties.
4. Click the Profiles tab.
5. Check box Profile path, and type `e:\profiles\%username%`
6. Click OK.

Adding the Web server role to DC1, and copying the Flash media to the wwwroot directory

1. Click Start→Administrative Tools→Server Manager→Add Roles.
2. Select Web Server (IIS), and click Next.
3. Skip the introduction to Web server (IIS), and click Next.
4. Confirm role services, and click Next,
5. Click Install.
6. Open the Login VSI install directory and copy `\setup\target Setup\Lib\Lib Shared\Websites` folder to `c:\intepub\wwwroot`
7. Open a Web browser to <http://dc1/websites/KA/> and verify the Flash media is running.

Setting up a VM to host the vCenter server (vCenter)

1. Connect to the infra server via the vSphere client.
2. Log into infra with the VMware vSphere client.
3. In the vSphere client, connect to the vCenter Server, and browse to the ESXi host.
4. Click the Virtual Machines tab.
5. Right-click, and choose New Virtual Machine.
6. Choose Custom, and click Next.
7. Assign the name `vCenter` to the virtual machine, and click Next.
8. Select `infra` for the host, and click Next.
9. Select `LUN1` for the storage, and click Next.
10. Choose Virtual Machine Version 8, and click Next.
11. Choose Windows, choose Microsoft Windows Server 2008 R2 (64-bit), and click Next.
12. For CPUs, select one virtual processor socket, and 2 cores per virtual socket, and click Next.
13. Choose 4GB RAM, and click Next.
14. Click 1 for the number of NICs, select `VMXNET3`, connect to the `PRIV-NET` portgroup, and click Next.
15. Leave the default virtual storage controller, and click Next.
16. Choose to create a new virtual disk, and click Next.
17. Make the OS virtual disk size 40 GB, choose thick-provisioned lazy zeroed, specify the OS datastore on the external storage, and click Next.
18. Keep the default virtual device node (0:0), and click Next.
19. Connect the VM virtual CD-ROM to the Microsoft Windows 2008 R2 installation disk.
20. Click Finish.
21. Right-click the vCenter VM, and click Edit settings.
22. Click the Resources tab, click Memory, check the Reserve all guest memory checkbox, and click OK.
23. Start the VM.

Installing the Microsoft Windows Server 2008 R2 operating system on the VM

1. Choose the language, time and currency, and keyboard input. Click Next.
2. Click Install Now.
3. Choose Windows Server 2008 R2 Enterprise (Full Installation), and click Next.

4. Accept the license terms, and click Next.
5. Click Custom.
6. Click the Disk, and click Drive options (advanced).
7. Click New→Apply→Format, and click Next.
8. After the installation completes, click OK to set the Administrator password.
9. Enter the administrator password twice, and click OK.
10. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
11. Enable remote desktop access.
12. Change the hostname to `vCenter` and reboot when prompted.
13. Set up networking for the data network:
 - a. Click Start, Control Panel, right-click Network Connections, and choose Open.
 - b. Right-click the VM traffic NIC, and choose Properties.
 - c. Uncheck TCP/IP (v6).
 - d. Select TCP/IP (v4), and choose Properties.
 - e. Set the IP address, subnet, gateway, and DNS server.
14. Join the VDI domain.
15. Reboot the system.
16. Install VMware Tools. For more information, see http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
17. Reboot.

Installing VMware vCenter 5

1. Log onto the vCenter as `VDI\administrator`
2. From the VMware vCenter5 install media, click Autorun.
3. Click Run to start the install wizard.
4. Click the Install button on the VMware vSphere 5.0 wizard.
5. Select the Install wizard language as English, and click OK.
6. At the Install wizard welcome screen, click Next.
7. Agree to the license agreement, and click Next.
8. Enter user information and a license key, and click Next.
9. Select Install the SQL express instance, and click Next.
10. Select the system account for the vCenter Server service account, and click Next.
11. Keep the installation directory as `C:\Program Files\VMware\Infrastructure\`, and click Next.
12. Select Create a standalone VMware vCenter Server instance, and click Next.
13. Keep the vCenter default ports, and click Next.
14. Select 1024 MB for the JVM memory, and click Next.
15. Click Install to finish the vCenter server installation.
16. Restart the server when complete.
17. Using the vSphere client, log into vCenter5 as `VDI\administrator`
18. Right-click the root of vCenter, and click New Data center.
19. Name the New datacenter `VDI`
20. Add the ESX server named `vDT-Host` to the datacenter.
21. Add the ESX server named `infra` to the datacenter.

Setting up ODBC DSN for composer

1. From the vCenter desktop, open Start→All Programs→Microsoft SQL Server 2008 R2→Configuration Tools→SQL Server Configuration Manager.
2. Click SQL Server Network Configuration→Protocols for VIM_SQLEXP.
3. Right-click TCP/IP, and select Enabled.

4. Click SQL Services→right-click SQL Server Browser, and select Properties.
5. IN the SQL Server Browser properties, select the Services tab, change the Start mode to Automatic, and click OK.
6. Start the SQL Server browser service.
7. Select Start→Run→odbcad32.exe.
8. Click the system DSN tab.
9. Click Add.
10. Click SQL Server, and click Finish.
11. In the Create a New Data Source to SQL Server text box, enter the connection name type: `composer`
12. For Server, select `vCenter\VIM_SQLEXP`, and click Next.
13. Leave authentication as default, click Next twice, and click Finish.
14. Click OK to create the composer ODBC connection.

Setting up VMware View Composer

1. Open the View5 media folder, and run the file names `VMware-viewcomposer-2.7.0-481620.exe`.
2. At the Welcome screen and the Patents screen, click Next.
3. Accept the VMware end user license agreement, and click Next.
4. Leave the Destination folder as default, and click Next.
5. In the Database information box, for source name type `composer` for user name type `VDI\Administrator` type the password, and click Next.
6. Leave the default SOAP port, and click Next.
7. Click Install, and click finish.

Setting up a VM to host the VMware View 5 connection server

1. Log into vCenter with the VMware vSphere client.
2. In the vSphere client, browse to the ESXi host named `infra`.
3. Click the Virtual Machines tab.
4. Right-click, and choose New Virtual Machine.
5. Choose Custom, and click Next.
6. Assign the name `View5` to the virtual machine, and click Next.
7. Select `infra` for the host, and click Next.
8. Select `LUN1` for the storage, and click Next.
9. Choose Virtual Machine Version 8, and click Next.
10. Choose Windows, choose Microsoft Windows Server 2008 R2 (64-bit), and click Next.
11. For CPUs, select one virtual processor socket, and 2 cores per virtual socket, and click Next.
12. Choose 4GB RAM, and click Next.
13. Click 1 for the number of NICs, select `VMXNET 3`, connect to the `PRIV-NET` portgroup, and click Next.
13. Leave the default virtual storage controller, and click Next.
14. Choose to create a new virtual disk, and click Next.
15. Make the OS virtual disk size 40 GB, choose thick-provisioned lazy zeroed, specify the OS datastore on the external storage, and click Next.
16. Keep the default virtual device node (0:0), and click Next.
17. Connect the VM virtual CD-ROM to the Microsoft Windows Server 2008 R2 installation disk.
18. Right-click the `View5` VM, and click Edit settings.
19. Click the Resources tab, click Memory, check the Reserve all guest memory checkbox, and click OK.
20. Click Finish.
21. Start the VM.

Installing the Microsoft Windows Server 2008 R2 operating system on the VM

1. Choose the language, time and currency, and keyboard input. Click Next.

2. Click Install Now.
3. Choose Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
4. Accept the license terms, and click Next.
5. Click Custom.
6. Click the Disk, and click Drive options (advanced).
7. Click New→Apply→Format, and click Next.
8. After the installation completes, click OK to set the Administrator password.
9. Enter the administrator password twice, and click OK.
10. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
11. Enable remote desktop access.
12. Change the hostname to `view5` and reboot when prompted.
13. Set up networking for the data network:
 - a. Click Start→Control Panel, right-click Network Connections, and choose Open.
 - b. Right-click the VM traffic NIC, and choose Properties.
 - c. Uncheck TCP/IP (v6).
 - d. Select TCP/IP (v4), and choose Properties.
 - e. Set the IP address, subnet, gateway, and DNS server.
14. Join the VDI domain.
15. Install VMware Tools. For more information, see http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
16. Reboot.

Installing the VMware View 5 connection server

1. Log into the server named `view5`.
2. Click Install Media for View Connection Server.
3. To begin the install wizard, click Next.
4. Agree to the license agreement, and click Next.
5. Keep the destination directory as `C:\Program Files\VMware View\Server\`, and click Next.
6. Select View Standard Server, and click Next.
7. Allow View Server to configure the firewall, and click Next.
8. Click Next.
9. Click Finish.
10. Reboot the View 5 server.
11. Log out of View 5.

Configuring the VMware View 5 connection server

1. Open a Web browser to `<the view server ipaddress>/admin`.
2. Log in as `administrator`
3. Open View Configuration→Servers.
4. In the vCenter Servers workspace, click Add...
5. In the Add vCenter Server settings, add the vCenter, and enable View Composer. Click OK.
6. Open View Configuration→Product Licensing and Usage.
7. Click Edit license...
8. Enter a valid license serial number, and click OK.
9. Close the View 5 administrator.

Setting up a VM to host XenDesktop 5.5

1. Connect to the infra server via the vSphere client.
2. Log into infra with the VMware vSphere client.

3. In the vSphere client, connect to the vCenter Server, and browse to the ESXi host.
4. Click the Virtual Machines tab.
5. Right-click, and choose New Virtual Machine.
6. Choose Custom, and click Next.
7. Assign the name XD-55 to the virtual machine, and click Next.
8. Select infra for the host, and click Next.
9. Select LUN1 for the storage, and click Next.
10. Choose Virtual Machine Version 8, and click Next.
11. Choose Windows, choose Microsoft Windows Server 2008 R2 (64-bit), and click Next.
12. For CPUs, select one virtual processor socket and two cores per virtual socket, and click Next.
13. Choose 4GB RAM, and click Next.
14. Click 1 for the number of NICs, select VMXNET3, connect to the PRIV-NET portgroup, and click Next.
15. Leave the default virtual storage controller, and click Next.
16. Choose to create a new virtual disk, and click Next.
17. Make the OS virtual disk size 40 GB, choose thick-provisioned lazy zeroed, specify the OS datastore on the external storage, and click Next.
18. Keep the default virtual device node (0:0), and click Next.
19. Connect the VM virtual CD-ROM to the Microsoft Windows 2008 R2 installation disk.
20. Click Finish.
21. Right-click the vCenter VM, and click Edit settings.
22. Click the Resources tab, click Memory, check the Reserve all guest memory checkbox, and click OK.
23. Start the VM.

Installing the Microsoft Windows Server 2008 R2 operating system on the VM

1. Choose the language, time and currency, and keyboard input. Click Next.
2. Click Install Now.
3. Choose Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
4. Accept the license terms, and click Next.
5. Click Custom.
6. Click the Disk, and click Drive options (advanced).
7. Click New→Apply→Format, and click Next.
8. After the installation completes, click OK to set the Administrator password.
9. Enter the administrator password twice, and click OK.
10. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
11. Enable remote desktop access.
12. Change the hostname to XD-55 and reboot when prompted.
13. Set up networking for the data network:
 - a. Click Start, Control Panel, right-click Network Connections, and choose Open.
 - b. Right-click the VM traffic NIC, and choose Properties.
 - c. Uncheck TCP/IP (v6).
 - d. Select TCP/IP (v4), and choose Properties.
 - e. Set the IP address, subnet, gateway, and DNS server.
14. Join the VDI domain.
15. Reboot the system.
16. Install VMware Tools. For more information, see http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
17. Reboot.

Installing Citrix XenDesktop 5.5

We installed XenDesktop desktop delivery controller and Provisioning services on two virtual machines to use vSphere. Before we can use XenDesktop and vSphere server, we needed to edit the vCenter proxy.xml file to allow access via http.

Editing the vCenter prox.xml file to allow http access

1. Open a console to the vCenter Server, and login as `VDI\administrator`
2. Open Wordpad, and edit the file `C:\Users\All Users\VMware\VMware VirtualCenter\proxy.xml`.
3. Find the `/sdk` entry.
4. Change `httpsWithRedirect` to `httpAndHttps`
5. Save the proxy/xml file, and reboot the vCenter server.

Installing the Citrix XenDesktop Delivery Controller

We installed the Citrix XenDesktop and XenDesktop licensing server on the XD-55 VM. After installation, we added licenses for 200 XenDesktop Platinum users.

1. Log into the server named XD-55.
2. Insert the media for Citrix XenDesktop 5.5.
3. Click Install XenDesktop.
4. Click I accept the terms and condition, and click Next.
5. Select all components to install, install SQL Express, and click Next.
6. Allow firewall ports to be open if necessary, and click Next.
7. Click Install.
8. Leave the checkbox next to Configure XenDesktop after closing checked, and click Close.
9. In the root of the Citrix Desktop Studio tool, click Desktop deployment.
10. Type `XD-site` for site name, use the default database option, and click Next.
11. Click Select from existing licenses, Add license file...
12. Select Citrix XenDesktop Platinum, and click Next.
13. For host type, select VMware virtualization and fill out the following fields:
 - a. Enter the host address as `http://vcenter.vdi.com/sdk`
 - b. Enter the username as `administrator`
 - c. Enter the administrator password.
 - d. Enter the connection name as `vCenter`
 - e. Select Manually create virtual machines.
14. Click Finish to create the site.
15. Open the Citrix Desktop Studio.
16. Select Browser→Desktop Studio→Configuration→Hosts, and click Add Host.
17. In Add Host Wizard, ensure vCenter is selected, and click Next.
18. For cluster, select vDT-host, for storage, select LUN1, for guest network, select PRIV-NET, and click Next.
19. Name the host `vDT-host` and click Finish.

Setting up a VM to host Provisioning Services

1. Connect to the infra server via the vSphere client.
2. Log into infra with the VMware vSphere client.
3. In the vSphere client, connect to the vCenter Server, and browse to the ESXi host.
4. Click the Virtual Machines tab.
5. Right-click, and choose New Virtual Machine.
6. Choose Custom, and click Next.

7. Assign the name `XD-PS` to the virtual machine, and click Next.
 8. Select `infra` for the host, and click Next.
 9. Select `LUN1` for the storage, and click Next.
 10. Choose Virtual Machine Version 8, and click Next.
 11. Choose Windows, choose Microsoft Windows Server 2008 R2 (64-bit), and click Next.
 12. For CPUs, select one virtual processor socket, and 2 cores per virtual socket, and click Next.
 13. Choose 4GB RAM, and click Next.
 14. Click 1 for the number of NICs, select `VMXNET3`, connect to the `PRIV-NET` portgroup, and click Next.
 15. Leave the default virtual storage controller, and click Next.
 16. Choose to create a new virtual disk, and click Next.
 17. Make the OS virtual disk size 40 GB, choose thick-provisioned lazy zeroed, specify the OS datastore on the external storage, and click Next.
 18. Keep the default virtual device node (0:0), and click Next.
 19. Connect the VM virtual CD-ROM to the Microsoft Windows 2008 R2 installation disk.
 20. Click Finish.
 21. Right-click the `XD-PS`, and choose Edit Settings.
 22. On the Hardware tab, click Add...
 23. Click Hard Disk, and click Next.
 24. Click Create a new virtual disk, and click Next.
- Specify 50 GB for the virtual disk size, thick-provisioned lazy zeroed, and specify `LUN1`.
25. Choose SCSI (1:0) for the device node, and click Finish.
 26. Click the new SCSI controller, and click Change type...
 27. Select VMware Paravirtual, and click OK.
 28. Click the Resources tab, click Memory, check the Reserve all guest memory checkbox, and click OK.
 29. Start the VM.

Installing SQL Express on XD-PS

A SQL database is required for Provisioning Services; we used the included SQL Express installation files on the Citrix Provisioning Service media to create a database on the XD-PS host.

1. Log into the server named XD-PS.
2. Insert the media for Citrix Provisioning services 6.0.
3. Browse to the `SQL Express 2005Express\directory`, and run `SQLEXPRESS.exe`.
4. Accept the End user agreement, and click Next.
5. At the Welcome screen, click Next.
6. Verify the system passes the system configuration check, and click Next.
7. Enter a name and organization, and click Next.
8. Select the default features, and click Next.
9. Select Windows authentication, and click Next.
10. Check both boxes to Enable user instances, add user to the SQL Server administrator Role, and click Next.
11. Click Next for error usage reporting, and click Next.
12. Click Install.
13. When completed, click Next, and click Finish.
14. Go to Start → All Programs → Microsoft SQL Server 2005 → Configuration Tools → SQL Server Configuration Manager.
15. Click SQL Server Network Configuration → Protocols for SQLEXPRESS.
16. Right-click TCP/IP, and select Enabled.
17. Click SQL Services → right-click SQL Server browser, and select Properties.
18. In the SQL Server Browser properties, select the Services tab, change the start mode to Automatic, and click OK.

19. Start the SQL Server browser service.

Installing Citrix Provisioning Services 6.0 on XD-PS

1. Log into the server named XD-PS as `VDI\administrator`
2. Insert the media for Citrix Provisioning services 6.0
3. Click Auto Run.
4. Click Server installation.
5. Click Install server.
6. At the welcome screen, click Next.
7. Accept the license agreement, and click Next.
8. Enter user name and organization name, and click Next.
9. Accept the default installation path, and click Next.
10. Select Complete setup, and click Next.
11. Click Install.
12. Click Finish.
13. The Provisioning services configuration wizard will automatically launch. Click Next to begin.
14. For DHCP, select Service runs on another computer, and click Next.
15. For PXE services, click Service runs on this computer, and click Next.
16. For Farm creation, click Create farm, and click Next.
17. For the database server, for server name, type `XD-PS` and for instance name, type `SQLEXPRESS` and click Next.
18. For the farm, enter the following, and click Next:
 - Database name= `ProvisioningServices`
 - Farm= `farm`
 - Site= `site`
 - Collection name= `Collection`
 - Farm Administrator group= `VDI/builtin/administrators`
19. For the store path, enter Store name= `Store` and for Path, browse to the root of the 50 GB SSD LUN `e:\` and click Next.
20. Enter `XD-55.vdi.com` for the license server, and click Next.
21. On the User account screen, enter the `vdi\administrator` password twice, click the checkbox next to Configure the database for the account, and click Next.
22. Keep the default number of days between password updates, and click Next.
23. Keep the primary interface and communication ports, and click Next.
24. Keep the TFTP service at default, and click Next.
25. Leave the stream service at default, and click Next.
26. Click Finish.

Installing Citrix Provisioning Services Administrative Console XD-PS

1. Insert the media for Citrix Provisioning Services 6.0.
2. Click Auto run.
3. Click Console installation.
4. Click Install to install the broker snap in.
5. Click I accept the terms in the License agreement, and click Install.
6. Click Finish.
7. At the welcome screen for Provisioning Services Console, click Next.
8. Accept the licensing agreement, and click Next.
9. Enter a user name and organization name, and click Next.

10. Accept the default install path, and click Next.
11. Accept the default install type, and click Next.
12. Click Install, and click Finish.

Setting up a VM to host Tcpreplay

1. Connect to the infra server via the vSphere client.
2. Log into infra with the VMware vSphere client.
3. In the vSphere client, connect to the vCenter Server, and browse to the ESXi host.
4. Click the Virtual Machines tab.
5. Right-click, and choose New Virtual Machine.
6. Choose Custom, and click Next.
7. Assign the name `tcpreplay` to the virtual machine, and click Next.
8. Select `infra` for the host, and click Next.
9. Select LUN1 for the storage, and click Next.
10. Choose Virtual Machine Version 8, and click Next.
11. Choose Linux, choose Red Hat Enterprise Linux 6 (64-bit), and click Next.
12. For CPUs, select one virtual processor socket and two cores per virtual socket, and click Next.
13. Choose 2GB RAM, and click Next.
14. Click 1 for the number of NICs, select VMXNET3, connect to the PRIV-NET portgroup, and click Next.
15. Leave the default virtual storage controller, and click Next.
16. Choose to create a new virtual disk, and click Next.
17. Make the OS virtual disk size 30 GB, choose thick-provisioned lazy zeroed, specify the OS datastore on the external storage, and click Next.
18. Keep the default virtual device node (0:0), and click Next.
19. Connect the VM virtual CD-ROM to the Red Hat Enterprise Linux Server 6 x86_64 disk.
20. Click Finish.
21. Right-click the vCenter VM, and click Edit settings
22. Click the Resources tab, click Memory, check the Reserve all guest memory checkbox, and click OK.
23. Restart the VM.

Installing the Red Hat Enterprise Linux 6.2 (64-bit), operating system on the VM

1. After welcome screen, select Install or upgrade an existing system.
2. Select Skip media test.
3. Select English for the installation language and keyboard.
4. Select Basic Storage Devices and click Next.
5. Enter Hostname, and click Next.
6. Select time zone, and click Next.
7. Enter `root` account password, and click Next.
8. Select Use All Space, and click Next.
9. Click on Write changes to disk.
10. Select the Desktop and click on Add additional software repositories.
11. Type `gcc` in the Repository name and change the Repository type to CD/DVD, and click OK.
12. Click Next to begin installation.
13. At the reboot screen, select Reboot.
14. At the Welcome screen, click Forward.
15. Select Yes, I agree to the License Agreement, and click Forward.
16. Install VMware Tools.
17. At the Set Up Software Updates screen, click Forward.
18. At the Create User screen, enter Username and Password, and click Forward.

19. At the Date and Time screen, click Forward.
20. At the Kdump screen, click Forward.
21. Log in as `root`.
22. Install VMware Tools from http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
23. Reboot.

Installing and configuring Tcpreplay

1. Download Tcpreplay from tcreplay.synfin.net.
2. Download and install Tcpreplay prerequisites.
3. Unpack the Tcpreplay file.
4. Open Terminal and navigate to the extracted Tcpreplay file.
5. Type `./ Configure`
6. Type `make`
7. Type `make install`.
8. After installation, open Terminal and type `$ tcprewrite --enet-dmac=00:55:33:bd:c6:35 - enet-smac=00:55:33:bd:fc:af --infile=example.pcap --outfile=new.pcap`
9. Replay traffic by typing `$ tcpreplay --intf1=eth0 sample.pcap`

Setting up a Windows 7 Enterprise x86 image template

Using the vSphere client, we created a Windows Enterprise X86 VMs base image and converted it into a template. Using our template, we deployed two VMs on vDT-host for gold image creation on VMware View and XenDesktop. We also deployed a Login VSI launcher and the WAN-Traffic VM on infra.

For the gold image VMs, we installed Microsoft Office 2007, installed the Login VSI target software, added them to the VDI domain, added them to the Login VSI OU, and installed the respective VMware View 5 and XenDesktop 5.5 agents.

For the Login VSI launcher VM, we installed the VMware View 5 client, the XenDesktop receiver and added it to the VDI domain, added it to Login VSI OU in Active Directory, and installed the Login VSI Launcher software.

Installing the Windows 7 Enterprise (x86) base image VM

1. Log into the vCenter.
2. In the vSphere client, connect to the vCenter Server, and browse to the infra host.
3. Click the Virtual Machines tab.
4. Right-click, and choose New Virtual Machine.
5. Choose Custom, and click Next.
6. Assign the name as `win7-temp` and click Next.
7. Select infra for the host, and click Next.
8. Select LUN1.
9. Choose Virtual Machine Version 8, and click Next.
10. Choose Windows, choose Microsoft Windows 7 (32-bit), and click Next.
11. For CPUs, select one virtual processor socket and one core per virtual socket, and click Next.
12. Choose 1GB RAM, and click Next.
13. Click 1 for the number of NICs, select VMX, and click Next.
14. Leave the default virtual storage controller, and click Next.
15. Choose to create a new virtual disk, and click Next.
16. Make the OS virtual disk size 20 GB, choose thick-provisioned lazy zeroed, specify the OS datastore on the external storage, and click Next.

17. Keep the default virtual device node (0:0), and click Next.
18. Click Finish.
19. Click Finish, and click OK.
20. Right-click the win7-temp VM, and click Edit settings.
21. Click the Resources tab, click Memory, and check the Reserve all guest memory checkbox.
22. Click the Hardware tab, CD/DVD Drive, and Connect the VM virtual CD-ROM to the Microsoft Windows 7 x86 installation disk.
23. Click OK.

Installing the Windows 7 Enterprise (X86) on the base image VM

1. When the installation prompts you, press any key to begin setup.
2. Enter your language preferences, and click Next.
3. Click Install.
4. Accept the license terms, and click Next.
5. Select Custom, and select the drive that will contain the OS.
6. Click Install, and the setup begins.
7. Type `user` for the username and change the computer name, and click Next.
8. Enter no password, and click Next.
9. For system protection, select Use recommended settings, and click Next.
10. Enter your time zone, and click Next.
11. Select the Work Network setting, and click Next.
12. Use Windows Update to patch the Windows 7 installation.
13. Install VMware Tools from http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
14. Reboot.

Installing Windows 7 Enterprise (X86), optimizing Windows 7

Adjusting page file

1. Log in as `administrator`
2. Right-click Computer → Properties → Change settings → Advanced → Performance → Settings.
3. In Performance settings, select the Advanced tab, and select Change for Virtual Memory.
4. Deselect automatically manage page file.
5. Select Custom size, type `1024` for both values, and select Set.

Disabling Windows Firewall

The domain GPO automatically disables the Windows Firewall.

Installing Office 2007 Professional and converting to template

1. From the Office 2007 media, run Setup.
2. Enter the product key for Office 2007, and click Continue.
3. Accept the licensing agreement.
4. Select default installation.
5. Click Install.
6. Download and run Office 2007 Service Pack 2.
7. Reboot the system.
8. Shut down the VM.
9. Right-click, and select Template → Convert to Template.

Enabling ClearType fonts

1. Click Start → Run, and type `cttune.exe`

2. Check the Turn on ClearType checkbox, and click Next.
3. Follow the wizard to enable ClearType fonts.

Deploying the view_gold image from template

1. In vSphere Client, browse to Home→VMs and Templates.
2. Right-click win7-temp to deploy a virtual machine from template.
3. For Name, type `view_gold` and click Next.
4. Click Datacenter, and click Next.
5. Click the vDT-host server, and click Next.
6. Select LUN1, and click Next.
7. Select customization using existing customization specifications, select the appropriate file, and click Next.
8. Click Finish to deploy the view_gold VM.
9. Repeat steps 1 through 8 to deploy a XD_gold VM.
10. Repeat steps 1 through 8 to deploy a Launcher_1 VM to host infra.
11. Repeat steps 1 through 8 to deploy the WAN-Traffic VM.

Preparing view_gold for deployment

Installing Login VSI target software on view_gold

1. Log into the view_gold VM as `VDI\administrator`
2. Browse to `\vsi-install\Target setup`.
3. Run the setup.exe.
4. In the Target Setup wizard, specify the VSI share `\\dc1\share`
5. Click Start.
6. At the security warnings, click OK.
7. Reboot the system.

Installing the View 5 agent on view_gold

1. Browse to the VMware View 5 media, and run the `VMware-viewagent-x86_64-5.0.0-481677.exe` file.
2. Click Run.
3. At the Welcome screen, click Next.
4. At the Patents screen, click Next.
5. Accept the VMware end user license agreement, and click Next.
6. Select defaults, and click Next.
7. Click Install.

Configuring Regedit for Quick prep (kb.vmware.com/kb/1026556)

1. Click Start→Run, and type `regedit`
2. Browse to `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\vmware-viewcomposer-ga`.
3. Right-click `SkipLicenseActivation`, and click Modify...
4. Change the value from 0 to 1.

Preparing XD_gold for deployment

Installing Login VSI target software on XD_gold

1. Log into the XD_gold VM as `VDI\administrator`
2. Browse to `\vsi-install\Target setup`.
3. Run the setup.exe.
4. In the Target Setup wizard, specify the VSI share `\\dc1\share`
5. Click Start.
6. At the security warnings, click OK.
7. Reboot the system.

Installing the XD agent on XD_gold

1. Browse to the Citrix XenDesktop media, and run the XdAgent_32.msi file.
2. Click the checkbox next to I accept the terms in the license agreement.
3. Click Install.
4. Click Finish.

Creating a ListOfDDCs entry in the registry on XD_gold

1. Click Start→Run, and type `regedit`
2. Browse to `HKEY_LOCAL_MACHINE\Software\Citrix\VirtualDesktopAgent`
3. Create a string value called `ListOfDDCs`
4. Right-click the ListOfDDCs string, and click Modify...
5. Type `XD-55.vdi.com` and click OK.
6. Close the registry editor.

Preparing Launcher_1 for testing

We installed our launcher with the Login VSI target software, and both View 5 and XenDesktop clients. To assist in automating our launchers with Citrix XenDesktop, we installed Python 2.6. For more information on how to use Login VSI and XenDesktop, please see <http://www.loginvsi.com/en/news/citrix-releases-whitepaper-on-how-to-use-vsi-in-testing-xendesktop>.

Installing Virtual Audio Cables

By default, the virtual launchers cannot render audio so we installed Virtual Audio Cables version 4.10. The software can be downloaded from <http://software.muzychenko.net/eng/vac.htm>

1. Download and extract the media.
2. Click Setup.
3. Click Yes to begin the install.
4. Click I accept to accept the software license agreement.
5. Click Install.

Installing the Login VSI launcher

1. Log into the XD_gold VM as `VDI\administrator`
2. Browse to `\vsi-install\Launcher setup`.
3. Run the setup.exe.
4. In the Target Setup wizard, specify the VSI share `\\dc1\share`

Patching the Login VSI launcher and updating the version of Adobe Flash

By default, Login VSI installs an older version of Flash. To ensure Flash Media Redirection works, ensure that the launcher version is 3.4.1 or greater and that adobe Flash player 11 plugin has been updated. It can be found here:

<http://www.adobe.com/support/flashplayer/downloads.html>.

Installing the Citrix Receiver 13.0.0 on the launcher

1. Browse to the Citrix XenDesktop media, and run the XdAgent_64.msi file.
2. When the installation is complete, reboot the launcher.

Preparing the launcher to execute scripted sessions to XenDesktop

To automate the testing of XenDesktop, we installed python2.6 and pywin 32-214. We used the Login VSI CCL to call a python script to launch the session to the Citrix broker. The launcher will need to have python, pywin and PAMIE

installed. You can load python from <http://www.python.org/getit/releases/2.6/> and pywin from <http://sourceforge.net/projects/pywin32/files/pywin32/>.

Installing Python 2.6

1. Download and extract python 2.6.
2. Click on the python-2.6.msi.
3. Click Install of all users, and click Next.
4. Accept the default directory, and click Next.
5. Accept the default options, and click Next.
6. Click Finish.

Installing Pywin-32 and PAMIE

1. Download and extract pywin32.
2. Execute the pywin32-214.win32-py2.6.exe file.
3. Click Next to being the Pywin-32 installer.
4. Accept the default file location, and click Next.
5. Click Finish.
6. Download PAMIE, and extract files into the C:\Python26\Lib\Site-Packages directory.
7. Create a file called c:\python26\WILauncher.py

Installing the VMware View 5 client

1. Browse to the VMware View 5 media, and run the VMware-viewclient-x86_64-5.0.0-481677.exe file.
2. Click Run.
3. At the welcome screen, click Next.
4. At the Patents screen, click Next.
5. Accept the VMware end user license agreement, and click Next.
6. Select defaults, and click Next.
7. Click Install.

Installing the Citrix Receiver 13.0.0

1. Browse to the Citrix XenDesktop media, and run the XdAgent_86.msi file.
2. When the installation is complete, reboot the launcher.

Configuring View 5 - creating a pool and adding entitlements for Login VSI users

1. Open vCenter→Datacenter→Infra, and right-click the view_gold VM, select Snapshot→Take Snapshot.
2. Name the snapshot `view_gold`
3. Open the View Administrator.
4. Log in as `administrator`
5. Click Pools, and in the right window, click Add...
6. Select Automatic Pool, and click Next.
7. Select Floating, enable automatic assignment, and click Next.
8. Select View Composer linked clones, and click Next.
9. Type `pool` for the pool ID and display name, and click Next.
10. Leave the pool settings as defaults, and click Next.
11. Select Redirect disposable files to a non-persistent disk, type `4096 MB` for Disk Size, and click Next.
12. For the naming pattern, type `View-` leave the pool size as `1`, and click Next.
13. For the pool settings, use:
 - Default image: `view_gold - view_gold`
 - VM folder: `/Datacenter/vm/Pool`
 - Host or cluster: `DataCenter/host/vd-host.vdi.com`

- Resource pool: /Datacenter/host/vd-host.vdi.com/Resources
 - Datastore=LUN2(Linked clones and replica disk), and click Next
14. For Guest customization, select the following:
 - Domain: VDI.com
 - AD container: OU=Users,OU=Login_VSI
 - Select Use Quick Prep, and click Next.
 15. Click Finish.
 16. Click Pool, and click Entitlements...
 17. Click Add, type Login_VSI_TS and click OK.
 18. Click Desktops, and wait for the View-1 virtual desktop to report as ready.

Configuring XD5.5 - creating a pool and adding entitlements for Login VSI users

To prepare the XD_gold image for deployment, we installed the provisioning services target device installation software on the XD_gold VM and created vDisk to stream from our Provisioning Service server.

1. Log into XD_gold as VDI\Administrator
2. Browse to the Provisioning Services media.
3. Execute the autorun.exe.
4. Click Target Device Installation.
5. Click Install DIM (Device Identity Management).
6. To begin the DIM wizard, click Install.
7. Accept the License agreement, and click Next.
8. Click Install, and click Finish when installation completes.
9. Click Yes to reboot.
10. Log into XD_gold as VDI\Administrator
11. Browse to the Provisioning services media.
12. Execute the autorun.exe.
13. Click Target Device Installation.
14. At the welcome screen for Provisioning Service Target Device Wizard, click Next.
15. Accept the License agreement, and click Next.
16. Enter user name and organization name, and click Next.
17. Accept the default path, and click Next.
18. Click Install.
19. Click Finish.

Provisioning Services Imaging Wizard

1. At the Welcome screen, click Next.
2. For server, type PSV IP Address, enter credentials and click Next.
3. Select Create new vDisk, and click Next.
4. Name the vDisk XD_gold_vdisk and click Next.
5. For Microsoft Volume Licensing, click None, and click Next.
6. Select the image volume defaults, ensure the Capacity is 20 GB and the free space is greater than 30 percent. Click Next.
7. For target device name, type PVS_XD_gold and click Next.
8. Click Optimize for Provisioning Services, and select OK.
9. Click Finish to begin creating the empty vDisk.
10. In vCenter, right-click XD_gold, and click Edit settings.
11. Click the Options tab→Boot options, check the box to force BIOS Setup, and click OK.
12. When the vDisk has been completed, click Yes to reboot the XD_gold VM.

13. In the VM BIOS, tab to the Boot menu, and change the boot order to:
 - a. CD-ROM Drive
 - b. VMware VMXNET3
 - c. Hard Drive
 - d. Removable Devices
14. Tab to Exit, and save existing changes.
15. When the VM boots, it will boot from PXE and Provisioning services will stream the vDisk to the device.
16. Log in as `VDI\administrator`
17. Provisioning services will now copy `XD_gold` to the vDisk.
18. Click Finish.
19. Shut down `XD_gold`.
20. In vCenter, right-click `XD_gold` edit settings.
21. Remove hard Disk 1 (do not delete the vmdk), and click OK.
22. Click `XD_gold`, and click Edit settings.
23. Click Add new hard disk.
24. Create a new virtual disk, and click Next.
25. For size, enter 4 GB, and click Next.
26. Leave the device as SCSI (0:0), and click Next.
27. Click Finish, and click OK.

Enabling `XD_gold` to boot from vDisk

1. Log into `XD-PS` as `VDI\administrator`
2. Open All Programs → Citrix → Provisioning Services → Provisioning Service Console.
3. Open Provisioning Services → Farm → Site → Device Collections → Collections, and right-click `PVS_XD_gold`.
4. Change boot from Hard Disk to vDisk, and click OK.
5. Open Provisioning Services → Farm → Site → vDisk Pool, and right click `XD_gold_vdisk`.
6. Change mode from private mode to standard image mode and Cache type to Cache on device hard drive.
7. Click the checkbox next to Enable Active Directory machine account password management.

Booting the `VM_gold` vm from vDisk and formatting the 4 GB change disk

1. In vCenter, right-click `VM_gold`, and click Start VM.
2. Log into `VM_gold` as `VDI\administrator`
3. Open Disk Manager.
4. Initialize disk0, and click Format NTFS.
5. Shut down the VM.

Enabling the 4GB local disk as cache

1. Open All Programs → Citrix → Provisioning Services → Provisioning Service Console.
2. Open Provisioning Services → Farm → Site → Device Collections → Collections, and right-click `PVS_XD_gold`.
3. In the General tab, change the cache type to Cache on device hard drive, and click OK.

Deploying a XenDesktop pool with the XenDesktop Setup wizard

1. In vCenter right click `VM_gold` and template → convert to template.
2. Name the snap shot `VM_gold_template`.
3. Open the Provisioning services console → Farm → Sites → Site, right-click and select XenDesktop Setup Wizard.
4. At the welcome screen, click Next.
5. Type `XD-55` for the XenDesktop Controller, and click Next.
6. Click the host `vDT-host`, and click Set Template.
7. Type the administrator password, and click Get templates.
8. Click `VM_gold_template`, click OK, and click Next.

9. Select the Provisioning services collection as collection and XD_gold_vdisk as the assigned vDisk, and click Next.
10. Enter the following, and click Next:
 - Number of virtual machines= 1
 - vCPUs=1
 - Memory=1024 MB
 - Active Directory= Create New accounts
11. For Active Directory location, click VDI.com→Login_VSI→Computers.
12. For Base name type XD-0#, and click Next.
13. Select Create a new catalog, name it catalog, and click Next.
14. Click Finish.

Creating Desktop group and adding the XD-01 VM

1. Log into XD-55.
2. Open the Citrix Desktop Studio→Assignments, and click Create Desktop Group.
3. Select the catalog named catalog, add all machines, and click Next.
4. For users add the VDI\Login_VSI_TS group, and click Next.
5. Leave delegations as default, and click Next.
6. Name the group pool, and click Finish.

Configuring the power policy for the pool desktop group

1. Right-click pool, and Edit Desktop Group.
2. Click Power Management, for weekdays select all hours, no action, and position the power on machines line to be uniform across all hours on the graph.
3. Click Weekends and select all hours, no action, and position the power on machines line to be uniform across all hours on the graph, and click OK.

Configuring the Citrix XenDesktop 5 server - creating a catalog and Citrix XenDesktop group

1. Open the Citrix Desktop Studio.
2. Browse Desktop Studio→Machines. In the right window, right-click and select Create Catalog.
3. For Machine type, select Pooled, and for Assignment, select Random. Click Next.
4. Click Desktop Studio→PowerShell, and click Launch PowerShell.
5. In PowerShell, type `Set-BrokerDesktopGroup -Name "pool" -ShutdownDesktopsAfterUse $False`
6. Browse Desktop Studio→Assignments, and verify that there is one desktop available.

Installing Citrix NetScaler Branch Repeater VPX 6.0.5

1. Download Branch Repeater VPX 6.0.5 virtual appliance for vSphere from <http://www.citrix.com/English/ss/downloads/index.asp>.
2. On vSphere client, select File and Deploy OVF template.
3. Browse to Branch Repeater OVF template, and click Next.
4. Enter a name and select inventory location, and click Next.
5. Select a storage destination, and click Next.
6. Select Thin Provision, and click Next.
7. Select network destinations for APA-1 and APA-2, and click Next.
8. At the Ready to Complete screen, click Finish.
9. Repeat steps 1 through 8 to create a second Branch Repeater appliance.

Configuring NetScaler Branch Repeater VPX 6.0.5

1. On vSphere Client, right-click the Branch Repeater appliance, and select Edit Settings.
2. Change the Memory to 4 GB and the size of Hard disk 1 to 250 GB, and click OK.

3. On vSphere, select the server(s) hosting the virtual appliance and go to Configuration→Networking.
4. On the vSwitches attached to the virtual appliances, select Properties.
5. Select the appropriate network(s) under Configuration, and click Edit...
6. Click Security, and enable Promiscuous Mode by checking the checkbox and selecting Accept.
7. Click OK, and click Close.
8. Turn on the virtual appliance to start software installation.
9. After boot up is complete, log in as `admin` and enter `password` for password.
10. Set the accelerated bridge (apA) using the following command: `set adapter apa -ip 172.0.2.X -netmask 255.255.252.0 -gateway 172.0.0.10`
11. Restart the appliance by typing `restart`
12. After boot up is complete, access the Web UI by entering the URL of apA: `https://172.0.2.X`
13. Enter admin credentials to log in.
14. At the Quick Installation screen, enter `172.0.0.10` for Primary DNS server and NTP Time server.
15. Adjust the WAN link Definition to 95% of total available bandwidth, and click Install.
16. Go to Configuration→Licensing→Local Licenses.
17. Click Add New License.
18. Add a License name and select Browse.
19. Select the appropriate license, and click Install.
20. Go to Features and enable Traffic Processing and Traffic Bridging.
21. Go to Configuration→Services Classes→Service Class Definitions and select Edit for ICA service class.
22. Change Traffic Shaping Police to Very High Priority Traffic.
23. Repeat steps 1 through 22 to configure the second Branch Repeater appliance.

Installing the PCoIP and HDX GPO snap-ins for Active Directory

To make changes to the way PCoIP and HDX rendered images, we installed the Active Directory snap-in to our Default Domain Group policy. We also used a snap-in to disable the XenDesktop welcome screen. The .adm files are located on the install media for VMware View and XenDesktop.

1. Log into DC1 as `VDI\administrator`
2. Open All Programs→Admin Tools→Group Policy Management.
3. In the Group Policy Management tool, open Forest→Domains→VDI.com→right-click the default domain Policy, and click Edit.
4. Browse Computer Configuration→Policies, right-click Administrative templates, and click Add/Remove Templates...
5. Click Add...
6. Browse to the `pcoip.adm`.
7. Click Add...
8. Browse to the `HdxFlash-Client.adm`.
9. Click Add...
10. Browse to the `WelcomeScreen.adm`.
11. Close the GPO editor.

Disabling the HDX GPO welcome screen

For all tests, we disabled the XenDesktop welcome screen.

1. Log into DC1 as `VDI\administrator`
2. Open All Programs→Admin Tools→Group Policy Management.
3. In the Group Policy Management tool, open Forest→Domains→VDI.com→right-click the default domain Policy, and click Edit.

4. Browse Computer Configuration→Policies→Administrative Templates→Classic Administrative Templates(ADM)→Citrix Components, and edit the Disable the Welcome Screen Policy.
5. Click Enabled, and OK.

Settings used in testing

Setting HDX to Client side Flash Redirection

For all tests, we disabled the XenDesktop welcome screen.

1. Log into DC1 as VDI\administrator
2. Open All Programs→Admin Tools→Group Policy Management.
3. In the Group Policy Management tool, open Forest→Domains→VDI.com, right-click the default domain Policy, and click Edit.
4. Browse Computer Configuration→Policies→Administrative Templates→Classic Administrative Templates(ADM)→HDX MediaStream Flash Redirection- Client.
5. Edit the Enable HDX MediaStream Flash Redirection on the user device policy.
6. Click Enabled, select Always, and click OK. (Note: Select 'Never' to enable server-side redirection).

Tuning View 5 for WAN connections

For our testing, we tuned View based on recommendations made by VMware's PCoIP Network Optimization Guide (<http://www.vmware.com/files/pdf/view/VMware-View-5-PCoIP-Network-Optimization-Guide.pdf>). We did not, however, utilize QoS as the ESG survey indicated that half of the bandwidth was used for non-VDI traffic.

1. Log into DC1 as VDI\administrator
2. Open All Programs→Admin Tools→Group Policy Management.
3. In the Group Policy Management tool, open Forest→Domains→VDI.com, right-click the default domain Policy, and click Edit.
4. Browse Computer Configuration→Policies→Administrative Templates→Classic Administrative Templates(ADM)→PCoIP Session Variables→Overridable Administrator Defaults.
5. Right-click Turn off Build-to-lossless feature. Right-click, and click Edit.
6. Select the radio button for Enabled, and tick the box next to I accept to turn off the Build-to-lossless feature.
7. Click OK.
8. Right-click Configure PCoIP image quality levels, and click Edit.
9. Select Enabled, change Minimum Image Quality to 40, Maximum Initial Image Quality to 70 and Frame Rate to 24, and click OK.
10. On the View 5 connection server, open a command window, and type `gpupdate /force`

LOGIN VSI INI FILES USED FOR TESTING

launcher.ini

```
[Launcher]
Servername=
Username=
Password=
Domain=
ConnectionType="Custom with CSV file"
ConnectionNumber=User
CCL=c:\python26\python.exe c:\python26\WILauncher.py http://XD-
DDC/Citrix/DesktopWeb/ %CSV_User% Password1 VDI pool 1 logout
CSV=Z:\csv\user.csv
Launchmode=Sequential
NumberOfSessions=10
SequentialInterval=30
Fancy_number=1
Autologoff=1
LogoffTimeOut=740
CreateProfile=0
UseLocalLauncher=0
```

user.csv

```
User
login_vsi1
login_vsi2
login_vsi3
login_vsi4
login_vsi5 (*)
```

(*) continue until login_vsi191

WILauncher.py

```
from distutils.core import setup
from PAM30 import PAMIE
import sys
import time

if len(sys.argv) < 6:
    print "Usage :: WILauncher.py baseURL username password domain
NFuse_Application [delay] [disconnect|logout]"
else:
    baseURL = sys.argv[1]
    username = sys.argv[2]
    password = sys.argv[3]
    domain = sys.argv[4]
```

```

nfuseAppName = sys.argv[5]

print "Message: Launching IE"
ie = PAMIE()

print "Message: Navigating to " + baseURL + "auth/login.aspx"
ie.navigate(baseURL + "auth/login.aspx")

loop = 10
while loop > 0 and not ie.textBoxExists("user"):
    print "Message: Page not loaded yet..."
    ie._wait()
    time.sleep(10)
    loop = loop - 1

if ie.textBoxExists("user"):
    print "Message: Setting TextBox 'user'"
    ie.setTextBox("user", username)
else:
    print "Message: Did not find TextBox 'user'"
    sys.exit(-1)

if ie.textBoxExists("password"):
    print "Message: Setting TextBox 'password'"
    ie.setTextBox("password", password)
else:
    print "Message: Did not find TextBox 'password'"
    sys.exit(-2)

if ie.textBoxExists("domain"):
    print "Message: Setting TextBox 'domain'"
    ie.setTextBox("domain", domain)
else:
    print "Message: Did not find TextBox 'domain'"

if ie.linkExists("Log On"):
    print "Message: 'Log On' Link found! Clicking..."
    ie.clickLink("Log On")

elif ie.buttonExists("Log On"):
    print "Message: 'Log On' Button found! Clicking..."
    ie.buttonClick("Log On")
else:
    print "Message: Failed to find a 'Log On' Button or Link"
    sys.exit(-4)

if len(sys.argv) > 6:
    print "Message: Sleeping for " + sys.argv[6] + " seconds"
    time.sleep(int(sys.argv[6]))
    if len(sys.argv) > 7:
        if sys.argv[7].lower() == "disconnect":
            print "Message: Disconnecting..."

```

```
        ie.clickLink("Disconnect")
        ie._wait()
    elif sys.argv[7].lower() == "logout" or sys.argv[7].lower() ==
"logoff":
        print "Message: Logging off..."
        ie.clickLink("Log Off")
        ie._wait()
    else:
        print "I don't understand the keyword: " + sys.argv[7]
print "Message: Closing IE"
ie.quit()
```

APPENDIX D – VIDEO CAPTURE OF OUR VDI SESSIONS

We recorded video of the VDI sessions and have made them available for viewing online.

Edited sessions

Small branch office comparisons

- XenDesktop MFR on vs. View – <http://www.youtube.com/watch?v=BlsZTM-3Skc>
- XenDesktop MFR on vs. View tuned – <http://youtu.be/vHvgSr7VH6o>
- XenDesktop Branch Repeater MFR on vs. View tuned – http://youtu.be/lgYx_NG5eRM

Medium-sized branch office comparisons

- XenDesktop MFR on vs. View – <http://www.youtube.com/watch?v=5qhu61ym0C0>
- XenDesktop MFR on vs. View tuned – <http://youtu.be/FgcstHBKv7I>
- XenDesktop Branch Repeater MFR on vs. View tuned – <http://youtu.be/HNnRaKxfvZM>

Complete sessions

Citrix XenDesktop 5.5 defaults

- Small branch office, MFR on – <http://youtu.be/gWO2yWj3ES0>
- Small branch office, MFR off – <http://youtu.be/clr3JgcfKl>
- Medium-sized branch office, MFR on – <http://youtu.be/rVSmAP0Hdd4>
- Medium-sized branch office, MFR off – <http://youtu.be/1aeJvJ4WEO0>

Citrix XenDesktop 5.5 and Branch Repeater

- Small branch office, MFR on – <http://youtu.be/kWD-XfPU0Os>
- Small branch office, MFR off – <http://youtu.be/Wo6566NB0YM>
- Medium-sized branch office, MFR on – <http://youtu.be/ZOLHaeP7ZQw>
- Medium-sized branch office, MFR off – <http://youtu.be/zONH4tQ9JJA>

VMware View 5 defaults

- Small branch office – <http://youtu.be/7WMCH4d9ycQ>
- Medium-sized branch office – <http://youtu.be/F5j4lZ0zgWY>

VMware View 5 tuned

- Small branch office – <http://youtu.be/5NM2ozN6VjA>
- Medium-sized branch office – <http://youtu.be/GfS1QJwkqZc>

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