SCALE TESTING AND COST ANALYSIS STUDY: VMWARE HORIZON VIEW 5.2 VIRTUAL DESKTOP DENSITY VS. CITRIX XENAPP 6.5 FP1

VMware® Horizon View™ 5.2

supported **19.2% more users** for **49.2% lower cost** compared to virtualized Citrix® XenApp™ 6.5 FP1:

174 concurrent users

$483 per user

vmware®

146 concurrent users

$950 per user

Citrix

For companies choosing between a virtual desktop infrastructure (VDI) and server-based computing (SBC) model, cost and density are among the most important considerations. In the Principled Technologies labs, we compared one VDI solution, Microsoft® Windows® 7 desktops on VMware® Horizon View™ 5.2, and one SBC solution, a Citrix® XenApp® 6.5 FP1 Hosted Shared Desktop farm consisting of eight Microsoft Windows Server® 2008 Remote Desktop Session Host (RDSH) virtual machines (VMs) hosted on VMware vSphere® 5.1.

Hosted on the same physical hardware resources we found that VMware Horizon View 5.2 supported 174 Microsoft Windows 7 virtual desktop sessions at a cost per user of $483.[1] Citrix XenApp 6.5 FP1, using the lossless settings that most closely match the VMware Horizon View solution, supported 146 sessions at a cost of $950 per user. These findings mean that VMware Horizon View 5.2 delivered 19.2 percent greater density and a 49.2 percent lower cost per user, making it an excellent choice for a company that wants to deliver a high-quality experience to users at an excellent price.

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[1] See Appendix C for cost analysis. We include costs for server hardware and software.

The advantages of VDI

Compared to server-based computing, a virtual desktop infrastructure has a number of advantages. Users enjoy greater control over their desktops and can customize them as needed. For example, users who need immediate access to applications or need granular control over OS settings, such as registry and drivers, can do so as often as needed. This is not possible in an SBC model in which all users share a server OS. The isolated VDI environment can also be a boon for security and can ease the process of backing up and restoring data. Users can also access their virtual desktops offline, something they cannot do with server-based computing. As we demonstrate in this report, VDI can also be a much more cost-effective approach.

As Figure 1 shows, in our testing, VMware Horizon View 5.2 delivered greater density at a dramatically lower cost compared to Citrix XenApp 6.5 FP1 with settings that most closely match the VMware Horizon View solution. It is important to note that VMware includes around-the-clock support to Horizon View users, whereas Citrix offers additional Premier support for each concurrent user at an additional cost.

	VMware Horizon View 5.2	Citrix XenApp 6.5 FP1 with lossless settings	VMware Horizon View 5.2 provides…
Number of users supported	174	146	19.2% greater density
Total licensing cost	$72,210	$126,787	43.0% lower total licensing cost
Hardware cost	$11,845	$11,845	N/A
Total cost	**$84,055**	**$138,632**	39.4% lower total licensing plus hardware cost
Cost per user	$483	$950	49.2% lower cost per user

Figure 1: Cost and density comparison for the two solutions.

We provide detailed system configuration information in Appendix A, our test methodology in Appendix B, and the details of our cost analysis in Appendix C.

Horizon View 5.2 virtual desktops vs. Citrix XenApp 6.5 FP1 Hosted Shared Desktop sessions

We loaded our server under test, an HP DL380p Gen8, with VMware vSphere 5.1 and connected it to four iSCSI LUNS on a Dell™ EqualLogic™ PS 6110X storage array. We hosted all VMware Horizon View 5.2 Microsoft Windows 7 virtual desktops and a Citrix XenApp 6.5 FP1 farm of eight Microsoft Server 2008 R2 VMs on the server under test. We hosted all infrastructure VMs on separate server resources. See Appendix B for detailed information.

We used Login VSI to generate a reproducible, real-world test case that simulated the execution of various applications including Microsoft® Internet Explorer®, Adobe® Flash® video, and Microsoft Office® applications to determine how many virtual desktop users or sessions each solutions could support.

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We configured Login VSI to run a medium workload against a Horizon View pool of virtual desktops and against a load-balanced Citrix XenApp farm of eight virtualized Windows Server 2008 hosts, and set up the test to incrementally log users into virtual desktops or XenApp sessions every 20 seconds for the duration of each test.

Login VSI measured the total response time of all the applications from each session and calculated the VSI Index by taking the average response times and dropping the highest and lowest 2 percent. The average response time of the first 15 sessions determined a baseline. As more sessions begin to consume system resources, response time degrades and the VSI index increases until it is above the VSImax (VSImax is baseline x 125% +3000ms). When this condition is met, the benchmark records a Login VSImax, which is the maximum number of sessions that platform could support. Once logged in, each session remained active for the duration of the test, and for at least 15 minutes. Not reaching VSImax is an indication of satisfactory user response at the predetermined user count.

VMware Horizon View 5.2 results

We created a Windows 7 x64 Enterprise Edition master image, and accepted all default settings during the Windows 7 installation. We used standard Login VSI installation instructions and best practices in preparing the Windows 7 master image. We installed Microsoft Office 2010, Login VSI target software, and the VMware Horizon View 5.2 agent on the Windows 7 VM. We deployed a pool of linked clone virtual desktops from the master image, housing the replicas and virtual desktops on three iSCSI LUNs presented to the server under test.

Figure 2 shows the response times, in milliseconds, as sessions increased for the VMware Horizon View 5.2 desktop pool with 174 active desktops.

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Figure 2: The test server was able to run 174 Horizon View 5.2 Windows 7 virtual desktop sessions without generating a VSI max.

Login VSI response times - Horizon View 5.2

View 5.2 - Windows 7
174 desktops
VSImax = Not reached
Baseline = 1,011

— Average Response
— VSI Index Average
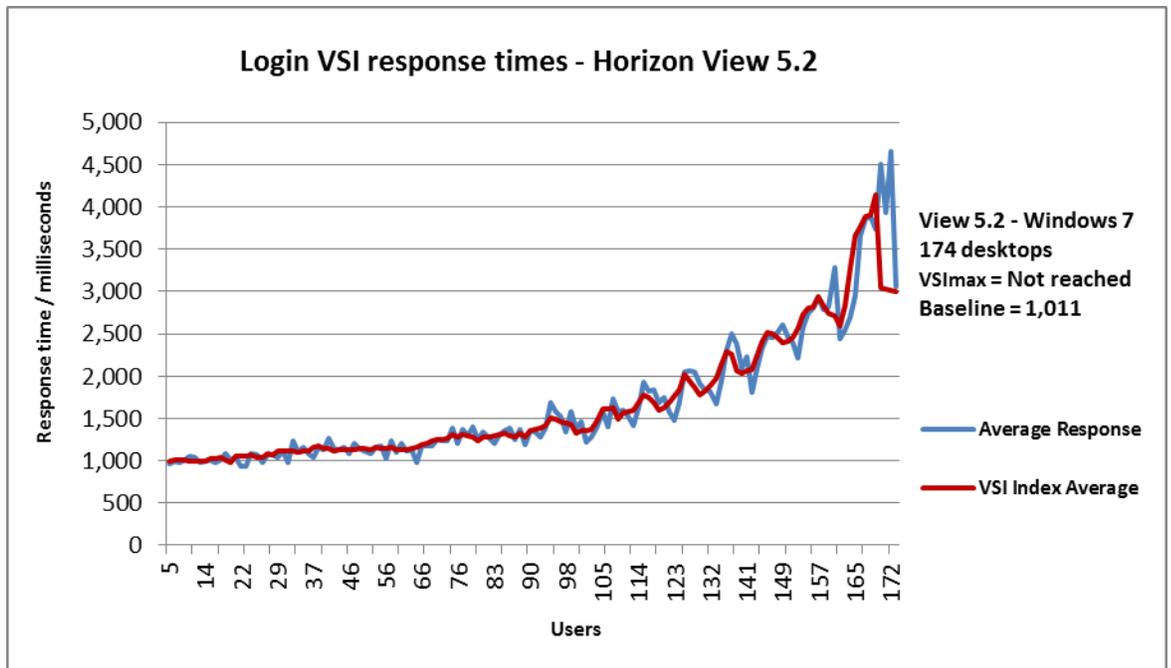
We collected performance data with ESXTOP and Figure 3 shows the percentage CPU utilization throughout our VMware Horizon View 5.2 test with 174 active desktops. Additional sessions exceed the VSImax for the server under test due to CPU utilization.

Figure 3: CPU utilization for our server under test throughout the Horizon View 5.2 test.[2]
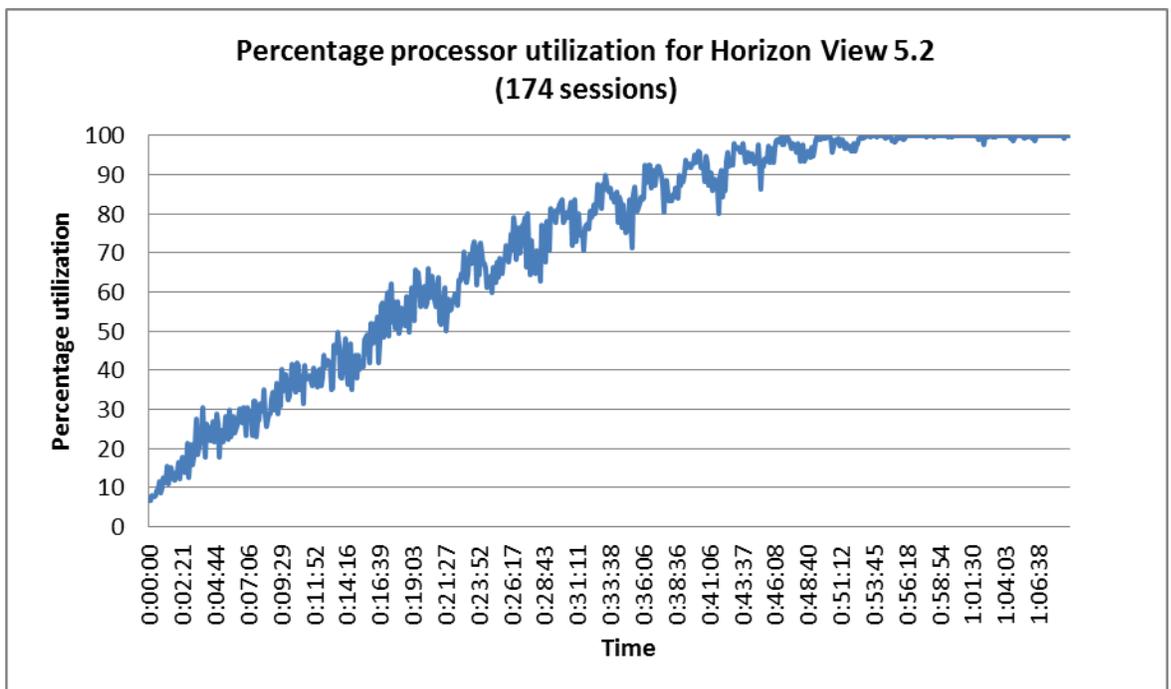
Percentage processor utilization for Horizon View 5.2
(174 sessions)

[2] This test is a VDI simulation that exercises the hardware components in the server. We ran the workload to fully utilize the processors within the system. However, each potential environment varies in hardware topology, SLA requirements, and hardware vendor best practices, so evaluate your environment and size your workloads with caution.

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Citrix XenApp 6.5 FP1 Hosted Shared Desktop results

For the testing that we report on below, we disabled Citrix XenApp 6.5 FP1's default lossy compression and increased the moving image rendering to 30 FPS so that the resulting lossless settings would most closely match the superior lossless image quality of the VMware Horizon View solution. (Note: We also conducted our tests with the default lossy compression at 24 FPS. The results appear in Appendix D.)

For our Citrix XenApp 6.5 FP1 lossless testing, we deployed eight Microsoft Windows Server 2008 R2 virtual servers via Citrix Provisioning Services onto our server under test and configured each VM with four vCPUs and 16 GB of memory. We installed Microsoft Office 2010 for each user using terminal services safe installation mode and activated it with a Volume License key.

To provide a richer user experience and to simulate the features of a full desktop system, we added the desktop experience feature to the base server image. We also used Citrix XenApp's built-in load-balancing method to ensure that virtual desktop user sessions were evenly distributed across all Windows Server 2008 targets.

Figure 4 shows the response times, in milliseconds, as the sessions increased in our Citrix XenApp 6.5 FP1 lossless tests with 146 active sessions.

Figure 4: In our lossless test, Citrix XenApp 6.5 FP1 was able to run 146 sessions without generating a VSImax.
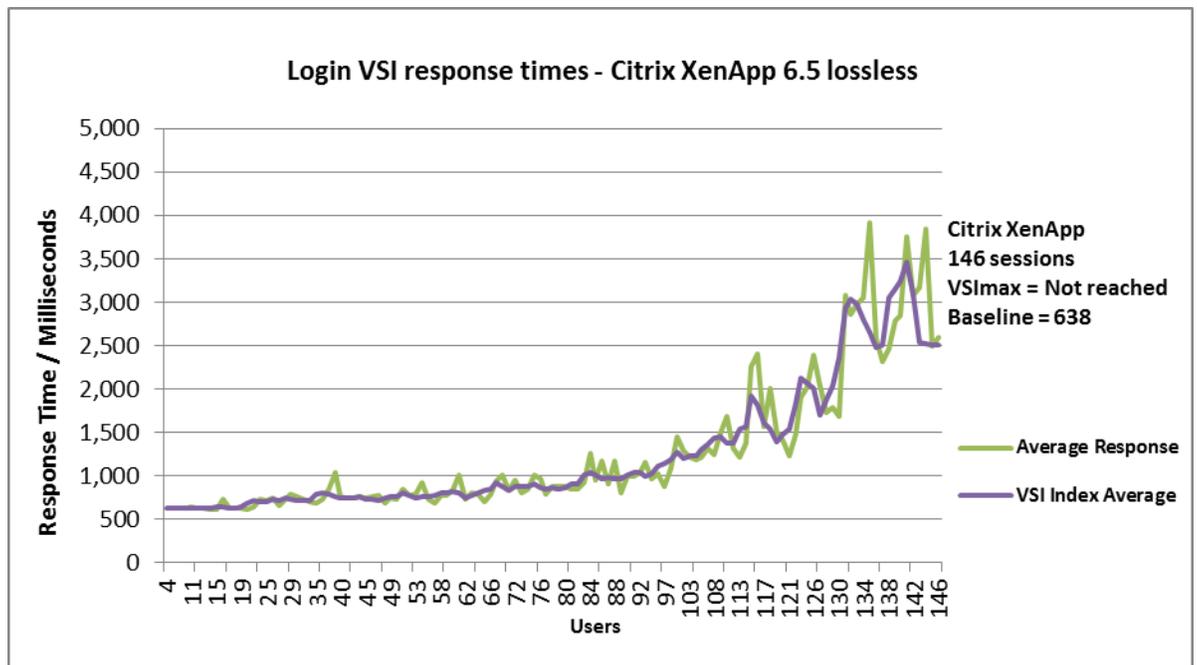
We collected performance data with ESXTOP and Figure 5 shows the percentage CPU utilization throughout our Citrix XenApp 6.5 FP1 lossless tests. Additional sessions exceed the VSImax for the server under test due to CPU utilization.

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Figure 5: CPU utilization for our server under test throughout the Citrix XenApp 6.5 FP1 lossless test.[3]
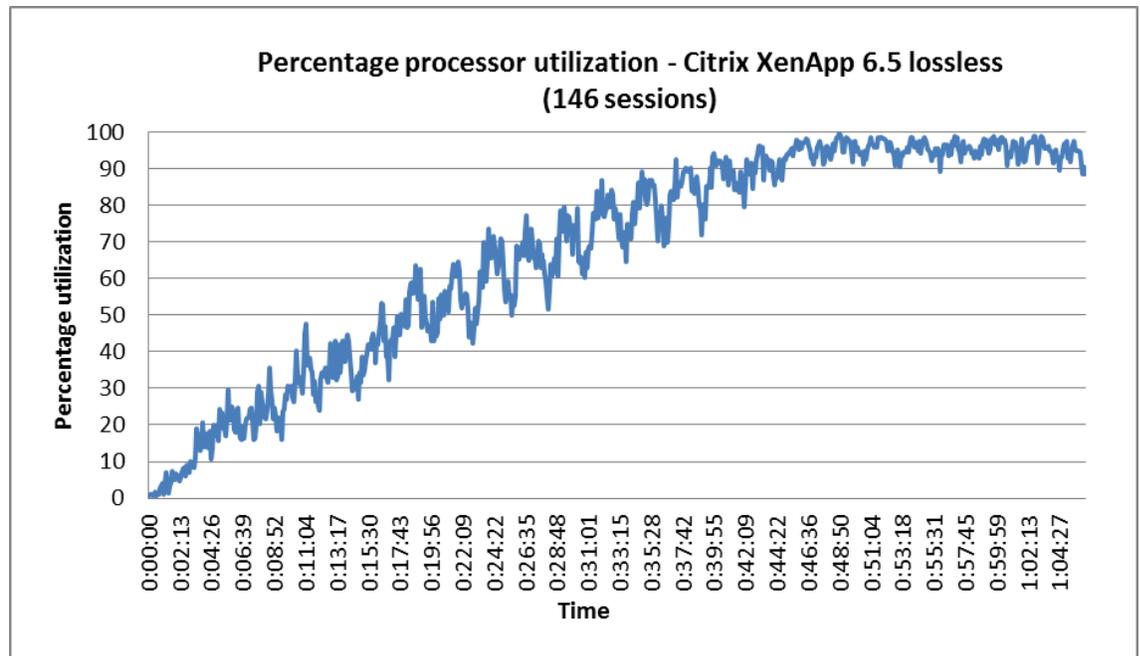
CONCLUSION

VDI offers many advantages over server-based computing: greater user control over desktops; easier security, backup, and data restoration; and the ability for users to access their sessions offline. VDI can also be a much more cost-effective approach.

Our scale testing with the Login VSI 3.7 medium workload for a VMware Horizon View virtual desktop solution and for a Citrix XenApp 6.5 FP1 Hosted Shared Desktop farm revealed that both delivered a rich Microsoft Windows 7 desktop experience. However, Horizon View 5.2 could support 174 concurrent users while Citrix XenApp 6.5 FP1 with comparable lossless settings could support only 146 concurrent users.

Not only did Horizon View 5.2 support 174 concurrent users in our testing, it did so at a cost per user of $483. In contrast, the 146 users Citrix XenApp 6.5 FP1 supported had a cost per user of $950. VMware Horizon View 5.2 delivered 19.2 percent greater density and a 49.2 percent lower cost per user, making it an excellent choice for a company that wants to deliver a high quality experience that includes around-the-clock telephone support for users

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[3] This test is a VDI simulation that exercises the hardware components in the server. We ran the workload to fully utilize the processors within the system. However, each potential environment varies in hardware topology, SLA requirements, and hardware vendor best practices, so evaluate your environment and size your workloads with caution.

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APPENDIX A – SYSTEM CONFIGURATION INFORMATION

Figures 6 and 7 detail the configuration information for the server and storage we used in our testing.

System	HP ProLiant DL380p Gen8
General	
Number of processor packages	2
Number of cores per processor	8
Number of hardware threads per core	2
CPU	
Vendor	Intel®
Name	Xeon®
Model number	E5-2690
Socket type	FCLGA2011
Core frequency (GHz)	2.90
Bus frequency	8 GT/s
L1 cache	32 KB + 32 KB
L2 cache	8 x 256 KB
L3 cache	20 MB (shared)
Platform	
Vendor and model number	HP ProLiant DL380p Gen8
Motherboard model number	346920-001
BIOS name and version	HP P77 12/14/2012
BIOS settings	Maximum performance
Memory module(s)	
Total RAM in system (GB)	256
Vendor and model number	Kingston KVR13LL9Q4/32
Type	PC3L-10600R
Speed (MHz)	1,333
Speed running in the system (MHz)	1,333
Timing/Latency (tCL-tRCD-tRP-tRASmin)	9-9-9-36
Size (GB)	32
Number of RAM module(s)	8
Chip organization	Double-sided
Rank	Quad
OS/hypervisor	
Name	VMware ESXi 5.1.0
Build number	914609
File system	VMFS
Kernel	ACPI x64-based PC
Language	English

System	HP ProLiant DL380p Gen8
RAID controller	
Vendor and model number	HP Smart Array P420i
Firmware version	3.22
Cache size (MB)	0
Ethernet adapter	
Vendor and model number	Broadcom® BCM5719 Gigabit Ethernet
Number of ports	4
Type	Integrated
USB ports	
Number	4
Type	2.0

Figure 6: System configuration information for our test server.

Storage array	Dell EqualLogic PS-6110X
Number of storage arrays	1
Number of storage controllers per array	2
RAID level	10
Firmware version	6.0.0
Number of drives	24
Model number	ST9900805SS
Drive size (GB)	900GB
Drive buffer size (MB)	16MB
Drive RPM	10K
Drive type	6Gb SAS 2.5"
Number of spare disks	2

Figure 7: Detailed configuration information for the Dell EqualLogic PS-6110X storage array.

APPENDIX B – TEST METHODOLOGY

We used a separate physical server to host all infrastructure VMs for both solutions. Figure 8 details our tested infrastructure configuration for VMware Horizon View, while Figure 9 details our tested infrastructure configuration for Citrix XenApp.

VM name	Hosted OS	Role (s)	Server	Memory	No. of vCPUs
AD01	Win 2008 R2 x64 Enterprise	AD Domain controller VSI Share, DHCP, DNS, NTP	Infra	4 GB	2
VMW-View	Win 2008 R2 x64 Enterprise	VMware View connection server	Infra	4 GB	4
vCenter	Win 2008 R2 x64 Enterprise	VMware Virtual Center, VMware Composer, SQL server	Infra	8 GB	4
Launcher	Windows 7 x 64 Enterprise	8x Login VSI launchers	Infra	4 GB	2

Figure 8: Layout of the VMware Horizon View infrastructure.

VM name	Hosted OS	Role (s)	Server	Memory	No. of vCPUs
AD01	Win 2008 R2 x64 Enterprise	AD Domain controller VSI Share, DHCP, DNS, NTP	Infra	4 GB	2
CitrixLIC	Win 2008 R2 x64 Enterprise	Licensing Services	Infra	4 GB	2
PVS	Win 2008 R2 x64 Enterprise	XenDesktop Provisioning Services	Infra	4 GB	4
vCenter	Win 2008 R2 x64 Enterprise	VMware Virtual Center, SQL server	Infra	8 GB	4
Launcher	Windows 7 x 64 Enterprise	8x Login VSI launchers	Infra	4 GB	2

Figure 9: Layout of the Citrix XenApp infrastructure environment.

We used generic NAS for the infrastructure VMs and a Dell EqualLogic PS6110X drive array for the server under test storage. We configured the Dell EqualLogic PS6110X drive array in a single member group with the RAID policy set at RAID 10. The PS6110X array contained 24 SAS disks with two reserved as spares. We cabled the PS6110X array directly to the HP DL380p Gen8. Using the default storage pool, we created six LUNs that distributed the virtual machines used for testing. For the internal storage, we configured a RAID 1 mirrored pair of disks for the operating system.

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INSTALLING AND CONFIGURING INFRASTRUCTURE

We installed Microsoft Server 2008 R2 on three virtual machines housed on an ESXi host (infra) that was not under test. We configured one as an Active Directory® domain controller, DNS server, DHCP server, file server, and NTP server, one as a vCenter server, and one as a Horizon View connection server. Additionally, we deployed two more Microsoft Server 2008 R2 virtual machines, the first one to server as Citrix licensing server and the second one as a Citrix Provisioning Services server. We also configured AD roaming profiles and folder redirection for all Login VSI users.

Configuring power settings on HP DL380p Gen8

1. Power on the server, and press F9 to enter Setup.
2. Select Power Management Options, and press Enter.
3. Select HP Power Profile, and press Enter.
4. Select Maximum Performance. Press F10 to save changes, and exit utility.

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

1. Connect to `infra` via the VMware vSphere client.
2. Log in as `root`.
3. Click the Virtual Machines tab.
4. Right-click, and choose New Virtual Machine.
5. Choose Custom, and click Next.
6. Assign the name `DC1` to the virtual machine, and click Next.
7. Select `infra` as the host, and click Next.
8. Select the appropriate datastore for 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 four cores per virtual socket, and click Next.
12. Choose 4 GB RAM, and click Next.
13. Click 1 for the number of NICs, select VMXNET3, connect to the VDI network, 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 40 GB, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
17. Keep the default virtual device node (0:0), and click Next.
18. Click Finish.
19. Right-click the VM, and choose Edit Settings.
20. On the Hardware tab, click Add…
21. Click Hard Disk, and click Next.
22. Click Create a new virtual disk, and click Next.

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23. Specify 40 GB for the virtual disk size, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
24. Choose SCSI (0:1) for the device node, and click Next.
25. On the Hardware tab, click Add…
26. Click Create a new virtual disk, and click Next.
27. Specify 40 GB for the virtual disk size, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
28. Choose SCSI (0:2) for the device node, and click Next.
29. On the Hardware tab, click Add…
30. Click Create a new virtual disk, and click Next.
31. Specify 40 GB for the virtual disk size, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
32. Choose SCSI (0:3) for the device node, and click Next.
33. Click Finish, and click OK.
34. Click the Resources tab, and click Memory.
35. Select Reserve all guest memory, and click OK.
36. Connect the VM virtual CD-ROM to the Microsoft Windows Server 2008 R2 installation disk.
37. 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. Install VMware Tools. For more information, see kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
11. Reboot the server.
12. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
13. Enable remote desktop access.
14. Change the hostname to DC1 and reboot when the installation prompts you.
15. Run diskmgmt.msc.
16. Select a 40 GB volume, name it profiles, format it NTFS, and assign it drive letter E.

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17. Select another 40 GB volume, name it `share`, format it NTFS, and assign it drive letter `F`.
18. Select the last 40 GB volume, name it `folders`, format it NTFS, and assign it drive letter `G`.
19. 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 `172.0.0.10/255.255.0.0`

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.local`, 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 the 172.0.0.x subnet.

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.

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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.local` for the parent domain.
5. Enter 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=`172.0.1.0`
   - End IP address=`172.0.10.0`
   - Subnet mask=`255.255.0.0`
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 that DHCP server install succeeded.
16. Click Close.

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 www.loginvsi.com/en/admin-guide/installation.html. Open Windows Explorer, and create the following folders: `f:\share, e:\profiles and g:\folderredirect`

1. Assign permissions of read/write to the vdi/everyone group.
2. Right-click the `f:\share, e:\profiles and g:\folderredirect` folders, and select Properties.
3. Click the Sharing tab, and click Share…
4. Add everyone, system and administrators to the Read/Write group, and click Share.
5. Right-click the `g:\folderredirect` folder and select Properties→Sharing→Advanced Sharing→Caching, and select No files or programs from the Share Folder are available offline.
6. Click OK, Apply, OK, and Close.
7. From the Login VSI 3.7 media, run the Login VSI AD Setup.
8. Keep the default settings, and click Start.

Setting up roaming profiles for users

1. Open Active Directory Users and Computers.
2. Browse to vdi.local→Login_VSI→Users→Target.

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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.

Configuring folder redirection

1. Log into DC1 as `administrator`.
2. Open the Group Policy Editor.
3. Open Forest→Domains→vdi.local, right-click Group Policy Objects, and select New.
4. Type `folder redirection`, leave source starter GPO as None, and click OK.
5. Right-click the folder redirection GPO, and click Edit.
6. Browse User Configuration→Policies→Windows Settings→Folder Redirection, and right-click AppData (roaming).
7. In the AppData (roaming) Properties, target-tab select the following:
   - Setting= select Basic= Redirect everyone's folders to the same location
   - Target folder location= Create a folder for each user under the root path
   - Root Path= `\\DC1\folderredirection`
8. In the AppData (roaming) Properties→Setting tab, clear the checkbox for Grant the user exclusive right to AppData (Roaming), and click OK.
9. Repeat steps 6 through 8 for all subfolders in the folder redirection tree.
10. Close the Folder Redirection group policy.
11. In the Group Policy Editor, right-click the folder redirection policy, and select→GPO status→Computer Configuration Settings Disabled.
12. In the Group Policy Editor, drag the folder redirect GPO to Forest→Domains→vdi.local→Login_VSI→Users→Target.

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

1. Log into the `infra` server with the VMware vSphere client.
2. In the vSphere client, under Basic Tasks, select Create a new virtual machine.
3. Choose Custom, and click Next.
4. Assign the name `vCenter` to the virtual machine, and click Next.
5. Select `infra` as the host, and click Next.
6. Select the appropriate storage, and click Next.
7. Choose Virtual Machine Version 8, and click Next.
8. Choose Windows, choose Microsoft Windows Server 2008 R2 (64-bit), and click Next.
9. For CPUs, select one virtual processor socket and two cores per virtual socket, and click Next.
10. Choose 4GB RAM, and click Next.
11. Click 1 for the number of NICs, select VMXNET3, connect to the `vdi-net` port group, and click Next.

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12. Leave the default virtual storage controller, and click Next.

13. Keep the default virtual device node (0:0), and click Next.

14. Connect the VM virtual CD-ROM to the Microsoft Windows 2008 R2 installation disk.

15. Click Finish.

16. Right-click the vCenter VM, and click Edit settings.

17. Click the Resources tab, click Memory, check the Reserve all guest memory checkbox, and click OK.

18. Start the VM.

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

1. Open a virtual machine console on `vCenter`.

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

3. Click Install Now.

4. Choose Windows Server 2008 R2 Enterprise (Full Installation), and click Next.

5. Accept the license terms, and click Next.

6. Click Custom.

7. Click the Disk, and click Drive options (advanced).

8. Click New→Apply→Format, and click Next.

9. After the installation completes, click OK to set the Administrator password.

10. Enter the administrator password twice, and click OK.

11. Install VMware Tools. For more information, see
    kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.

12. Reboot.

13. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.

14. Enable remote desktop access.

15. Change the hostname to `vCenter` and reboot when the installation prompts you.

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, subnet, gateway, and DNS server.

17. Join the VDI domain.

18. Reboot the system.

Installing Microsoft SQL Server 2008 R2

1. Insert installation media, and click OK to install .NET framework.

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2. Wait for the SQL Installer to launch. On the left menu, click Installation.
3. Click New installation or add features to an existing installation. Click OK.
4. Enter the Product Key, and click Next.
5. Check the I accept the license terms checkbox, and click Next.
6. Click Install to install the Setup Support Files (required).
7. Resolve any issues displayed in the setup wizard, and click Next.
8. At the Setup Role screen select SQL Server Feature Installation, and click Next.
9. Select the Database Engine Services, Full-Text Search, Client tools Backwards Compatibility, Management Tools Basic and Complete, and click Next twice.
10. Accept instance configuration defaults, and click Next.
11. Accept defaults for disk space requirements, and click Next.
12. Click Use the same account for all SQL Server services, select NT Authority\System, and click OK. Click Next.
13. Select Mixed Mode and enter a password for the SA account. Click Add Current User, and click Next.
14. Accept defaults for error reporting, and click Next.
15. Review installation configuration rules check, and click Next.
16. To begin installation, click Install.
17. At completion screen, click Close.
18. Run Windows Update to receive all updates and security patches.

Setting up a database and ODBC DSN for vCenter

1. From the server desktop, open Start→All Programs→Microsoft SQL Server 2008 R2→Configuration Tools→SQL Server Configuration Manager.
2. Click SQL Server Network Configuration→Protocols for MSSQLSERVER.
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. Repeat this step for the SQL Server Agent service.
6. Start the SQL Server browser service and the SQL Server Agent service.
7. From the SQL server desktop, open Start→All Programs→Microsoft SQL Server 2008 R2→Configuration Tools→SQL Server Management Studio
8. Click Connect.
9. Select the Databases folder, right-click, and select New Database.
10. Provide the name `vCenter` for the new database.
11. Click Options and change the recovery model from full to simple, and click OK.
12. From the desktop of the vCenter server, select Start→Run→`odbcad32.exe`.
13. Click the system DSN tab.

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14. Click Add.
15. Click SQL Server Native Client 10.0, and click Finish.
16. In the Create a New Data Source to SQL Server text box, enter the connection name type: `vCenter`.
17. For Server, select SQL, and click Next.
18. Change authentication to With SQL Server authentication using a login ID and password entered by the user, enter `sa` as the Login ID, use the password you defined in SQL server setup for the SA account, and click Next.
19. Select the Change the default database to checkbox, choose `vCenter` from the pull-down menu, and click Next.
20. Click Finish.
21. Click Test Data Source… to confirm correct configuration.
22. Click OK to create the vCenter ODBC connection.

Installing VMware vCenter 5.1

1. Log onto the vCenter as `VDI\administrator`.
2. From the VMware vCenter 5.1 install media, click Autorun.
3. Click Run to start the install wizard.
4. Click the Install button on the VMware vSphere 5.1 Simple Install wizard.
5. Select the Install wizard language as English, and click OK.
6. At the Install wizard welcome screen, click Next.
7. At the End User Patent Agreement, click Next.
8. Agree to the License Agreement, and click Next.
9. Enter and confirm the password you wish to use with the Administrator account for vCenter Single Sign On, and click Next.
10. Select Install a local Microsoft SQL Server 2008 R2 Express Instance, and click Next.
11. Enter and confirm the passwords for the DBA and SQL user accounts, and click Next.
12. Confirm the Fully Qualified Domain Name or IP address is correct, and click Next.
13. Check the Use network service account checkbox, and click Next.
14. Accept the default installation path, and click Next.
15. Accept the default https port, and click Next.
16. Click Install.
17. After Single Sign On completes, and vCenter Server installation begins, enter user information and a license key, and click Next.
18. Select "Use an existing supported database" and select the Data Source Name (DSN) for the connection to the SQL Server: `vCenter`.
19. Enter `sa` as the database username, provide the password for the SA account, and click Next.
20. Select the system account for the vCenter Server service account, and click Next.

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21. Keep the vCenter default ports, and click Next.
22. Select 1024 MB for the JVM memory, and click Next.
23. Click Install to finish the vCenter server installation.
24. Click Finish to exit the wizard.
25. Click OK to confirm completion.
26. Click Exit on the installer.
27. Restart the server.
28. Using the vSphere client, log into the vCenter server as `VDI\administrator`.
29. Right-click the root of vCenter, and click New Data center.
30. Name the New datacenter `vdi`.
31. Add the `infrastructure` server to the datacenter.
32. Add the `server under test` to the datacenter.

Setting up a database and ODBC DSN for Composer

1. Open a virtual machine console on `vCenter`.
2. From the server desktop, open Start→All Programs→Microsoft SQL Server 2008 R2→Configuration Tools→SQL Server Management Studio.
3. Click Connect.
4. Select the Databases folder, right-click and select New Database.
5. Provide the name `composer` for the new database.
6. Click Options and change the recovery model from full to simple, and click OK.
7. From the desktop of the vCenter server, select Start→Run→`odbcad32.exe`.
8. Click the system DSN tab.
9. Click Add.
10. Click SQL Server Native Client 10.0, and click Finish.
11. In the Create a New Data Source to SQL Server text box, enter the connection name: `composer`.
12. For Server, select SQL, and click Next.
13. Change authentication to With SQL Server authentication using a login ID and password entered by the user, enter `sa` as the Login ID, use the password you defined in SQL server setup for the SA account, and click Next.
14. Select the Change the default database to checkbox, choose `composer` from the pull-down menu, and click Next.
15. Click Finish.
16. Click Test Data Source… to confirm correct configuration.
17. Click OK to create the Composer ODBC connection.

Setting up VMware Horizon View 5.2 Composer 5.2

1. Open the View5 media folder, and run the file named VMware-viewcomposer-5.2.0.exe

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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, type `composer` as the source name and `sa` as the user name. Enter the password, and click Next.

6. Leave the default SOAP port, and click Next.

7. Click Install, and click Finish.

8. Restart the server.

Setting up a VM to host the VMware Horizon View 5.2 connection server

1. Log into vCenter with the VMware vSphere client.

2. In the vSphere client, browse to the ESXi host named infrastructure.

3. Click the Virtual Machines tab.

4. Right-click, and choose New Virtual Machine.

5. Choose Custom, and click Next.

6. Assign the name `View Connection` to the virtual machine, and click Next.

7. Select infrastructure for the host, and click Next.

8. Select the appropriate 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 two 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 `vdi-net` port group, and click Next.

13. Leave the default virtual storage controller, and click Next.

14. Choose to create a new virtual disk, and click Next.

14. Make the OS virtual disk size 40 GB, choose thick-provisioned lazy zeroed, specify the OS datastore on the external storage, and click Next.

15. Keep the default virtual device node (0:0), and click Next.

16. Connect the VM virtual CD-ROM to the Microsoft Windows Server 2008 R2 installation disk.

17. Right-click the `View` VM, and click Edit settings.

18. Click the Resources tab, click Memory, check the Reserve all guest memory checkbox, and click OK.

19. Click Finish.

20. Start the VM.

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

1. Open a virtual machine console on `View`.

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

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3. Click Install Now.

4. Choose Windows Server 2008 R2 Enterprise (Full Installation), and click Next.

5. Accept the license terms, and click Next.

6. Click Custom.

7. Click the Disk, and click Drive options (advanced).

8. Click New→Apply→Format, and click Next.

9. After the installation completes, click OK to set the Administrator password.

10. Enter the administrator password twice, and click OK.

11. Install VMware Tools. For more information, see
   kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.

12. Reboot.

13. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.

14. Enable remote desktop access.

15. Change the hostname to `View` and reboot when the installation prompts you.

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, subnet, gateway, and DNS server.

17. Join the VDI domain.

18. Reboot the system.

Installing the VMware Horizon View 5.2 Connection Server 5.2

1. Log into the server named `View`.

2. Browse to VMware Horizon View 5.2 installation media, and click VMware-viewconnectionserver-x86_64-5.2.0.exe

3. Click Run.

4. At the Welcome screen, click Next.

5. Agree to the End User License Agreement, and click Next.

6. Keep the default installation directory, and click Next.

7. Select View Standard Server, and click Next.

8. At the Data Recovery screen enter a backup password, and click Next.

9. Allow View Server to configure the Windows firewall automatically, and click Next.

10. Authorize the local administrator to administer View, and click Next.

11. Choose whether to participate in the customer experience improvement program, and click Next.

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12. Complete the installation wizard to finish installing View Connection Server.
13. Click Finish.
14. Reboot server.

Configuring the VMware Horizon View 5.2 Connection Server

1. Open a Web browser to <view connection server ip address>/admin.
2. Log in as `administrator`.
3. Under Licensing, click Edit License…
4. Enter a valid license serial number, and click OK.
5. Open View Configuration→Servers.
6. In the vCenter Servers tab, click Add…
7. Enter vCenter server credentials, and click Next.
8. At the View composer screen select View Composer co-installed with vCenter Server, and click Next.
9. At the View composer domains screen click Add…
10. Enter full domain name and user credentials.
11. At the storage screen, select Reclaim VM disk space and Enable View Storage Accelerator.
12. Change the Default host cache size to 2048 MB, and click Next.
13. At the ready to complete screen, click Finish.

Installing the Windows 7 Enterprise (x64) base image VM for VMware Horizon View 5.2

We created a single Windows 7 Enterprise x64 VM as the gold image for VMware Horizon View 5.2 linked clone deployment.

Installing the Windows 7 Enterprise (x64) VMware Horizon View 5.2 5 gold image

1. Log into vCenter.
2. In the vSphere client, connect to the vCenter Server, and browse to the ESXi host named SUT.
3. Click the Virtual Machines tab.
4. Right-click, and choose New Virtual Machine.
5. Choose Custom, and click Next.
6. Assign the name `gold_image` to the virtual machine, and click Next.
7. Select view_infra datastore and click Next.
8. Choose Virtual Machine Version 8, and click Next.
9. Choose Windows, choose Microsoft Windows 7 (64-bit), and click Next.
10. Choose one virtual processor, and click Next.
11. Choose 1024 MB RAM, and click Next.
12. Click 1 for the number of NICs, select VMXNET 3, VDI-NET, and click Next.
13. Leave the default virtual storage controller, and click Next.
14. Choose to create a new virtual disk, and click Next.

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15. Make the OS virtual disk size 24 GB, choose thin-provisioned, click Next.
16. Keep the default virtual device node (0:0), and click Next.
17. Click Finish, and click OK.
18. Edit the gold_image VM.
19. Remove the virtual floppy, and click OK.
20. In the Options tab→General, deselect Enable logging, and click OK.
21. Click the Resources tab, click Memory, click the box next to Reserve all guest memory, and click OK.

Installing Windows 7 Enterprise (x64)

1. Connect the VM virtual CD-ROM to the Microsoft Windows 7 x64 installation disk.
2. Start the VM.
3. When the installation prompts you, press any key to begin setup.
4. Enter your language preferences, and click Next.
5. Click Install.
6. Accept the license terms, and click Next.
7. Select Custom, and select the drive that will contain the OS.
8. Click Install, and the setup begins.
9. Type user for the username and change the computer name, and click Next.
10. Enter no password, and click Next.
11. For system protection, select Use recommended settings, and click Next.
12. Enter your time zone, and click Next.
13. Select the Work Network setting, and click Next.
14. Use Windows Update to patch the Windows 7 installation.
15. Install VMware Tools. For more information, see
    kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId
    =340
16. Reboot.
17. Join the vdi.local domain, and reboot.

Adjusting page file

1. Log in as vdi\administrator.
2. In the Metro UI, right-click Computer→Properties→Advanced system 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 2048 for both values, and select Set.

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Disabling Windows Firewall

The domain GPO automatically disables the Windows Firewall.

Installing Office 2010 Professional

1. Log in as vdi\administrator.
2. From the Office 2010 media, run Setup.
3. Enter the product key for Office 2010, and click Continue.
4. Accept the licensing agreement.
5. Select Install Now.
6. Reboot the system.

Installing the Login VSI Target software on gold_image

1. Log in as `vdi\administrator.`
2. Browse to \\dc1\share\vsi_install\setup\target setup\setup-x64.setup.
3. In the target setup wizard, type `\\dc1\share.`
4. Wait for the install to complete.

Installing the VMware Horizon View 5.2 agent on gold_image

1. Log in to gold_image.
2. Browse to the VMware Horizon View 5.2 agent media.
3. At the Welcome screen and License agreement, accept the terms, and click Next.
4. Accept install defaults, and click Next.
5. Select Do not enable the remote desktop capability on this computer, and click Next.
6. Keep the default install directory, and click Install.
7. Start the Windows Registry Editor, and navigate to the following registry key:
   `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\vmware-viewcomposer-ga.`
8. Navigate to the SkipLicenseActivation registry value. The default value is 0.
9. Set the value to `1`.
10. Reboot the VM gold_image.

Removing XPS printers

1. Click Start→Control Panel→View Devices and Printers.
2. In the Services and Printers window, delete the XPS printers and document writers.
3. Power off the VM and take a snapshot.

Disabling Windows auto-recovery and Java update scheduler

1. Open CMD prompt.
2. Type the following:
   ```
   bcdedit /set {default} recoveryenabled No <enter>
   bcdedit /set {default} bootstatuspolicy ignoreallfailures <enter>
   ```

3. Type `regedit` and press Enter.
4. Browse to `HKEY_LOCAL_MACHINE\SOFTWARE\JavaSoft\Java Update\Policy\`.
5. Create a DWORD key named `EnableAutoUpdateCheck` and set the value to 0.
6. Prevent the java update scheduler from running. Browse to
   `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run\`
   and delete the key named `SunJavaUpdateSched`.
7. Power off the VM and take a snapshot.

Creating the desktop pool and adding entitlements for Login VSI users

We set up a VMware Horizon View 5.2 pool of 200 desktops on three LUNs housed on the Dell EqualLogic PS 6110X array. We created 200 Login VSI users for use within this pool, and added the group as entitled users of the View pool.

Creating a linked clone desktop pool

1. Open the View Administrator.
2. Log in as `vdi\administrator`.
3. Click Pools, and in the right window, click Add….
4. Select Automatic pool, and click Next.
5. Select Floating, and click Next.
6. Select View Composer Linked clones, and click Next.
7. Use the vCenter (administrator) as the source, and click Next.
8. Type `WIN7-pool` for the pool ID and display name, and click Next.
9. Leave the pool settings as defaults, and click Next.
10. Edit the disposable disk size as `4096`, and click Next.
11. Type a naming pattern of `Win7-{n:fixed=003}` and type `200` for both max number of desktops, and 1 as the number of spares.
12. Enter the virtual machine settings as follows:
    - Parent VM: `/New Datacenter/vm/gold_image`
    - Snapshot: `/snap_v1`
    - VM folder: `/New Datacenter/vm/View Pool/WIN8`
    - Host or cluster: `/New Datacenter/host/serverundertest`
    - Resource pool: `/New Datacenter/host/serverundertest,`
    - Linked clone Datastores: `EQL1,EQL2,EQL3`
13. Choose the AD container OU=Computers,OU=Login_VSI, and use quickprep.
14. Click Finish to create the pool.
15. Highlight the pool named `Pool`, and click Entitlements.
16. Click Add, select login_VSI_TS/vdi.local, and click OK.
17. Ensure all 200 desktops have a status of ready.

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INSTALLING AND CONFIGURING CITRIX XENAPP 6.5 FP1

We installed a fresh copy of Microsoft Server 2012 R2 on a virtual machine housed on the ESXi host under test and used this VM as a XenApp master image. We also installed Microsoft Office 2010, and configured it as a VSI target. We also created two additional VMs on the infrastructure server to serve as a Citrix licensing server and a Citrix provisioning server.

Setting up a VM to host the Citrix Licensing Server

1. Log into the `infra` server with the VMware vSphere client.
2. In the vSphere client, under Basic Tasks, select Create a new virtual machine.
3. Choose Custom, and click Next.
4. Assign the name `CitrixLIC` to the virtual machine, and click Next.
5. Select `infra` as the host, and click Next.
6. Select the appropriate storage, and click Next.
7. Choose Virtual Machine Version 8, and click Next.
8. Choose Windows, choose Microsoft Windows Server 2008 R2 (64-bit), and click Next.
9. For CPUs, select one virtual processor socket, and two cores per virtual socket, and click Next.
10. Choose 4GB RAM, and click Next.
11. Click 1 for the number of NICs, select VMXNET3, connect to the `vdi-net` port group, and click Next.
12. Leave the default virtual storage controller, and click Next.
13. Keep the default virtual device node (0:0), and click Next.
14. Connect the VM virtual CD-ROM to the Microsoft Windows 2008 R2 installation disk.
15. Click Finish.
16. Right-click the vCenter VM, and click Edit settings.
17. Click the Resources tab, click Memory, check the Reserve all guest memory checkbox, and click OK.
18. Start the VM.

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

1. Open a virtual machine console on `CitrixLIC`.
2. Choose the language, time and currency, and keyboard input. Click Next.
3. Click Install Now.
4. Choose Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
5. Accept the license terms, and click Next.
6. Click Custom.
7. Click the Disk, and click Drive options (advanced).
8. Click New→Apply→Format, and click Next.
9. After the installation completes, click OK to set the Administrator password.

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10. Enter the administrator password twice, and click OK.
11. Install VMware Tools. For more information, see
    kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
12. Reboot.
13. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
14. Enable remote desktop access.
15. Change the hostname to `CitrixLIC` and reboot when the installation prompts you.
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, subnet, gateway, and DNS server.
17. Join the VDI domain.
18. Reboot the system.

Installing Citrix Licensing Server

5. Click Start→Administrative Tools→Server Manager→Features→Add Features.
6. Select .NET Framework 3.5.1 Features, and click Add Required Role Services.
7. Click Next on the Web Server (ISS) screen.
8. Click Next on the Select Role Services screen, and click Install.
9. Click Close on the successful installation screen.
10. Insert XenApp 6.5 FP1 media.
11. Click Manually install components→Common Components→Citrix Licensing.
12. Click I accept the terms in the license agreement, and click Next.
13. At the Destination Folder screen, click Install.
14. Click Finish on the Installation completed screen.
15. At the Configuration screen, select the default ports, and enter Administrator password.
16. Click Start→All Programs→Citrix→Management Consoles→ License Administrator Console.
17. Click Administration, and enter user credentials.
18. Click Vendor Daemon Configuration, and click Import License.
19. Browse to location of the license, and click Import License.

Setting up a VM to host the Citrix Provisioning Server

1. Log into the `infra` server with the VMware vSphere client.
2. In the vSphere client, under Basic Tasks, select Create a new virtual machine.
3. Choose Custom, and click Next.
4. Assign the name `PVS` to the virtual machine, and click Next.
5. Select `infra` as the host, and click Next.
6. Select the appropriate storage, and click Next.
7. Choose Virtual Machine Version 8, and click Next.
8. Choose Windows, choose Microsoft Windows Server 2008 R2 (64-bit), and click Next.
9. For CPUs, select one virtual processor socket, and two cores per virtual socket, and click Next.
10. Choose 4GB RAM, and click Next.
11. Click 1 for the number of NICs, select VMXNET3, connect to the `vdi-net` port group, and click Next.
12. Leave the default virtual storage controller, and click Next.
13. Keep the default virtual device node (0:0), and click Next.
14. Connect the VM virtual CD-ROM to the Microsoft Windows 2008 R2 installation disk.
15. Click Finish.
16. Right-click the vCenter VM, and click Edit settings.
17. Click the Resources tab, click Memory, check the Reserve all guest memory checkbox, and click OK.
18. Start the VM.

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

1. Open a virtual machine console on `PVS`.
2. Choose the language, time and currency, and keyboard input. Click Next.
3. Click Install Now.
4. Choose Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
5. Accept the license terms, and click Next.
6. Click Custom.
7. Click the Disk, and click Drive options (advanced).
8. Click New→Apply→Format, and click Next.
9. After the installation completes, click OK to set the Administrator password.
10. Enter the administrator password twice, and click OK.
11. Install VMware Tools. For more information, see kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
12. Reboot.

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13. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
14. Enable remote desktop access.
15. Change the hostname to PVS and reboot when the installation prompts you.
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, subnet, gateway, and DNS server.
17. Join the VDI domain.
18. Reboot the system.

Installing SQL Express on Provisioning Services server

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. Insert the media for Citrix Provisioning services 6.5.
2. Browse to the SQL Express 2005 Express directory, and run SQLEXPR.exe.
3. Accept the End user agreement, and click Next.
4. Click Install to install prerequisites.
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 Finish.
14. From the vCenter desktop, open 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

1. Click Start→Administrative Tools→Server Manager→Features→Add Features.
2. Select .NET Framework 3.5.1 Features, and click Add Required Role Services.
3. Click Next on the Web Server (ISS) screen.
4. Click Next on the Select Role Services screen and then click Install.
5. Click Close on the successful installation screen.
6. Execute Citrix Provisioning Services x64.exe from the Citrix install media.
7. Click Install to install the required items.
8. At the Welcome Screen, click Next.
9. Click I accept the terms in the license agreement, and click Next.
10. Enter a user name and organization, select all users, and click Next.
11. Select a destination folder, and click Next.
12. On the Setup Type screen select Complete, and click Next, and click Install.
13. Click Finish on the Installation completed screen.
14. Click OK on the PVS Console warning.
15. Click Next on the Provisioning Services Configuration Wizard.
16. At the DHCP Services screen, select The service that runs on another computer.
17. At the PXE Services screen, select The service that runs on this computer.
18. At the Farm Configuration screen, select Create a farm, and click Next.
19. At the Database Server screen, click Browse… select the local SQLEXPRESS instance, and click Next.
20. At the New Farm screen, enter the following, and click Next:
    - Database name = ProvisioningServices
    - Farm = farm
    - Site = site
    - Collection name = Collection
    - Farm Administrator group = vdi.local/builtin/administrators
19. At the New Store screen, enter Store name as `Store`. For Path, browse to the root of e:\, and click Next.
21. Enter the License Server name, and click Next.
22. At the User account screen select Specified user account, enter the VDI\Administrator Password twice, click the checkbox next to Configure the database for the account, and click Next.
23. Keep the default number of days between password updates, and click Next.
24. Keep the primary interface and communication ports, and click Next.
25. Select Use the Provisioning Services TFTP service, and click Next.
26. Leave the stream service at default, and click Next.

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27. Click Finish and click Done.

Installing Citrix Provisioning Services Administrative Console

1. Execute Citrix Provisioning Services Console x64.exe.
2. At the welcome screen, click Next.
3. Accept the licensing agreement, and click Next.
4. Enter a user name and organization name, and click Next.
5. Accept the default install path, and click Next.
6. Accept the default install type, and click Next.
7. Click Install and Finish.

Configuring Citrix Provisioning Services

1. Click Start→All Programs→Citrix→Provisioning Services→Provisioning Services Console.
2. Right-click Provisioning Services Console, and select Connect to farm.
3. Enter IP of provisioning server, and click Connect.
4. Under Farm→Stores, right-click Store, and select Create a vDisk.
5. Enter a filename, adjust the size select Fixed as the type, and click Create vDisk.
6. Under Farm→Sites→Site→Device Collections right-click Collection, and select Create Device.
7. Enter a name for the new device. Under Type, select Maintenance. Under Boot from, select Hard Disk, and enter the MAC address of the XenApp master image.
8. Click the vDisk tab, and under vDisk for this Device select Add…
9. Select the vDisk previously created, and click OK twice.

Configuring Boot Server option on Domain Controller

1. Click Start→Run and type `DHCPmgmt.msc`.
2. DHCP→dc1.vdi.com→IPv4→Server Options.
3. Right-click Server Options, and select Configure options.
4. Activate option 66 Boot Server Host Name.
   - String value=`<ip of the provisioning server>`
5. Activate option 67 Boot file Name.
   - String value= `ARDBP32.BIN`
6. Click OK.

Setting up a VM to host Citrix XenApp

1. Log into the `infra` server with the VMware vSphere client.
2. In the vSphere client, under Basic Tasks, select Create a new virtual machine.
3. Choose Custom, and click Next.
4. Assign the name `XenAppGold` to the virtual machine, and click Next.
5. Select `infra` as the host, and click Next.

6. Select the appropriate storage, and click Next.

7. Choose Virtual Machine Version 8, and click Next.

8. Choose Windows, choose Microsoft Windows Server 2008 R2 (64-bit), and click Next.

9. For CPUs, select one virtual processor socket, and four cores per virtual socket, and click Next.

10. Choose 16GB RAM, and click Next.

11. Click 1 for the number of NICs, select VMXNET3, connect to the `vdi-net` port group, and click Next.

12. Leave the default virtual storage controller, and click Next.

13. Keep the default virtual device node (0:0), and click Next.

14. Connect the VM virtual CD-ROM to the Microsoft Windows 2008 R2 installation disk.

15. Click Finish.

16. Right-click the vCenter VM, and click Edit settings.

17. Click the Resources tab, click Memory, check the Reserve all guest memory checkbox, and click OK.

18. Start the VM.

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

1. Open a virtual machine console on `XenAppGold`.

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

3. Click Install Now.

4. Choose Windows Server 2008 R2 Enterprise (Full Installation), and click Next.

5. Accept the license terms, and click Next.

6. Click Custom.

7. Click the Disk, and click Drive options (advanced).

8. Click New→Apply→Format, and click Next.

9. After the installation completes, click OK to set the Administrator password.

10. Enter the administrator password twice, and click OK.

11. Install VMware Tools. For more information, see kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.

12. Reboot.

13. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.

14. Enable remote desktop access.

15. Change the hostname to `XenAppGold` and reboot when the installation prompts you.

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).

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d.   Select TCP/IP (v4), and choose Properties.

e.   Set the IP address, subnet, gateway, and DNS server.

17. Join the VDI domain.

18. Reboot the system.

Installing XenApp Server 6.5

1.   Insert media for Citrix Provisioning services 6.5.

2.   Click Install XenApp Server.

3.   Click OK to install .NET 3.5 SP1 Framework.

4.   At the XenApp Server Role Manager screen, click Add server roles.

5.   Select Platinum Edition.

6.   Select I accept the terms of this license agreement, and click Next.

7.   Under Common Roles, select XenApp, and click Next.

8.   At the roles subcomponents screen, click Next.

9.   At the Review prerequisites screen, click Next.

10. At the Ready to install screen, click Install.

11. Click Finish, and restart the server.

12. After the server restarts, click Resume Install.

13. At the ready to Install screen, click Install.

14. Click Finish after the server roles are installed.

15. Under Server Configuration Task, click Specify Licensing.

16. Enter the License server name, test the connection, and click Next.

17. Select XenApp as the licensing mode, and click Apply.

18. Under Server Configuration Task click Configure.

19. Click Create a new server farm.

20. Enter NewFarm under farm name and VDI\administrator under administrator account, and click Next.

21. Click Existing Microsoft SQL Server database, and click Next.

22. Enter the Database server name and Database name, and click Next.

23. Enter administrator credentials, test the connection, and click Next.

24. At the Configure shadowing screen, click Next.

25. At the Specify advanced server settings screen, click Next.

26. At the ready to configure screen, click Apply.

27. At the Server configured successfully screen, click Finish.

28. Reboot the server.

Installing Applications on XenApp Server 6.5

1.   Click Start→Control Panel→Install Application on Remote Desktop Server.

2.   At the Install program from floppy disk or CD-ROM, click Next.

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3. Click Browser and select Office 2010.exe, click Open, click Next, and run Setup.

4. Enter the product key for Office 2010, and click Continue.

5. Accept the licensing agreement.

6. Select Install Now.

7. Click Start→Control Panel→Install Application on Remote Desktop Server.

8. At the Install program from floppy disk or CD-ROM, click Next.

9. Click Browser and select Login VSI Target Setup.exe, click Open, click Next, and run Setup.

10. In the Target Setup wizard, specify the VSI share \\AD01\share.

11. Click Start.

12. At the security warnings, click OK.

13. When the installation is complete, reboot the system.

Installing Provisioning Services Target Device on XenApp Server 6.5

1. Execute Citrix Provisioning Services Target Device x64.exe.

2. At the welcome screen, click Next.

3. Accept the licensing agreement, and click Next.

4. Enter a user name and organization name, and click Next.

5. Accept the default install path, and click Next.

6. At the Ready to Install the Program screen, click Install.

7. At the Installation Wizard Completed, click Finish.

8. Restart the server.

9. Install the Windows6.1 KB2550978-x64 Microsoft Update Standalone Package.

10. Restart the server.

Creating a VM template for Provisioning Services

1. Shut down XenAppGold Virtual Machine.

2. On vCenter, clone the Virtual Machine, and name it GoldTemplate.

3. Before cloning, edit the virtual hardware, and click Continue.

4. Select Hard disk 1, and click Remove.

5. Select Remove from virtual machine and delete files from disk, and click OK.

6. Right-click GoldTemplate, and select Template→Covert to template.

Provisioning Services Imaging Wizard

1. Launch the Citrix XenApp Server Role Manager.

2. Under Server Configuration Tasks, select Edit Configuration.

3. Select Prepare this server for imaging and provisioning.

4. Select Remove the current server instance from the farm and clear database location settings from this server, and click Next. Click Apply.

5. Click Start→Imaging Wizard.

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6. At the Welcome screen, click Next.
7. At the Connect to Farm screen, enter the Provisioning Services Server information, and click Next.
8. Select use existing vDisk, and choose the previously created vDisk. Click Next.
9. At the Microsoft Volume Licensing screen, select None, and click Next.
10. At the Configure Image Volumes, click Autofit, and click Next.
11. At the Existing Target Device screen, click Next.
12. At the Summary of Farm Changes screen, click Optimize for Provisioning Services, and click OK.
13. Click Finish, and shutdown the serve.
14. In vCenter, right-click the XenApp master image VM, and click Edit settings.
15. Click Options tab→Boot options, check the box to force BIOS Setup, and click OK.
16. In the VM BIOS, tab to the Boot menu, and change the boot order to:
    a. Network boot from VMware VMXNET3
    b. Removable Devices
    c. Hard Drive
    d. CD-ROM Drive
17. Tab to Exit, and save exiting changes.
18. On the boot menu, select the vDisk, and hit enter.
19. When the VM boots, it will boot from PXE, and Provisioning services will stream the vDisk to the device.
20. Log in as VDI\administrator.
21. Provisioning services will now copy XenApp master image to the vDisk.
22. Click Finish.
23. Shut down XenApp master image.

Deploying a XenApp pool with the Streamed VM Setup Wizard

1. Open the Provisioning services console→Farm→Sites→Site→vDisk Pool, and right-click the vDisk.
2. Select Properties, and change the Access mode to Standard Image and Cache type to Cache on server. Click OK.
3. Go to Farm→Sites, right-click Site, and select XenDesktop Setup Wizard.
4. At the welcome screen, click Next.
5. At the Hypervisor connection, select VMWare vSphere/ESX, and enter credentials for the vCenter VM. Click Next.
6. Select the Cluster or Host, and click Next.
7. Select GoldTemplate, and click Next.
8. Select the Provisioning services collection and vDisk, and click Next.
9. Enter the following, and click Next:
    a. Number of virtual machines=8

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       b.   vCPUs=4

       c.   Memory=16384 MB

       d.   Active Directory= Create New accounts

10. For Active directory location, click VDI.com→Login_VSI→computers.

11. For Base name type `XenApp#`, and click Next.

12. Click Finish, and click Done.

Configuring the XenApp Server Farm

1. On the Provisioning Server VM, put the vDisk in Private Access mode.

2. Power on XenApp1 VM.

3. Click Start→Administrative Tools→Citrix→XenApp Server Role Management→XenApp Server Role Manager.

4. Under Server Configuration Task, click Configure.

5. Click Create a new server farm.

6. Type `XenAppFarm` under farm name and `VDI\administrator` under administrator account, and click Next.

7. Click Existing Microsoft SQL Server database, and click Next.

8. Enter the Database server name and Database name, and click Next.

9. Enter administrator credentials, test the connection, and click Next.

10. At the Configure shadowing screen, click Next.

11. At the Specify advanced server settings screen, click Next.

12. At the ready to configure screen, click Apply.

13. At the Server configured successfully screen, click Finish.

14. Restart the server.

15. Click Start→Administrative Tools→Citrix→Management Consoles→Citrix AppCenter.

16. Click Disable Authenticode signature checking.

17. At the Configure and run discovery screen, click Next.

18. At the Select Products or Components screen, select XenApp, and click Next.

19. At the Select Servers screen, click Add Local Computer, and click Next.

20. At the Preview Discovery screen, click Next. Click Finish.

Joining the XenApp Server Farm

1. On the Provisioning Server VM, put the vDisk in Standard Access mode.

2. Power on all XenApp servers.

3. Log into all the XenApp servers, and click Start→Administrative Tools→Citrix→Management Consoles→Citrix AppCenter.

4. At the Welcome screen, click Next.

5. At the Select Products or Components screen, select XenApp, and click Next.

6. At the Select Servers screen, click Add…, type `XenApp1`, click OK, and click Next.

7. At the Preview Discovery screen, click Next. Click Finish.

Publishing Applications on the XenApp Server Farm

1. On Citrix AppCenter, go to XenAppFarm, and right-click Applications.
2. Click Publish application.
3. At the welcome screen, click Next.
4. Enter a Display name, and click Next.
5. Under Choose the type of application to publish, select Server desktop, and click Next.
6. At the Servers screen, click Add…, select all XenApp Servers, and click Next.
7. Under users, click Add…, select the `Login_VSI_TS` group, and click Next.
8. At the Shortcut presentation screen, click Next.
9. Click Finish.

Creating a load balancing policy on XenApp Server Farm

1. On Citrix AppCenter, go to XenAppFarm, and right-click Load Balancing Policies.
2. Select Create load balancing policy.
3. Enter a name for the policy.
4. Under Filters, select Client IP Address.
5. Select Filter based on client IP address, and select Apply to all client IP addresses.
6. Click Ok and make sure the policy is enabled.

Disabling XenApp lossy settings and changing frames per second

1. On Citrix AppCenter, go to XenAppFarm, and click Policies.
2. Select the User tab.
3. Under Citrix User Policies, click New.
4. Enter a Policy name, and click Next.
5. On the search bar, type `Lossy compression level`.
6. Select the Lossy compression level policy, and click Add.
7. Change the Value to None, and click OK.
8. On the search bar, type `Max frames per second`.
9. Select the Max frames per second policy, and click Add.
10. Change the Value (fps) setting to 30, and click OK. Click Next.
11. Under Filter select User or Group, and click Add.
12. Enter the VDI\Login_VSI_TS group, and click OK. Click Next.
13. Select Enable this policy, and click Create.

CREATING WINDOWS 7 ENTERPRISE X64 IMAGE VSI LAUNCHERS

Using the vSphere client, we created a Windows 7 Enterprise x64 VM with the Login VSI launcher software, and cloned it to create eight Login VSI launchers on the infrastructure server that was not under test.

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Setting up a VM to use as a Windows 7 Enterprise (x64) Login VSI launcher

1. Log into the vCenter.
2. In the vSphere client, connect to the vCenter Server, and browse to the infrastructure server.
3. Click the Virtual Machines tab.
4. Right-click, and choose New Virtual Machine.
5. Choose Custom, and click Next.
6. Assign the name `Launcher` to the virtual machine, and click Next.
7. Select the appropriate datastore, and click Next.
8. Choose Virtual Machine Version 8, and click Next.
9. Choose Windows, choose Microsoft Windows 7 (64-bit), and click Next.
10. Choose 1 virtual socket, 2 cores per virtual socket, and click Next.
11. Choose 8 GB RAM, and click Next.
12. Click 1 for the number of NICs, select VMXNET3 and VDI-NET, 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 32 GB, choose thin provision, and click Next.
16. Keep the default virtual device node (0:0), and click Next.
17. Click Finish.
18. Click Finish, and click OK.
19. Click the Resources tab, and click Memory.
20. Click Reserve all guest memory.
21. Click the Hardware tab.
22. Connect the VM virtual CD-ROM to the Microsoft Windows 7 x64 installation disk.

Installing Windows 7 Enterprise (x64)

1. Start the VM.
2. When the installation prompts you, press any key to begin setup.
3. Enter your language preferences, and click Next.
4. Click Install.
5. Accept the license terms, and click Next.
6. Select Custom, and select the drive that will contain the OS.
7. Click Install, and the setup begins.
8. Type `user` for the username, change the computer name, and click Next.
9. Enter a password, and click Next.
10. For system protection, select Use recommended settings, and click Next.
11. Enter your time zone, and click Next.
12. Select the Work Network setting, and click Next.
13. Use Windows Update to patch the Windows 7 installation.

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14. Install VMware Tools. For more information, see kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340

15. Reboot.

16. Join the vdi.local domain, and reboot.

Adjusting page file on the launcher

1. Log in as vdi\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 `8191` for both values, and select Set.

Disabling Windows Firewall

The domain GPO automatically disables the Windows Firewall.

Installing the VMware Horizon View 5.2 client

1. Browse to the VMware Horizon View 5.2.1 media, and run the VMware-viewclient-x86_64-5.2.1-937772.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. Download the latest Citrix Receiver from www.citrix.com/receiver.

2. Double-click CitrixReceiverWeb.

3. At the welcome screen, click Install.

Installing Virtual Audio Cables

By default, the virtual launchers cannot render audio, so we installed Virtual Audio Cables version 4.10 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 Login VSI target software on the launcher

1. Browse to VSIinstall media\setups\Launcher\.
2. Run the setup.exe.
3. In the Target Setup wizard, specify the VSI share (\\dc1\share).
4. Click Start.
5. Reboot the system.
6. Shut down the launcher VM.

Cloning the launcher

We created a template from the VM named launcher and deployed eight launchers using the sysprep functionality built into vCenter. For more information on how to clone virtual machines in VMware vCenter, please read www.vmware.com/support/pubs/vsphere-esxi-vCenter-server-pubs.html.

Login VSI testing pre-configuration

Before running the tests, we created 200 roaming profiles on the \\dc1\profiles share, and 200 redirected folders the \\dc1\folders share.

Running the Login VSI benchmark

We used eight launchers, configured in parallel, to run a medium workload with a launch interval of 20 seconds. For more information on how to run a Login VSI test, see www.loginvsi.com/en/admin-guide/performing-tests.

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APPENDIX C – COST ANALYSIS

We base this analysis on the following assumptions:

- Number users = number connections
- The server has two processors
- Each user is covered by a Microsoft Core CAL suite which includes Windows Server 2012 CAL
- Costs include software licenses plus 3 years of support
- Costs do not include Windows 7 or desktop software such as Microsoft Office
- For software that comes in bundles or packs, we use the average cost per item in the pack and multiply that by the number of units

Software cost analysis

Figures 10 through 12 show software cost estimates for the configurations and user counts we discuss in this report.

VMware Horizon View 5.2 Enterprise Edition for 174 users

	Unit	Cost per unit	No. of units	Total	Source
VMware Horizon View (10 Pack) + Production Support/Subscription for 3 years - $4,150.00 (averages $415 per desktop)	Concurrent user	$415.00	174	$72,210.00	store.vmware.com/store/vmware/en_US/DisplayProductDetailsPage/productID.265434800
Total				**$72,210.00**	
Cost per user for 174 users	**$415.00**				

Figure 10: Cost analysis for VMware Horizon View 5.2.

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Citrix XenApp 6.5 FP1 Enterprise Edition (Hosted Shared Desktop) - Lossless, 30 fps - 146 users

	Unit	Cost per unit	No. of units	Total	Source
Microsoft Windows Server Datacenter 2012, Single Open, One License, No Level (licenses up to two processors on a server)	2 processors	$4,810.00	1	$4,810.00	mla.microsoft.com/default.aspx
Microsoft Windows Server Datacenter 2012, two-year Software Assurance - $2,405 (averages $1,202.50 per year or $3,607.50 for three years)	2 processors	$3,607.50	1	$3,607.50	mla.microsoft.com/default.aspx
Citrix XenApp 6.5 FP1 Enterprise Edition Concurrent User License with one-year Subscription Advantage	Concurrent User	$450.00	146	$65,700.00	Easy XenApp Enterprise Edition Concurrent User License with one-year Subscription Advantage. www.thinclientpricing.com/citrix_xenapp.asp
Citrix XenApp two-year Subscription Advantage, Enterprise Edition Add-On	Concurrent User	$100.00	146	$14,600.00	Two-year Subscription Advantage add-on for one concurrent user. www.lscwarehouse.com/software-other.html and www.citrix.com/content/dam/citrix/en_us/documents/support/Subscription_Advantage_Price_Schedule.pdf
Windows Server 2012 Remote Desktop Services, one-user CAL	User	$149.00	146	$21,754.00	www.microsoftstore.com/store/msusa/en_US/pdp/productID.255866300
Windows Server 2012 Remote Desktop Services, one-user CAL Software Assurance	User	$111.75	146	$16,315.50	Estimate at 25 percent license cost per year.
Total				**$126,787.00**	
Cost per user for 146 users		**$868.40**			

Figure 11: Cost analysis for Citrix XenApp 6.5 FP1 with lossless settings.

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Citrix XenApp 6.5 FP1 Enterprise Edition (Hosted Shared Desktop) - Lossy, 24 fps - 151 users

	Unit	Cost per unit	No. of units	Total	Source
Microsoft Windows Server Datacenter 2012, Single Open, One License, No Level (licenses up to two processors on a server)	2 processors	$4,810.00	1	$4,810.00	mla.microsoft.com/default.aspx
Microsoft Windows Server Datacenter 2012, two-year Software Assurance - $2,405 (averages $1,202.50 per year or $3,607.50 for three years)	2 processors	$3,607.50	1	$3,607.50	mla.microsoft.com/default.aspx
Citrix XenApp 6.5 FP1 Enterprise Edition Concurrent User License with one-year Subscription Advantage	Concurrent user	$450.00	151	$67,950.00	MSRP for Easy XenApp Enterprise Edition, Concurrent User License with one-year Subscription Advantage. www.thinclientpricing.com/citrix_xenapp.asp
Citrix XenApp two-year Subscription Advantage, Enterprise Edition Add-On	Concurrent user	$100.00	151	$15,100.00	Two-year Subscription Advantage add-on for one concurrent user. www.lscwarehouse.com/software-other.html and www.citrix.com/content/dam/citrix/en_us/documents/support/Subscription_Advantage_Price_Schedule.pdf
Windows Server 2012 Remote Desktop Services, one-user CAL	User	$149.00	151	$22,499.00	www.microsoftstore.com/store/msusa/en_US/pdp/productID.255866300
Windows Server 2012 Remote Desktop Services one-User CAL Software Assurance	User	$111.75	151	$16,874.25	Estimate at 25 percent license cost per year.
Total				**$130,840.75**	
Cost per user for 151 users		**$866.50**			

Figure 12: Cost analysis for Citrix XenApp 6.5 FP1 with lossy settings.

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Hardware Cost Analysis

Figure 13 shows detailed hardware costs for the system used in both configurations.

HP ProLiant DL380p Gen8

Item	Cost per unit	No. of units	Total
HP ProLiant DL380p G8	$2,190.72	1	$2,190.72
Intel Xeon E5-2680 Processor	$2,224.50	2	$4,449.00
HP 8GB PC3L-10600 RDIMM	$157.13	24	$3,771.00
HP 750W Common Slot Platinum Plus Hot Plug Power Supply Kit	$234.50	2	$469.00
HP 2U Small Form Factor Ball Bearing Gen8 Rail Kit with CMA	$140.00	1	$140.00
HP C13 - AS3112-3 AU 250V 10Amp 2.5m Power Cord	$10.00	2	$20.00
Intel X520 Dual Port 10Gbe SFP+ Adapter	$528.00	1	$528.00
Total (incl. tax)			**$11,845.00**

Figure 13: Cost analysis for HP ProLiant DL380p Gen8 hardware.

Totals of Software and Hardware

Figures 14-16 combine the software and hardware costs from the previous figures to present a total cost for each tested configuration.

	Total
VMware Horizon View 5.2 Enterprise Edition for 174 users	$72,210.00
HP ProLiant DL380p Gen8	$11,845.00
Total	**$84,055.00**
Average cost per user	$483.07

Figure 14: Cost analysis for VMware Horizon View 5.2.

	Total
Citrix XenApp 6.5 FP1 Enterprise Edition (Hosted Shared Desktop) - Lossless, 30 fps - 146 users	$126,787.00
HP ProLiant DL380p Gen8	$11,845.00
Total	**$138,632.00**
Average cost per user	$949.53

Figure 15: Cost analysis for Citrix XenApp 6.5 FP1 with lossless settings.

	Total
Citrix XenApp 6.5 FP1 Enterprise Edition (Hosted Shared Desktop) - Lossy, 24 fps - 151 users	$130,840.75
HP ProLiant DL380p Gen8	$11,845.00
Total	**$142,685.75**
Average cost per user	$945.94

Figure 16: Cost analysis for Citrix XenApp 6.5 FP1 with lossy settings.

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APPENDIX D – CITRIX XENAPP 6.5 FP1 LOSSY RESULTS

In addition to our lossless testing, we also tested Citrix XenApp 6.5 FP1 with out-of-box defaults, 24 frames per second with lossy compression. Figure 17 shows the response times, in milliseconds, as the sessions increased. Lossy 24 FPS is an inferior image rendering and as such we chose lossless 30 FPS for our testing.

Figure 17: In our lossy test, Citrix XenApp 6.5 FP1 was able to run 151 sessions without generating a VSImax.
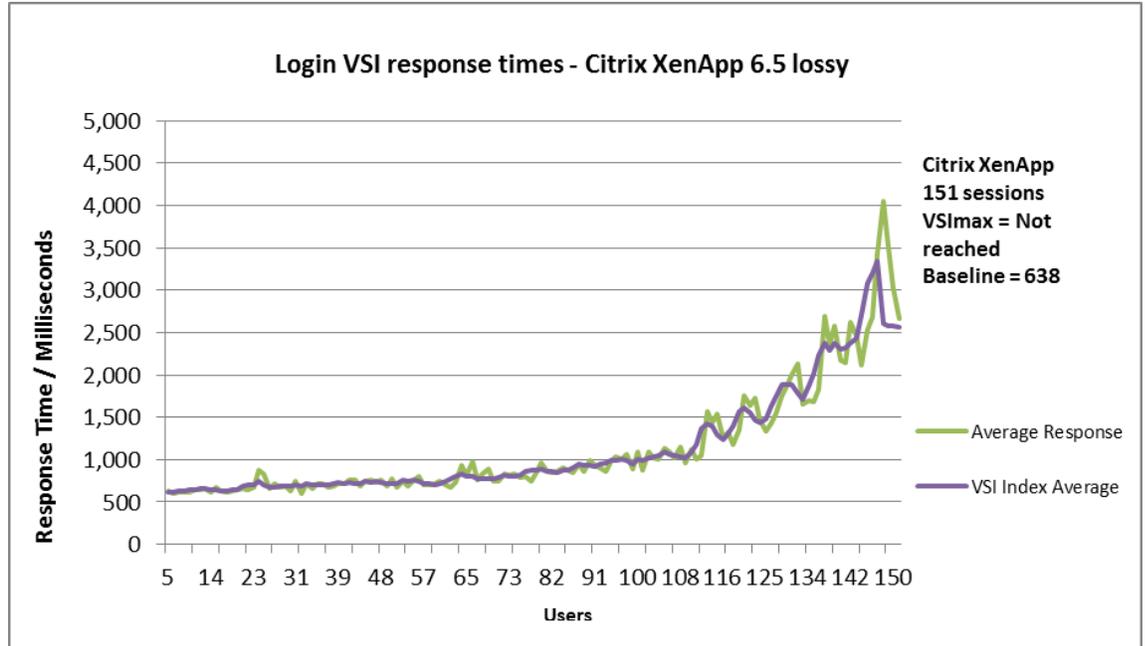
Figure 18 shows the percentage CPU utilization throughout our lossy Citrix XenApp 6.5 FP1 tests. Additional sessions exceed the VSImax for the server under test due to CPU utilization.

Figure 18: CPU utilization for our server under test throughout the lossy Citrix XenApp 6.5 FP1 test.

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ABOUT PRINCIPLED TECHNOLOGIES
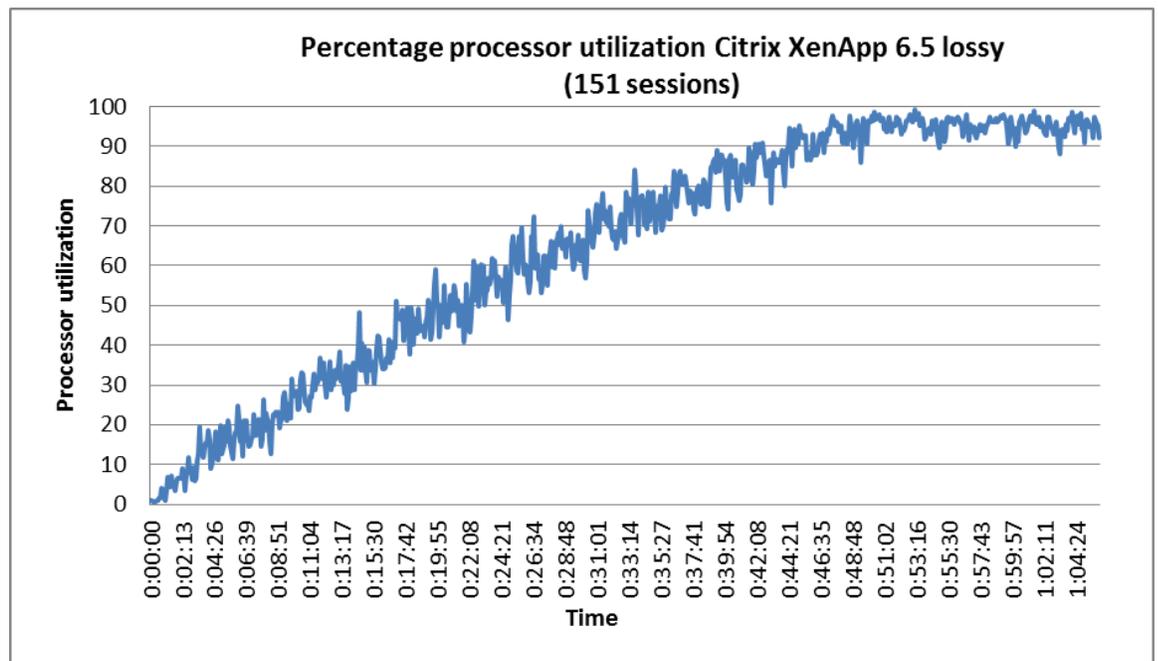
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When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help our clients assess how it will fare against its competition, its performance, its market readiness, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.

Scale testing and cost analysis study: VMware Horizon View 5.2 virtual desktop density vs. Citrix XenApp 6.5 FP1

A Principled Technologies test report **45**