VIRTUAL DESKTOP SCALABILITY AND PERFORMANCE WITH VMWARE VIEW 5.2 AND VIRIDENT FLASHMAX II STORAGE

Virident FlashMAX II storage with VMware® View® 5.2 virtual desktops

Delivered very low latency

Scaled easily and dependably

Handled storage-intensive tasks without sacrificing end-user performance

Whether you are planning to make the move to desktop virtualization or are looking to expand your existing virtual desktop infrastructure (VDI), it is important that you choose the right software and storage for your enterprise environment. It is also vital to be able to add hardware and predictably scale your environment so that you know how many users you can expect to support as your VDI needs grow. Choosing VMware View 5.2 software with a fast and reliable internal storage solution, such as Virident FlashMAX II™ storage devices, can maximize performance, reduce latency, and scale predictably as you add users.

In the Principled Technologies labs, we found that a single server running VMware View 5.2 virtual desktops with two low-profile Virident FlashMAX II storage devices could support 162 virtual desktops with nearly no latency to provide an excellent experience for end users. To verify how predictably and linearly this solution scales, we had only to add another server; two servers, each with two Virident devices, scaled perfectly to support 324 users. We also ran a storage-intensive recompose job on the desktops and found that Virident FlashMAX II devices could handle heavy maintenance jobs without sacrificing end-user performance.

MANY USERS, VERY LOW LATENCY, AND PREDICTABLE SCALABILITY

The success of a virtual desktop environment is dependent on the number of enterprise users your solution supports, the performance and response times it provides for your users, and the ability to predict the number of users you can expect to support when you scale your hardware. The storage solution that you use can have a significant effect on these factors.

We configured a server with two Virident FlashMAX II storage devices, an internal, PCIe, Flash-based storage solution to see how many VMware View 5.2 virtual desktops the solution could support. We used a tool (Login VSI 3.6) to create workloads that mimic the activity of typical office users completing moderate workloads, and then determined how many virtual sessions, reported as the VSImax, that the solution could handle simultaneously, while still offering a satisfactory user experience.

We used the Login VSI Medium workload 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.

We configured Login VSI to run the Medium workload against a pool of virtual desktops and set up the test to incrementally log users into virtual desktop sessions over a 45-minute period. Login VSI measures the total response time of all the applications from each session and calculates the VSI Index by taking the average response times and dropping the highest and lowest 2 percent.
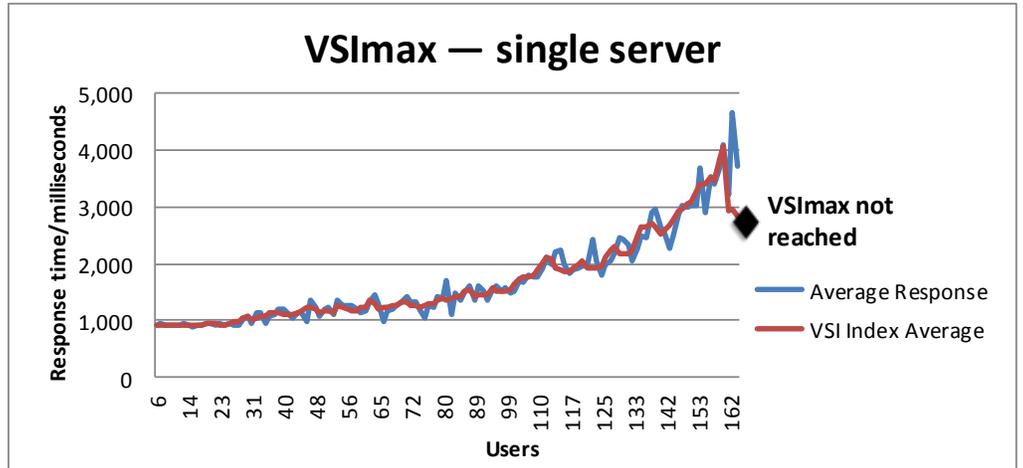
To test for scalability, we added an identical server with two Virident FlashMAX II devices and measured the maximum supported users. The second server supported 162 additional virtual desktops.

We then ran an I/O intensive maintenance task, recomposing half of a server's virtual desktops while the others continued to run simulated user workloads in order to determine the impact of heavy I/O on VDI performance. Continue reading for our findings. For information about the server we used for testing, see Appendix A. For complete details on how we tested, see Appendix B. For CPU utilization throughout our testing, see Appendix C.

Need double the performance? Double your servers and storage.

As Figure 1 shows, a single server with two Virident FlashMAX II storage cards was able to support 162 VMware View 5.2 virtual desktop users without reaching VSImax. VSImax represents the maximum user capacity at which performance did not degrade; therefore, not reaching VSImax is a positive indicator that response time remained satisfactory. In our tests, the processor was the bottleneck that prevented the server and storage solution from hosting more desktops (see Appendix C for details).

VSImax — single server

Figure 1: A single server with two Virident FlashMAX II storage devices supported 162 VMware View 5.2 virtual desktops.

[Chart: Response time/milliseconds (0–5,000) vs Users (6 to 162). Lines: Average Response, VSI Index Average. Label: "VSImax not reached."]

If you want to expand your virtual desktop infrastructure, it's important to know how your solution scales. When we added a second identical host server, the two-server solution running on Virident FlashMAX II storage cards was able to double exactly the VMware View 5.2 desktops of the single-server tests, for a total of 324 virtual desktop users (see Figure 2). The predictable scalability of the Virident FlashMAX II storage card solution makes it easy to plan and expand your VDI capacity as your needs grow.

VSImax — two servers

Figure 2: Two servers each with two Virident FlashMAX II storage cards supported 324 VMware View 5.2 virtual desktops.

[Chart: Response time/milliseconds (0–5,000) vs Users (11 to 315). Lines: Average Response, VSI Index Average. Label: "VSImax not reached."]
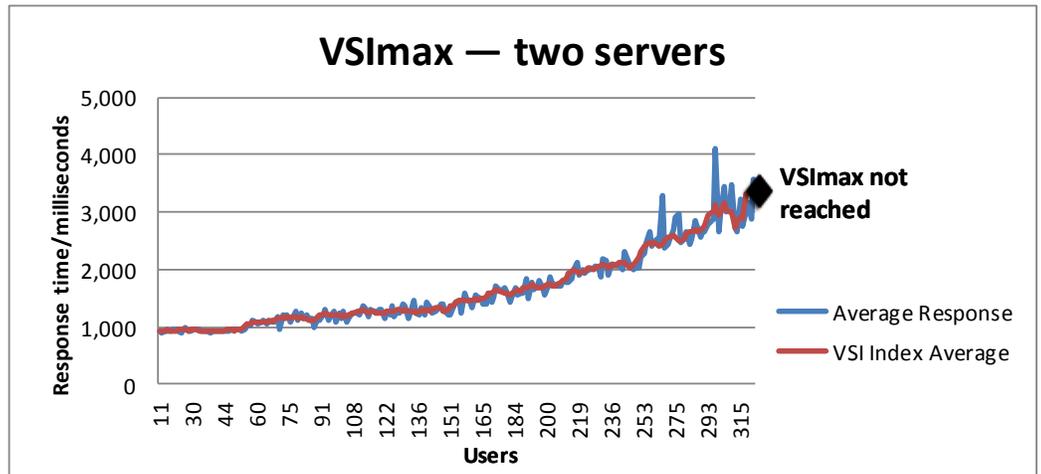
Figure 3 shows the datastore latency throughout our test with one server using two Virident FlashMAX II devices. Throughout the test, the storage had a very low latency, or response time, which translated to a better experience for users. Because latency did not approach the response time threshold, we can be sure that the high performance of the storage did not limit the number of virtual desktop sessions the server supported.

Figure 3: Storage latency throughout our test for VMware View 5.2 desktops on one server with two Virident FlashMAX II storage devices.

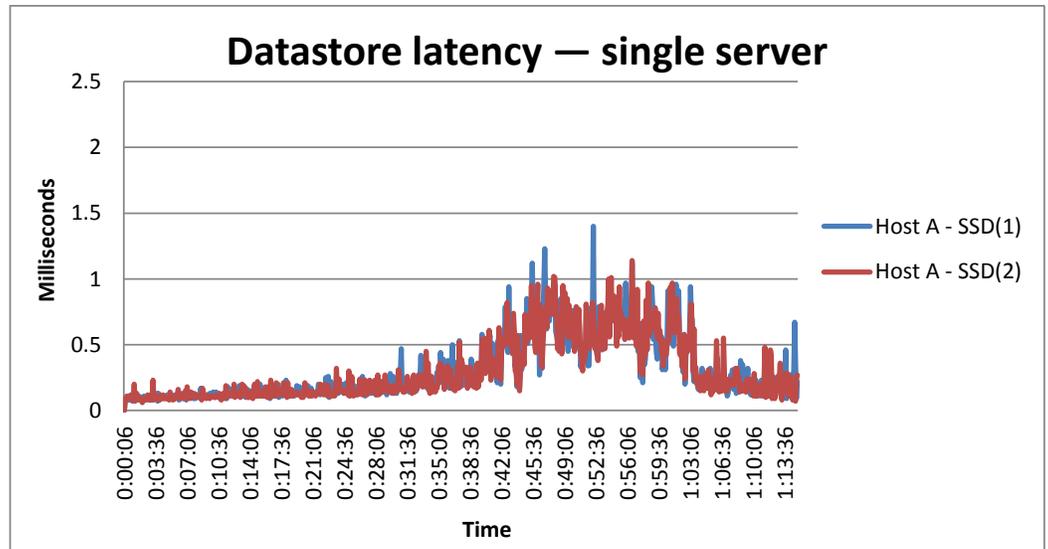**Datastore latency — single server**

Figure 4 shows the datastore latency throughout our test with two servers each with two Virident FlashMAX II cards. As in the single-server test, the cards performed with very low latency, which shows that the storage performance did not max out and was not the bottleneck for hosting more users.

Figure 4: Storage latency throughout our test for VMware View 5.2 desktops on two servers each with two Virident FlashMAX II storage devices.

Datastore latency — two servers
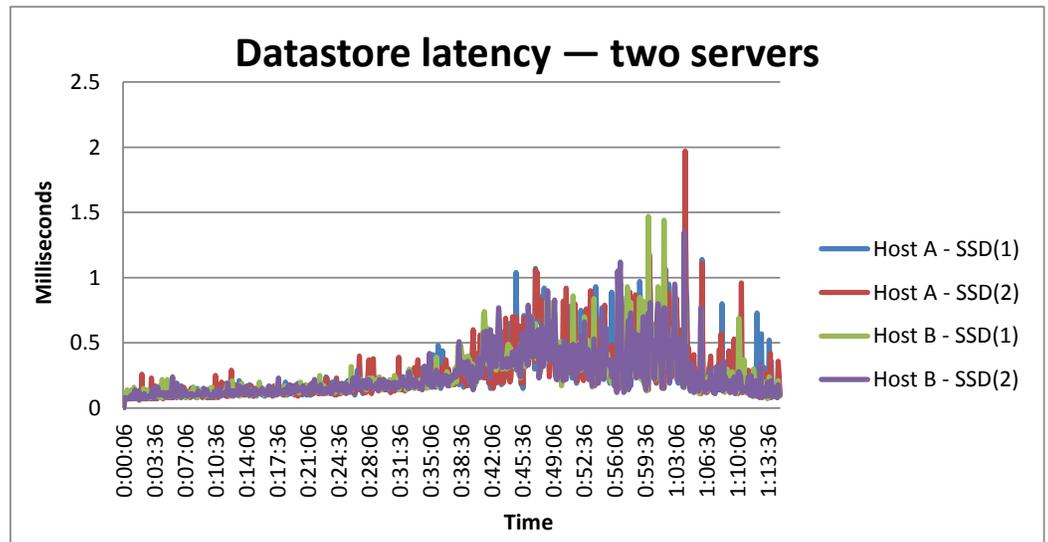
RECOMPOSE DESKTOPS WITHOUT SACRIFICING PERFORMANCE

If your solution isn't up to the task of running a virtual desktop environment, heavy maintenance tasks can grind performance to a halt. From time to time, administrators may need to recompose desktops so that they can install new applications or update existing ones, patch operating systems, or change hardware settings. To determine how our test solution could handle such a job, we split the 162 virtual desktops from a single server into two equal pools and ran an I/O-intensive recompose on one pool of 81 desktops, leaving the other desktops live for users to continue work.

As Figure 5 shows, the Virident FlashMAX II storage devices were able to handle the heavy I/O demand, and performance for the desktops didn't suffer from the maintenance task. The response time for the 81 desktops remained well below the threshold of acceptable performance, and the solution did not reach VSImax.

Figure 5: Response times for the 81 active desktops while recomposing the remaining desktops.
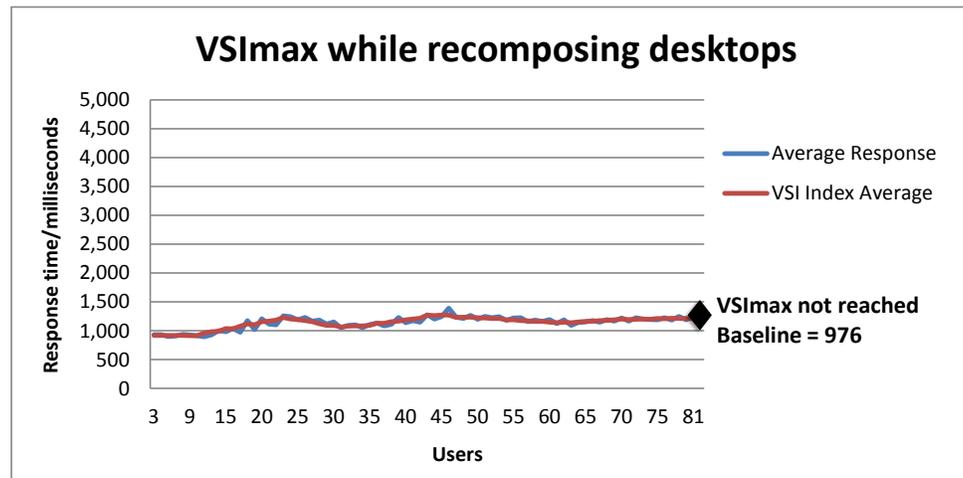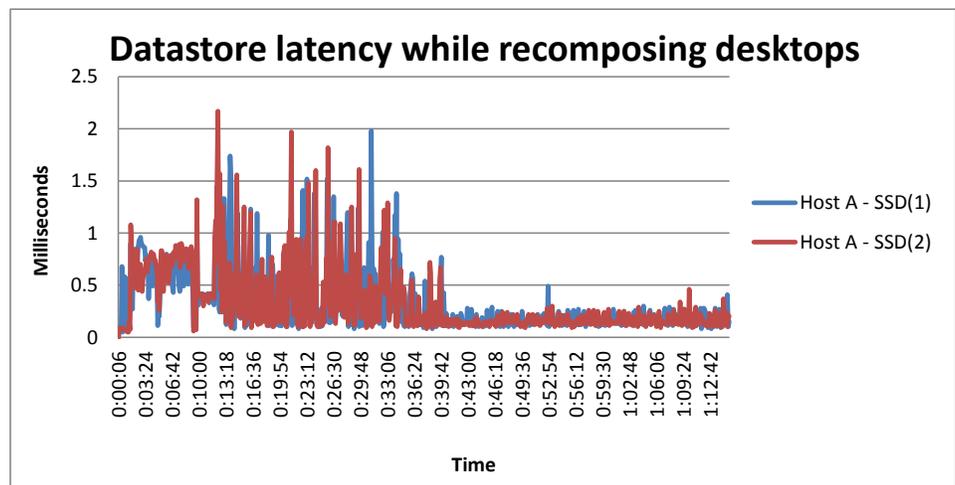

Figure 6 shows the datastore latency throughout our desktop recomposition test, which remained extremely low, indicating excellent user response times for the active virtual desktops running the simulated workloads.

Figure 6: Storage latency while recomposing desktops.

WHAT WE TESTED

About Virident FlashMAX II storage devices

According to Virident, Virident FlashMAX II is an internal storage-class memory solution that combines specialized software and hardware to deliver memory-class performance while delivering storage-class capacity, with sustained and predictable performance capabilities. By using Flash media instead of the traditional moving parts of hard drives, FlashMAX II storage maximizes storage performance. FlashMAX II uses Virident Flash-management with Adaptive Scheduling (vFAS™) to optimize access for increased performance and to ensure applications continuously receive a steady stream of data. The small footprint storage comes in a half-height, half-length PCIe card form factor, and connects via PCI Express 2.0 x8.

Virident FlashMAX II is a VMware Ready storage solution, which means that VMware considers the storage optimized for VMware vSphere and VMware View. For more information on Virident FlashMAX II storage, visit http://www.virident.com/products/flashmax/.

About VMware View 5.2

View 5.2 is the latest desktop virtualization software from VMware. VMware designed its View desktop virtualization software to simplify IT management of virtual desktops from within the cloud. A centralized interface allows administrators to manage upwards of tens of thousands of end-users. An administrator can easily manage settings such as policy enforcement, performance monitoring, connection brokering, and provisioning, to name a few. The result includes improved security, less costly management, and faster provisioning and maintenance of desktop images and applications. The end-user enjoys easier access to his or her View desktop from a variety of locations, less downtime, a customizable desktop, and robust multimedia capabilities.

VMware View 5 introduces View Persona Management™, a technology they designed to preserve and dynamically synchronize user desktops. According to VMware, Persona Management simplifies how administrators handle user profiles by allowing them to manage user profiles completely from within View, and by minimizing the time it takes to log in and out of desktops. Furthermore, VMware View allows you to maintain persistent desktops, where user documents are on a separate disk so users feel like they are logging onto the same PC each day, or non-persistent desktops, where user changes don't stick, or a mix of the two to address the needs of users in your organization.

To learn more about VMware View 5.2, visit http://www.vmware.com/products/view/overview.html.

Login Virtual Session Indexer (Login VSI) 3.6 is a tool that assesses the virtual desktop performance, capacity, and scalability of a server. After all desktops are idle, Login VSI incrementally logs users into virtual desktop sessions and begins workloads on each. Login VSI measures the total response times of seven typical office operations from each session and calculates the VSI Index Average by taking the average response times and dropping the highest and lowest 2 percent. The average response time of the first 15 session determines a baseline; the VSImax is baseline x 125% +3000ms.

As more sessions begin to consume system resources, response times degrade and the VSI index increases until it is above the Dynamic VSImax. When this condition is met, the benchmark records a Login VSImax, which is the maximum number of sessions that the platform can support.

The newest version of Login VSI, Login VSI 3.6, includes client side performance testing that test character response, large text response, mouse-click feedback, and image quality and loading times on clients to ensure good end-user performance.

For more information about Login VSI 3.6, see http://www.loginvsi.com/product-overview.

CONCLUSION

The software and storage you choose for desktop virtualization can make all the difference in your enterprise environment. Choosing high-performance, low-latency storage that can support a high number of users and deliver predictable scalability—all with a small footprint—can help ensure the success of your deployment.

In our tests, a single server with Virident FlashMAX II storage devices was able to support 162 VMware View 5.2 virtual desktops while delivering low latency for maximum performance and an optimized user experience. The solution scaled predictably—we had only to add another server with FlashMAX II storage to double the VDI users to 324. The VMware View 5.2 and Virident FlashMAX II storage solution also handled heavy I/O performance without impacting user performance – when we recomposed half of a server's virtual desktops, the other half ran with excellent response times and performance.

These factors make Virident FlashMAX II storage cards an excellent choice for your VMware View VDI environment.

APPENDIX A – SYSTEM CONFIGURATION INFORMATION

Figure 7 provides configuration information about the server we used in our tests.

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	E5-2680
Socket type	FCLGA2011
Core frequency (GHz)	2.7
Bus frequency	8 GT/s
L1 cache	8 x 32 KB instruction 8 x 32 KB data
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
Hard drives	
Vendor and model number	Virident FlashMAX II
Number of drives	2
Size (GB)	550
Type	SSD
Ethernet adapter	
Vendor and model number	Broadcom® BCM5719 Gigabit Ethernet
Number of ports	4
Type	Integrated
USB ports	
Number	4
Type	2.0

Figure 7: System configuration information for our test server.

APPENDIX B – HOW WE TESTED

Figure 8 presents the settings we used to configure the VMware View environment.

VM name	Hosted OS	Role (s)	Server	Memory	# vCPUs
AD01	Win 2008 R2 x64 Enterprise	AD Domain controller VSI Share, DHCP, DNS, NTP.	Infrastructure	4 GB	2
View Connection	Win 2008 R2 x64 Enterprise	VMware View Connection server	Infrastructure	4 GB	4
vCenter	Win 2008 R2 x64 Enterprise	VMware Virtual Center, Composer, SQL server	Infrastructure	4 GB	4
Persona Management	Win 2008 R2 x64 Enterprise	File server for View Persona Management	Infrastructure	8 GB	2
Launcher	Windows 7 x 64 Enterprise	Login VSI master launcher	Infrastructure	4 GB	2
Golden Desktop	Windows 7 x 86 Enterprise	View master image	Infrastructure	1 GB	1

Figure 8: Settings for the VMware View environment we tested.

Installing Virident FlashMAX II PCI3 storage-class memory (SCM) devices
1. Install the Virident FlashMax II devices on two PCI-Express x8 electrical slots.
2. Boot the server under test, and press F9 to enter Set Up.
3. Select Advanced Options→Thermal Configuration, select Increased Cooling, and press Enter.
4. Select Power Management Options→HP Power Profile, and select Maximum Performance. Press Enter.
5. Press the Esc key, and press F10 to exit Set Up.

Installing VMware ESXi 5.1.0 on HP ProLiant DL380p Gen8 (server under test)
1. Insert the installation media, and select boot from disk.
2. At the VMware Installer screen, press Enter.
3. At the EULA screen, press F11 to Accept and Continue.
4. Under Storage Devices, select USB storage, and press Enter.
5. Select US as the keyboard layout, and press Enter.
6. Enter the Root password twice, and press Enter.
7. Press F11 to start installation.
8. After the server reboots, press F2 to configure the network settings.

Installing Virident Driver VIBs using offline bundle
1. Connect to the `server under test` via the VMware vSphere client.
2. Select Configuration→Security Profile, and under Services, click Properties…
3. Select SSH, and click Options…
4. Select Start and stop with host, and click Start. Click OK twice to exit.
5. Using v Sphere Remote CLI utility (VCLI), execute the following command:
   ```
   # esxcli software vib install –d /tmp/VSI-49400.C5.zip –no-sig-check
   ```
6. After the installation is complete, reboot the server:
   ```
   # reboot
   ```
7. Confirm the driver installation after reboot:
   ```
   # esxcli software vib list | grep –I virident
   ```

Configuring FlashMax II datastores
1. Connect to the `server under test` via the VMware vSphere client.

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2. Select Configuration→Storage→Add Storage…
3. Under Storage Type, select Disk\LUN, and click Next.
4. Select the drives you want to add, and click Next.
5. Under File System Version, select VMFS-5, and click Next.
6. Under Disk Layout, click Next.
7. Enter a datastore name, and click Next.
8. Under Capacity, select Maximum available space, and click Next.
9. Repeat steps 2-8 to add the second device.

Setting up a VM to host Microsoft Windows Active Directory® server (AD01) on (infrastructure server)

1. Connect to the `infrastructure` sever via the VMware vSphere client.
2. Log in as `root`.
3. In the vSphere client, under Basic Tasks, select Create a new virtual machine.
4. Choose Custom, and click Next.
5. Assign the name `AD01` to the virtual machine, and click Next.
6. Select `infrastructure` as the host, and click Next.
7. Select the appropriate storage, and click Next.
8. Choose Virtual Machine Version 8, and click Next.
9. Choose Windows, choose Microsoft Windows Server® 2008 R2 (64-bit), and click Next.
10. For CPUs, select one virtual processor socket, and 2 cores per virtual socket, and click Next.
11. Choose 4 GB RAM, and click Next.
12. Click 1 for the number of NICs, select VMXNET3, connect to the `PRIV-NET` network, 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 external storage, and click Next.
16. Keep the default virtual device node (0:0), and click Next.
17. Click Finish.
18. Right-click the VM, and choose Edit Settings.
19. On the Hardware tab, click Add…
20. Click Hard Disk, and click Next.
21. Click Create a new virtual disk, and click Next.
22. Specify 40 GB for the virtual disk size, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
23. Choose SCSI (0:1) for the device node, and click Next.
24. Click the Resources tab, and click Memory.
25. Select Reserve all guest memory, and click OK.
26. Connect the VM virtual CD-ROM to the Microsoft Windows Server 2008 R2 installation disk.
27. Start the VM.

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

1. Open a virtual machine console on `AD01`.
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
    http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
12. Reboot the server.
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 `AD01` and reboot when the installation prompts you.
16. Click Start→Run, type `diskmgmt.msc`
17. Select the 40 GB volume, name it `Share` format it NTFS, and assign it drive letter `E`
18. 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 `172.0.0.10/255.255.252.0`

Installing Active Directory and DNS services on AD01

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. Click Start→Run, type `dnsmgmt.msc`
13. Create a reverse lookup zone for `AD01`.
14. Create static entries for the `infrastructure server` and the `server under test`.

Configuring the Windows time service on AD01

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 AD01

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=`172.0.0.20`
   - 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.

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. Open Windows Explorer, and create the following folder: `E:\share`

- Right-click the `E:\share` folder, and select Properties.
- Click the Sharing tab, and click Share…
- Add everyone, system and administrators to the Read/Write group, and click Share.
- Click OK, Apply, OK, and Close.
- From the Login VSI 3.6 media, run the Login VSI AD Setup.
- Keep the defaults settings, and click Start.

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

1. Log into the `infrastructure` 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 `infrastructure` 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 2 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 `PRIV-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 `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
    http://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.
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.
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.
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 View Composer 5.2

1. Open the View5 media folder, and run the file named VMware-viewcomposer-5.2.0
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 View 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 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` 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 Connection` 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 Connection`.
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
    http://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 `ViewConnection` 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 View Connection Server 5.2

1. Log into the server named View Connection.
2. Browse to VMware View installation media, and click VMware-viewconnectionserver-x86_64-5.2.0
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 back up 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.
12. Complete the installation wizard to finish installing View Connection Server.
13. Click Finish.
14. Reboot server.

Configuring the VMware View 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.

Setting a VM for View Persona Management

1. Log into vCenter with the VMware vSphere client.
2. In the vSphere client, click on the `infrastructure` 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 `Persona Management` to the virtual machine, and click Next.
7. Select `infrastructure` as 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 1 virtual processor socket, and 4 cores per virtual socket, and click Next.
12. Choose 8GB RAM, and click Next.

13. Click 1 for the number of NICs, select VMXNET 3, connect to the `PRIV-NET` port group, and click Next.
14. Leave the default virtual storage controller, and click Next.
15. 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. Click Finish.
17. Right-click the VM, and choose Edit Settings.
18. On the Hardware tab, click Add…
19. Click Hard Disk, and click Next.
20. Click Create a new virtual disk, and click Next.
21. Specify 50 GB for the virtual disk size, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
22. Choose SCSI (0:1) for the device node, and click Next.
23. On the Hardware tab, click Add…
24. Click Create a new virtual disk, and click Next.
25. Specify 50 GB for the virtual disk size, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
26. Choose SCSI (1:0) for the device node, and click Next.
27. On the Hardware tab, click Add…
28. Click Create a new virtual disk, and click Next.
29. Specify 50 GB for the virtual disk size, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
30. Choose SCSI (2:0) for the device node, and click Next.
31. On the Hardware tab, click Add…
32. Click Create a new virtual disk, and click Next.
33. Specify 50 GB for the virtual disk size, choose thick-provisioned lazy zeroed, specify external storage, and click Next.
34. Choose SCSI (3:0) for the device node, and click Next.
35. Click Finish, and click OK.
36. Click the Resources tab, and click Memory.
37. Select Reserve all guest memory, and click OK.
38. Connect the VM virtual CD-ROM to the Microsoft Windows Server 2008 R2 installation disk.
39. 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 40GB 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
    http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
11. Reboot.
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 `PersonaManagement` and reboot when the installation prompts you.
15. Set up networking for the data network:
    f.   Click Start, Control Panel, right-click Network Connections, and choose Open.
    g.   Right-click the VM traffic NIC, and choose Properties.
    h.   Uncheck TCP/IP (v6).
    i.   Select TCP/IP (v4), and choose Properties.
    j.   Set the IP address, subnet, gateway, and DNS server.
16. Join the VDI domain.
17. Reboot the system.
19. After the server restarts, click Start→Run, type `diskmgmt.msc`
18. Right click on Disk 1 - 4 and select Online.
19. Right click on Disk 1 and select Initialize Disk.
20. At the Initialize Disk screen select all 4 disks and select MBR (Master Boot Record) and click OK.
21. Right click on Disk 1 and select New Spanned Volume…
22. At the welcome screen click Next.
23. Select all 4 available disks and click Next.
24. Assign drive letter `E:` and click Next.
25. Add a Volume label and perform a quick format. Click Next.

Creating a Network Share for View Persona Management
1.   Open Windows Explorer and create the following folder `e:\personarepository`
2.   Right-click the `e:\personarepository` folder, 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.   Click Done, and Close.

Adding the Persona Management ADM Template to Active Directory
1.   Copy the View Persona Management ADM Template file `viewPM.adm` to the Active Directory server. The file is located in the `C:\Program Files\VMware\Vmware View\Server\extras\GroupPolicyFiles` folder on the View Connection server.
2.   On the Active Directory server click Start→Run, type `gpmc.msc` and click OK.
3.   On the left pane, select the Login_VSI→ Computers OU.
4.   Right-click the Computers folder and select Create a GPO in this domain, and Link it here…
5.   Enter the name `PersonaMgmt` and click OK.
6.   Right-click the new GPO and select Edit…
7.   In the Group Policy Object Editor, right-click Administrative templates under Computer Configuration, Policies and select Add/Remove Templates.
8.   Click Add, browse to the `viewPM.adm` file, and click Open.
9.   Click Close to apply the policy settings in the ADM Template file to the GPO.

Configure View Persona Management Policies
1.   Browse to Computer Configuration→Policies→Administrative Templates→Classic Administrative Templates (ADM) →VMware View Agent Configuration→Persona Management. And open Roaming & Synchronization.
2.   Double-click Manage user persona and click Enabled. Click OK.
3.   Double-click Persona repository location and click Enable.
4.   Enter the UNC path `\\personamagement\personarepository` for the Network file server share that will store user profiles. Click OK.

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 a View gold image and a Login VSI launcher.

On the gold image, we installed Microsoft Office 2010, 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 5.2 agents.

For the Login VSI launcher VM, we installed the VMware View 5.2 client, added it to the vdi domain/Login VSI OU in Active Directory, and installed the Login VSI Launcher software.

Installing the Windows 7 Enterprise (x86) base image VM

1. In the vSphere client, connect to the vCenter Server, and browse to the `infrastructure` host.
2. Click the Virtual Machines tab.
3. Right-click, and choose New Virtual Machine.
4. Choose Custom, and click Next.
5. Assign the name as `win7-temp` and click Next.
6. Select the `infrastructure` host, and click Next.
7. Select the appropriate storage.
8. Choose Virtual Machine Version 8, and click Next.
9. Choose Windows, choose Microsoft Windows 7 (32-bit), and click Next.
10. For CPUs, select one virtual processor socket and one core per virtual socket, and click Next.
11. Choose 1GB RAM, and click Next.
12. Click 1 for the number of NICs, select VMXNET 3, 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 20 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. Click Finish.
18. Click Finish, and click OK.
19. Right-click the win7-temp VM, and click Edit settings.
20. Click the Resources tab, click Memory, and check the Reserve all guest memory checkbox.
21. Click the Hardware tab, CD/DVD Drive, and Connect the VM virtual CD-ROM to the Microsoft Windows 7 x86 installation disk.
22. 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.
7. Type `user` for the username, and click Next.
8. Enter no password, and click Next.
9. At the system protection screen, 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. Install VMware Tools. For more information, see
    http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=340.
13. Reboot.
14. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
15. Join the domain and restart the VM.

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 `2048` for both values, and select Set.

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.

Converting the base image VM to a template
1. In vSphere Client, right-click `win7-temp` VM and select Template→Convert to Template.

Deploying the view_gold VM from base template
2. In vSphere Client, browse to Home→VMs and Templates.
3. Right-click `win7-temp` to deploy a virtual machine from template.
4. Type `view_gold` as the new VM name, and click Next.
5. Click Datacenter, and click Next.
6. Click on `infrastructure`, and click Next.
7. Select the appropriate storage, and click Next.
8. Select customization using existing customization specifications, select the appropriate file, and click Next.
9. Click Finish to deploy the `view_gold` VM.
10. Repeat steps 1 through 8 to deploy a `launcher` VM to launcher server.

Preparing view_gold for deployment

Installing Office 2010 Professional
1. From the Office 2010 media, run Setup.
2. Enter the product key for Office 2010, and click Continue.
3. Accept the licensing agreement.
4. Select Install Now.
5. Reboot the system.

Installing Login VSI target software
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 \\ad01\share.
5. Click Start.
6. At the security warnings, click OK.
7. When the installation is complete, reboot the system.

Installing the View 5 agent
1. Browse to the VMware View 5 media, and run the VMware-viewagent-x86_64-5.2.0 file.
2. Click Run.
3. At the Welcome screen, click Next.
4. Accept the VMware end user license agreement, and click Next.
5. Select defaults, and click Next.
6. Enter the server name of the View Connection Server, and click Next.
7. Click Install.

Optimizing Windows 7 for VMware View

We executed the `CommandsPersonaManagement` script to prepare the `view_gold` VM as recommended by VMware. This script is included as part of the VMware View Optimization Guide for Windows 7.

For more information, visit http://www.vmware.com/files/pdf/VMware-View-OptimizationGuideWindows7-EN.pdf.

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 Launcher_1 for testing

We installed Login VSI target software and View 5.2 client on our launcher. Once all the necessary software was installed, we converted the launcher VM into another template that was used to deploy multiple launchers required for testing.

Installing the Login VSI launcher
1. Log into the `launcher` 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 \\ad01\share.

Installing the VMware View client
1. Browse to the VMware View 5.2 media, and run the VMware-viewclient-x86_64-5.2.0 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.

Converting the launcher VM to a template
1. In vSphere Client, right-click `launcher` VM, and select Template→Convert to Template.

Deploying the launchers VM from launcher template
1. In vSphere Client, browse to Home→VMs and Templates.
2. Right-click `launcher` to deploy a virtual machine from template.
3. Type `launcher_1` as the new VM name, and click Next.
4. Click Datacenter, and click Next.
5. Click on the launcher server, and click Next.

6. Select the appropriate storage, and click Next.
7. Select customization using existing customization specifications, select the appropriate file, and click Next.
8. Click Finish to deploy the new VM.
9. Repeat steps 1 through 8 to deploy more launcher VMs to launcher server.

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

1. Open vCenter→Datacenter→`infrastructure`, 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, 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. Under Naming Pattern, use `View-{n:fixed=003}`
12. Under Pool Sizing, enter `160` for Max number of desktops and number of spare (power on) desktops.
13. Select provision all desktops up-front, and click Next.
14. Select Redirect disposable files to a non-persistent disk, type `4096` MB for Disk Size, and click Next.
15. Under Storage Optimization, click Next.
16. Under vCenter Settings, use:
    - Parent VM: `/vdi/vm/view_gold`
    - VM folder: `/vdi/vm/Pool`
    - Host or cluster: `/vdi/host/server under test`
    - Resource pool: `/vdi/host/server under test/Resources`
    - Datastores= `FlashMAX II A – FlashMax II B  (linked clone, replica, VAAI, etc.) Overcommit: Moderate`
17. Under Advanced Storage Options select Use host caching, OS disk, 7 days, and click Next.
18. Under Guest customization, select the following:
    - Domain: `vdi.com`
    - AD container: `OU=Users,OU=Login_VSI`
    - Select Use Quick Prep, and click Next.
19. Click Finish.
20. Click Pool, and click Entitlements…
21. Click Add, type `Login_VSI_TS` and click OK.
22. Click Desktops, and wait for the virtual desktops to report as ready.

Configuring the Login VSI Management Console

For VMware View testing we used the following Settings:

- Connection Type: Custom Commandline with CSV
- Specify Custom Commandline:
  ```
  c:\program files\VMware\VMware View\Client\bin\wswc.exe –serverURL
  http://viewconnection.vdi.com –username: %view_user% -password Password1 –
  domainname vdi –desktopname Pool –Standalone –LoginAsCurrentUser False –
  ConnnectUSBonStartup False
  ```
- Specify CSV file:

\\ad01\Share\csv\view_user.csv
- Connection Settings session:
  - Connect: Specify User
  - Formatting Length: Set to 1
  - Server Name: Leave blank
  - User Name: Leave blank
  - Password: Leave blank
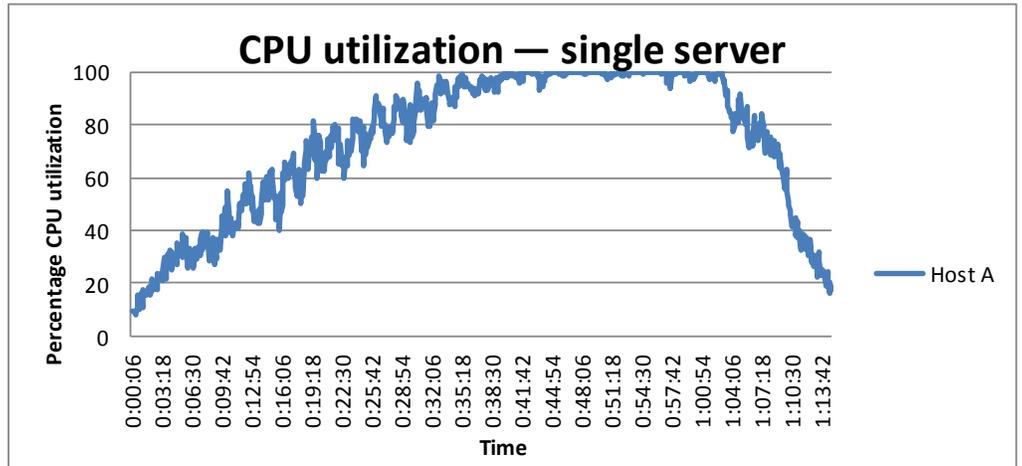 - Domain: Leave blank

APPENDIX C – CPU UTILIZATION DURING TESTING

Figure 9 shows the percentage of CPU utilization throughout the single-server tests. CPU utilization approached or hit 100 percent at various points in the test, which prevented the server from hosting any virtual desktop sessions.

Figure 9: CPU utilization during our single-server test.

Figure 10 shows the percentage of CPU utilization throughout the tests with two servers. CPU utilization approached or hit 100 percent at various points in the test, which prevented the servers from hosting more virtual desktop sessions.

Figure 10: CPU utilization for the servers in our dual-server tests.
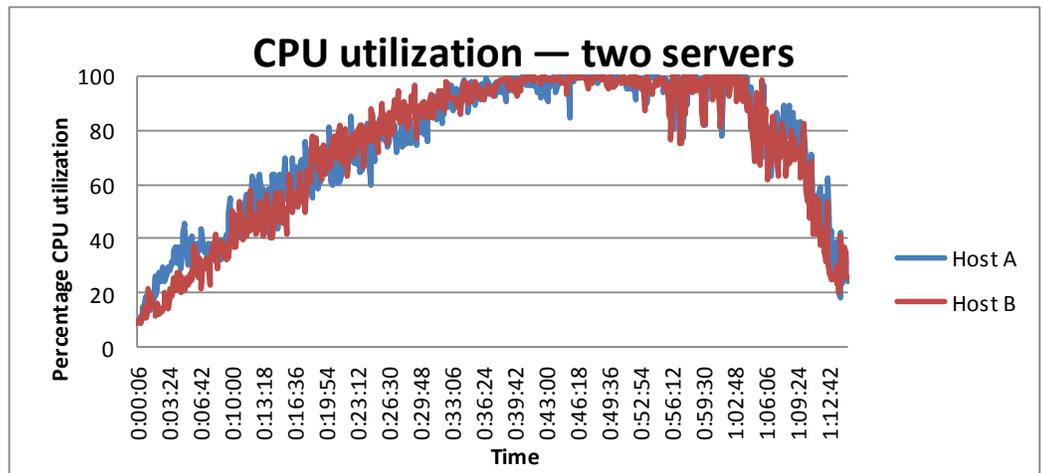
While we recomposed half of the 162 desktops on one host server and ran workloads on the other half, CPU utilization did not max out, showing that the Virident FlashMAX II storage devices handled the I/O-intensive task without incident (see Figure 11).

Figure 11: CPU utilization during our desktop recomposition test.

CPU utilization while recomposing desktops
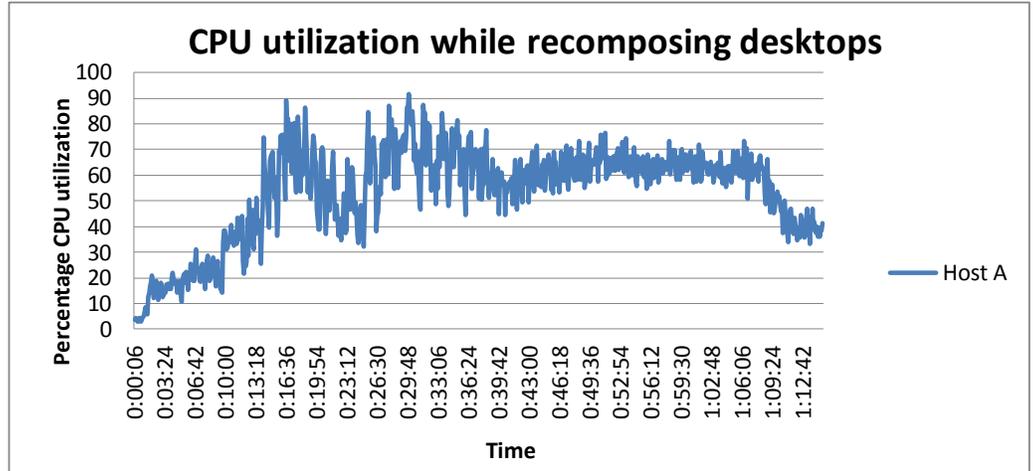
APPENDIX D – PER-CLIENT COSTS

Per-client costs	Product cost	Support annual cost
VMware Horizon View 5.2 Premier edition (average per connection)	$250.00	$62.50
Software subtotal (per connection)	**$250.00**	**$62.50**
Hardware costs		
HP ProLiant DL380 G8, Intel Xeon processors E5-2680, 256GB RAM with two FlashMAX II Cards (one node)	$25,607.00	
HP ProLiant DL380 G8, Intel Xeon processors E5-2680, 256GB RAM with two FlashMAX II Cards (two nodes)	$51,214.00	
Cost for one server	**License only**	**One-year support**
VMware Horizon View 5.2 licenses	$40,500.00	$10,125.00
One hardware node	$25,607.00	
Total for all virtual desktops (one node)	**$66,107.00**	**$10,125.00**
Cost per desktop (one node)	**$408.07**	**$62.50**
Total license plus one-year support average per client (one node)*	**$470.57**	
Total license plus one-year support average per client (two nodes)*	**$470.57**	

Figure 12: Per-client cost totals.

*We assume a 4-vCPU/8GB vRAM Microsoft Windows Server® 2008 R2 VM is available to host VMware vCenter, a 2-vCPU/4GB vRAM Windows Server 2008 R2 VM is available to host VMware View Connection Server, a 2-vCPU/4GB Windows Server VM is available for VMware Persona management, and a pre-existing Windows infrastructure (Active Directory®, etc.) is in place. Windows desktop operating system licenses or client access licenses are not part of this pricing.

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.