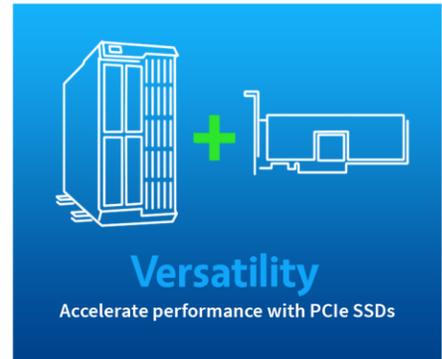


SAVE SPACE, INCREASE EFFICIENCY, AND BOOST PERFORMANCE
IN YOUR REMOTE OFFICE WITH DELL POWEREDGE VRTX

Simplicity. Efficiency. Versatility.

Dell™ PowerEdge™ VRTX



Powered by Intel® Xeon® processor E5-2400 v2 product family

Replacing the servers in your remote office or branch office (ROBO) with the powerful new Dell PowerEdge VRTX, powered by the Intel Xeon processor E5-2400 v2 product family and running Microsoft® Windows® Server 2012 R2, can be a wise move. Dell designed the VRTX with simplicity, efficiency, and versatility in mind. Its space-saving design can greatly simplify the office environment—it installs almost anywhere, reduces cabling because the server, storage, and networking are converged in a single compact chassis, and contributes further to space savings through consolidation of legacy servers into the VRTX. The VRTX brings efficiency to IT staff, who can manage servers, storage, and networking with the unified, integrated Chassis Management Controller. Businesses can enjoy the versatility of this solution, which lets them deploy performance anywhere and experience accelerated performance with a unique PCIe SSD option.

In this report, we focus on the simplicity and versatility aspects of the Dell PowerEdge VRTX by looking specifically at performance comparisons to a legacy dual-socket server. To learn about the management advantages of the Dell PowerEdge VRTX, see our companion report.* To show simplicity via consolidation and space savings, we first measured the database performance of a prior-generation dual-socket HP ProLiant server, typical of those in use today. To explore the versatility of the Dell PowerEdge

*For management and automation highlights, see the companion to this one, "Efficient and versatile hardware management with Dell PowerEdge VRTX," at www.principledtechnologies.com/Dell/VRTX_management_0314.pdf.



TCO

A June 2013

Principled Technologies study compared the Dell PowerEdge VRTX and a legacy solution composed of multiple servers.¹ That study found that the VRTX delivered a lower total cost of ownership than the multi-server legacy solution.

VRTX, we then measured its performance using an accelerated configuration with a Micron® P420m PCIe solid-state drive (SSD) attached to each node. In our tests, the base-configuration VRTX could consolidate four legacy dual-socket servers using the same database and workload configuration while providing 5.4 times the performance of one legacy server. With the Micron P420m PCIe SSD added to the configuration, the performance advantage was even greater—the VRTX consolidated eight legacy dual-socket servers and delivered 10.7 times the performance of one legacy server.

Based on the overall performance advantage the VRTX had in our testing, you would need six legacy servers to do the work of a single base-configuration VRTX and 11 legacy servers to deliver the performance of a single accelerated-configuration VRTX. Because the Dell PowerEdge VRTX in its tower form factor uses approximately the same square footage as a typical tower, replacing multiple legacy tower servers with a VRTX would yield an immediate gain in square footage efficiency in your remote office. This gain would be in addition to the benefits of a shared storage platform and encapsulated networking components.

For both performance and space efficiency, consolidating your older servers with the Dell PowerEdge VRTX makes excellent business sense. You can free up space in your remote or branch office, and you can save on power and cooling.

MORE PERFORMANCE, LESS SPACE

In many remote offices, performance needs are steadily increasing, space is at a premium, and cabling has become complex. If your remote office faces any or all of these challenges, the Dell PowerEdge VRTX is an attractive, compact, integrated solution that can fit easily beside a desk and uses minimal cabling. As our testing showed, in addition to reducing the compute footprint of your environment, the VRTX could also deliver exceptional performance.

To measure the performance of the Dell PowerEdge VRTX with two M520 server nodes, we tested with an OLTP workload that uses a performance metric of orders per minute (OPM). We tested the base configuration of the VRTX and an accelerated version with a Micron P420m PCIe SSD card to further boost performance. As we will show, both Dell PowerEdge VRTX configurations performed the workloads of multiple legacy servers and did so using a fraction of the compute space the equivalent legacy solution would require.

For the legacy system, we tested a three-year-old dual-socket HP ProLiant server configured with two Intel Xeon processor X5670s, 12 GB of memory, and eight 300GB SAS hard drives configured in a two-disk RAID 1 for OS and logs and a six-disk RAID 10 for database. On the new VRTX-powered environment, we configured the VMs

Configuration note

For testing, we configured the Dell PowerEdge VRTX with two M520 server nodes as our base configuration, leaving room for further expansion.

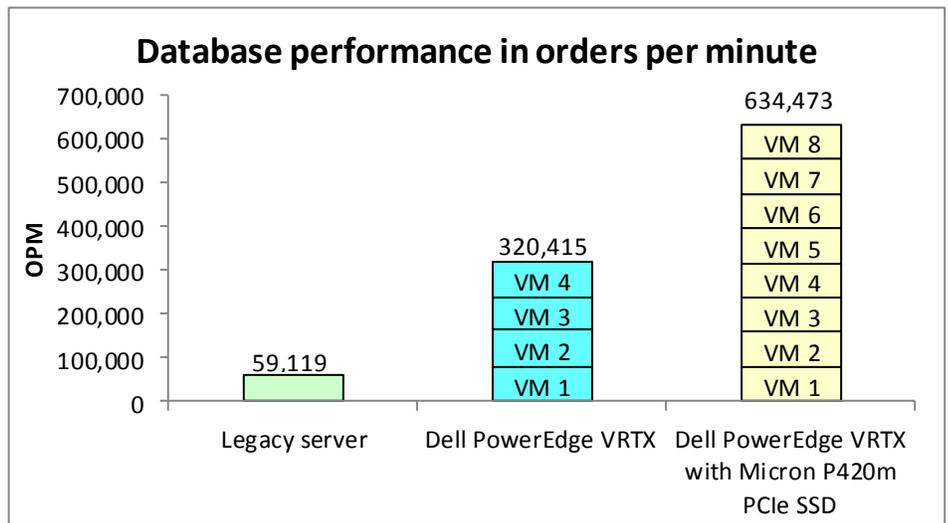
Adding additional nodes to populate the PowerEdge VRTX fully could increase performance and further your space savings.

¹ Comparing performance and cost: Dell PowerEdge VRTX vs. legacy hardware solution
www.principledtechnologies.com/Dell/VRTX_performance_TCO_0713.pdf

with 12 vCPUs and 12 GB of memory to match the legacy server configuration. For detailed configuration information about the solutions we tested, see [Appendix A](#). For testing details, see [Appendix B](#).

As Figure 1 shows, the Dell PowerEdge VRTX in both configurations delivered far greater database performance than the legacy server did. The base-configuration VRTX ran four database VMs, delivering 320,415 orders per minute, 5.4 times as many as the legacy server using the same database and workload configuration. Upgrading the Dell PowerEdge VRTX with the Micron P420m PCIe SSD card doubled the number of VMs the server could support under the same conditions, and those eight VMs delivered 10.7 times the orders per minute the legacy server delivered.

Figure 1: Both configurations of the Dell PowerEdge VRTX delivered far greater database performance than the legacy server.



Adding to the performance advantage of the Dell PowerEdge VRTX server is the fact that it delivers this performance in a space-efficient profile and greatly reduces the cabling complexity that can come with multiple servers, whether those servers are in rack or tower form factor.

As we noted earlier, in June 2013, Principled Technologies conducted a study similar to this one. That study compared the number of Ethernet cables and power cables required by the Dell PowerEdge VRTX and a legacy solution composed of multiple servers.² Figure 2, excerpted from that study, shows how the Dell PowerEdge VRTX used only six cables, 13 fewer cables than the legacy, disparate hardware solution consisting of three tower servers, a switch, and a storage array.

² Comparing performance and cost: Dell PowerEdge VRTX vs. legacy hardware solution www.principledtechnologies.com/Dell/VRTX_performance_TCO_0713.pdf

Cabling comparison from 2013 Principled Technologies study		
Dell PowerEdge VRTX	Ethernet cables	Power cables
Total by type	2	4
Total cables		6
Legacy, disparate hardware solution	Ethernet cables	Power cables
HP ProLiant ML310 G5	2	1
HP ProLiant ML370 G5	2	1
HP ProLiant ML110 G6	2	1
NETGEAR ProSAFE Smart Switch	1	1
Storage	6	2
Total by type	13	6
Total cables		19

Figure 2: In a June 2013 Principled Technologies study, the Dell PowerEdge VRTX reduced cabling complexity compared to the legacy, disparate hardware solution.

While the 2013 study used different workload parameters than this study, it is reflective of the potential cabling savings when consolidating tower servers to the Dell PowerEdge VRTX.

About the Dell PowerEdge VRTX

The Dell PowerEdge VRTX is a compact, integrated solution in a 5U rack-able tower chassis. Designed to be quiet under normal operating conditions, the Dell PowerEdge VRTX can be stowed beside a desk. Its four bays house Dell PowerEdge M520 or M620 server nodes, providing a space-saving alternative to tower or rack servers. In addition to space savings, the Dell PowerEdge VRTX provides administrators with a unified interface, the Chassis Management Controller, for performing routine systems management tasks. The Dell PowerEdge VRTX chassis supports up to 48 TB of shared internal storage that is presentable as virtual drives to single or multiple compute nodes, and provides eight PCIe slots for additional device connectivity. The chassis integrated storage can be configured with 25 bays for 2.5-inch drives or with 12 bays for 3.5-inch drives. The Dell PowerEdge VRTX integrated switch contains multiple external network ports for easy expansion or integration into existing computing environments.

For more information about the Dell PowerEdge VRTX, visit www.Dell.com/PowerEdge/VRTX.

About the Intel Xeon processor E5-2400 v2 product family

According to Intel, the Intel Xeon processor E5-2400 v2 product family is designed to complement the E5-2600 v2 product family with “lower core counts, lower frequency, and lower TDP options. The new Intel Xeon processor E5-2400 v2 product family is based on a 22nm manufacturing process and includes 12 different models. It is designed to offer performance and features to address small and medium business, enterprise storage, and entry to mid-range communications markets.”

For more information on the Intel Xeon processor E5-2400 v2 product family, visit www.intel.com.

About the Micron P420m PCIe SSD

According to Micron, their low-latency, high-IOPS PCIe SSDs “are real overachievers, providing the highest read throughput in the industry, combined with extended endurance, exceptional reliability, and remarkable power efficiency. They are ideal solutions for optimizing applications with heavy read access, from web accelerators to media streaming and video-on-demand servers, as well as data warehousing.

“Built on server-grade Micron NAND, [their] PCIe SSDs furnish up to 50 petabytes of drive life and an astounding power economy of up to 30,000 read IOPS per watt. Our custom controller is designed specifically to interact with and optimize our leading-edge NAND, achieving read IOPS up to 785,000 and sequential speeds up to 3.2 GB/s.”

For more information on the Micron P420m PCIe SSD 2.0 card, visit www.micron.com/products/solid-state-storage/enterprise-pcie-ssd.

About Microsoft Windows Server 2012 R2

Microsoft Windows Server 2012 R2, the newest version of Microsoft Windows Server, was designed with the enterprise-class datacenter and cloud platforms in mind. It includes a range of new and enhanced features to boost efficiency and performance for corporate workloads.

For more information on Microsoft Windows Server 2012 R2, visit www.microsoft.com/en-us/server-cloud/products/windows-server-2012-r2/.

IN CONCLUSION

Two realities drive many remote and branch office server decisions: the need for a versatile platform that delivers excellent performance, and the need for simplification by using fewer servers and cables. By consolidating your older servers to the powerful, space-efficient Dell PowerEdge VRTX server, you can increase database performance while saving valuable space. In our tests, the base-configuration Dell PowerEdge VRTX could consolidate four legacy servers while providing 5.4 times the overall performance. With the Micron P420m PCIe SSD added to the configuration, the VRTX consolidated eight legacy servers and delivered 10.7 times the overall performance.

Investing in the Dell PowerEdge VRTX—in either configuration—can elevate your IT infrastructure by answering database performance and space-saving challenges that face your remote and branch offices.

In addition to providing excellent performance in a space-efficient manner, the VRTX simplifies the office environment, brings efficiency to IT staff through its management advantages, and offers businesses the versatility of deploying performance anywhere.

APPENDIX A – DETAILED CONFIGURATION INFORMATION

Figure 3 presents detailed configuration information for the Dell PowerEdge VRTX solution we tested.

System	Dell PowerEdge VRTX solution
Enclosure	
Compute node enclosure	Dell PowerEdge VRTX
General dimensions of compute node enclosure	
Height (inches)	8.0
Width (inches)	19.0
Depth (inches)	29.5
Power supplies	
Total number	4
Vendor and model number	Dell 80 Plus Platinum E1100E-S0 (P/N OYT39Y)
Wattage of each	1,100
Cooling fans	
Total number	6
Vendor and model number	Delta Electronics, Inc.
Dimensions (h × w) of each	60mm × 60mm
Volts	12
Chassis RAID controller	
Vendor and model number	Dell Shared PERC8
Firmware version	23.8.2-0005
Cache size (GB)	1
PCIe SSD card	
Vendor and model number	Micron P420m PCIe SSD
Number of cards	2
Capacity (TB)	1.4 (each card)
Chassis shared hard drives	
Hard drive #1	
Vendor and model number	Hitachi HUC151414CSS600
Number of drives	21
Size (GB)	146
RPM	15,000
Hard drive #2	
Vendor and model number	Fujitsu MBE2147RC
Number of drives	4
Size (GB)	146
RPM	15,000
Chassis USB ports	
Number	2
Type	2.0

System	Dell PowerEdge VRTX solution
Platform	
Vendor and model number	Dell PowerEdge M520
Motherboard model number	0NRG83X03
BIOS name and version	Dell BIOS 2.0.23
BIOS settings	Performance
General	
Number of processor packages	2
Number of cores per processor	10
Number of hardware threads per core	2
System power management policy	Performance
CPU	
Vendor	Intel
Name	Xeon E5-2470 v2
Stepping	M1
Socket type	Socket 1356 / LGA1356
Core frequency (GHz)	2.40
L1 cache	32 KB (per core)
L2 cache	256 KB (per core)
L3 cache	256 MB (shared)
Memory modules (per node)	
Total RAM in system (GB)	96
Vendor and model number	Hynix Semiconductor HMT42GR7MFR4C-PB
Type	PC3-12800
Speed (MHz)	1,600
Speed in the system currently running @ (MHz)	1,600
Timing/latency (tCL-tRCD-iRP-tRASmin)	11-11-11-35
Size (GB)	16
Number of RAM modules	6
Chip organization	Double-sided
RAID controller	
Vendor and model number	Dell PERC H310 mini
Firmware version	20.12.0-0004
Cache size (GB)	0
Hard drive	
Vendor and model number	FUJITSU MBD2147RC
Number of drives	2
Size (GB)	146
RPM	10K
Type	SAS
Network adapter	
Vendor and model number	Broadcom® NetXtreme® BCM5720 Gigabit Ethernet PCIe
Type	Embedded
Number of ports	2

System	Dell PowerEdge VRTX solution
USB ports (per node)	
Number	2 external, 1 internal
Type	2.0

Figure 3: Detailed configuration information for the Dell PowerEdge VRTX solution.

Figure 4 presents detailed configuration information for the legacy server we tested.

System	HP ProLiant DL380 G7
Power supplies	
Total number	2
Vendor and model number	HP DPS-750RB A
Wattage of each (W)	750
Cooling fans	
Total number	6
Vendor and model number	Nidec® UltraFlo®
Dimensions (h × w) of each	2-3/8" × 2-5/8"
Volts	12
Amps	2.45
General	
Number of processor packages	2
Number of cores per processor	6
Number of hardware threads per core	2
System power management policy	High Performance
CPU	
Vendor	Intel
Name	Xeon X5670
Stepping	B1
Socket type	Socket 1366 LGA
Core frequency (GHz)	2.93
L1 cache	32 KB + 32 KB (per core)
L2 cache	256 KB (per core)
L3 cache (MB)	12
Platform	
Vendor and model number	HP ProLiant DL380 G7
BIOS name and version	HP P67
BIOS settings	High Performance
Memory modules	
Total RAM in system (GB)	12
Vendor and model number	Kingston KVR1333D3D8R9S/2G
Type	PC3-10600R
Speed (MHz)	1,333
Speed in the system currently running @ (MHz)	1,333
Timing/latency (tCL-tRCD-iRP-tRASmin)	9-9-9-24
Size (GB)	2

System	HP ProLiant DL380 G7
Number of RAM modules	6
Chip organization	Double-sided
RAID controller	
Vendor and model number	HP Smart Array P410i
Cache size (MB)	512
Hard drive #1	
Vendor and model number	HP ST9300603SS
Number of drives	8
Size (GB)	300
RPM	10K
Type	SAS
Network adapter	
Vendor and model number	HP NC382i Dual Port Gigabit Adapter
Type	Integrated
Number of ports	4
USB ports (per node)	
Number	4 external, 1 internal
Type	2.0

Figure 4: Detailed configuration information for the HP ProLiant DL380 G7.

APPENDIX B – HOW WE TESTED

About DVD Store Version 2.1

To create our OLTP workload, we used the DVD Store Version 2.1 (DS2) benchmarking tool. DS2 models an online DVD store, where customers log in, search for movies, and make purchases. DS2 reports these actions in orders per minute that the system could handle, to show what kind of performance you could expect for your customers. The DS2 workload also performs other actions, such as adding new customers, to exercise the wide range of database functions you would need to run your ecommerce environment.

For more details about the DS2 tool, see www.delltechcenter.com/page/DVD+Store.

SETTING UP THE INFRASTRUCTURE

We detail our Dell PowerEdge VRTX configuration steps below. Perform the following steps on each Dell PowerEdge server.

Setting up and configuring an Active Directory VM

We configured a virtual machine to be used as an Active Directory server for authentication on a separate utility hypervisor.

Installing Windows Server 2012 R2 on the Active Directory VM

1. Create a VM on a separate hypervisor host, and choose 4GB RAM and 30GB virtual disk size.
2. Install the operating system on the VM.
3. Copy the installation DVD image for Windows Server 2012 R2 into the local machine storage. Mount the DVD ISO to the guest VM.
4. Choose the language, time and currency, and keyboard input. Click Next.
5. Click Install Now.
6. Enter product key, and click Next.
7. Choose Windows Server 2012 R2 Datacenter (Server with a GUI), and click Next.
8. Accept the license terms, and click Next.
9. Click Custom, and select Install Windows Only.
10. Click the Disk, and click Drive options (advanced).
11. Click New→Apply→Format, and click Next.
12. After the installation completes, click OK to set the administrator password.
13. Enter the administrator password twice, and click OK.
14. Connect the machine to the Internet and install all available Windows updates. Restart as necessary.
15. In Server Manager, select Local Server and change each of the following parameters by clicking on the highlighted field for each.
16. Enable remote desktop access.
17. Click Windows Firewall, and set to Off (all).
18. Click IE Enhanced Security Configuration, and set to Off.
19. Click Windows Updates, and set to Disabled.
20. Change the hostname and reboot when the installation prompts you.
21. Create a shared folder to store test script files. Set permissions as needed.

22. Set up networking for the Hyper-V management console by creating a static IP address.

Configuring TCP/IP and computer name on the Active Directory VM

1. Connect to the AD VM.
2. After the initial installation, the Server Manager comes up and you are presented with initial system configuration. Select Local Server and click the current IP address to bring up the network properties.
3. In Network Connections, right-click Local Area Connection, and click Properties.
4. Click Internet Protocol Version 4 (TCP/IPv4), and click Properties.
5. Select Use the following IP address and enter an appropriate IP address, subnet mask, and Preferred DNS.
6. Close the Network Connections window.
7. In Server Manager, click the current computer name.
8. In System Properties, click Change. In Computer name, type the name of the domain controller machine, click OK twice, and click Close. When you are prompted to restart the computer, click Restart Now.
9. After restarting, log in using the local administrator account.

Configuring the Active Directory VM as a domain controller and DNS server

1. Log into the AD VM.
2. In Server Manager select Local Server and in the upper right corner select Manage. Click Add Roles and Features. In the details pane, click Role-Based or Feature-Based Installation, and click Next.
3. On the Select Server Roles page, click Active Directory Domain Services, click Add Required Features, click Next twice, and click Install. When installation is complete, click Close.
4. To start the Active Directory Installation Wizard, click Start, type `dcpromo` and press Enter.
5. In the Active Directory Installation Wizard dialog box, click Next twice.
6. On the Choose a Deployment Configuration page, click Create a new domain in a new forest, and click Next.
7. On the Name the Forest Root Domain page, type the desired domain name, and click Next.
8. On the Set Forest Functional Level page, in Forest Functional Level, click Windows Server 2012 R2, and click Next.
9. On the Additional Domain Controller Options page, click Next, click Yes to continue, and click Next.
10. On the Directory Services Restore Mode Administrator Password page, type a strong password twice, and click Next.
11. On the Summary page, click Next.
12. Wait while the wizard completes the configuration of Active Directory and DNS services, and click Finish.
13. When the wizard prompts you to restart the computer, click Restart Now.
14. After the computer restarts, log into the domain using the Administrator account.
15. Create Computer accounts for each server to be used in the domain in the Active Directory Manager.

Configuring the database workload clients

For each test VM on the host machines, there needs to be a corresponding client VM to generate the workload to stress the database under test. To do this, we configured a virtual machine with Windows Server 2008 R2 SP1 on a separate utility hypervisor. To create these clients, we installed Windows Server 2008 R2 SP1, assigned a static IP address, and installed .NET 3.5.

SETTING UP THE VRTX

We detail our Dell PowerEdge VRTX configuration steps below.

Configuring the VRTX shared storage

1. Open a Web browser, and enter the address listed for the CMC IP on the front LCD display.
2. Log in with the appropriate credentials.
3. Expand Storage.
4. Click Storage.
5. Click the Setup tab.
 - a. Under Assignment Mode, select the radio button for Multiple Assignment, and click Apply.
 - b. Click OK to confirm the message box indicating Operation Successful.
6. Configure virtual disks:
 - a. Click Storage → Virtual Disks.
 - b. On the Virtual Disks tab, click Create.
 - i. For Choose a virtual disk type, select RAID 10.
 - ii. Select the first six disks, and click Create Virtual Disk.
 - iii. Click OK to confirm the message box indicating Operation Successful.
 - iv. Repeat steps i-iii for the second Virtual Disk, selecting the first 18 disks remaining.
 - c. On the Virtual Disks tab, click Manage.
 - i. Select the Virtual Disks Action pull-down menu for Virtual Disk 0 and initialize the drives.
 - ii. Click Apply.
 - iii. Click OK to confirm the message box indicating Operation Successful once the initialization completes.
 - iv. Repeat steps i-iii for the second virtual disk.
 - d. Configure the remaining physical disk as a global hot spare.
 - e. In this step, we will allow shared LUN access to both compute nodes. On the Virtual Disks tab, click Assign.
 - i. Use the pull-down menu for all virtual disks and SLOT-01, and select Full Access.
 - ii. Use the pull-down menu for all virtual disks and SLOT-02, and select Full Access.
 - iii. Click Apply.
 - iv. Click OK to confirm the message box indicating Operation Successful.

Configuring boot properties of the Dell PowerEdge M520s

1. Open a Web browser, and enter the address listed for the CMC IP on the front LCD display.
2. Log in with the appropriate credentials.
3. Expand Server Overview, and select Slot-01.
4. Click the Setup Tab. Perform the following steps in the iDRAC settings:
 - a. Check the box for Enable LAN.
 - b. Check the box for Enable IPv4.
 - c. Check the box for DHCP.
 - d. Check the box for IPMI Over LAN.
 - e. Click Apply iDRAC Network Settings.

- f. To confirm changes to the iDRAC network settings, click OK.
5. Power on the server.
 - a. Click the Power Tab.
 - b. Select Power On Server.
 - c. Click Apply.
 - d. To confirm server control action, click OK.
 - e. To confirm operation was successful, click OK.
6. Click the Properties tab.
7. Click Launch Remote Console.
8. On new browser page, click Continue to website (not recommended) if prompted.
 - a. If a message appears indicating a pop-up was blocked, select Always allow pop-ups from this site.
 - b. Close the browser tab for the iDRAC.
 - c. Click Launch Remote Console.
 - d. If a message appears indicating the Web page wants to run an add-on called "Virtual Console from Dell Inc.," select Allow for all websites.
9. A new window appears showing the console for the server to configure. Select Power→Reset System.

Installing the Microsoft Windows Server 2012 R2 operating system

1. Insert the installation disk to the VRTX chassis drive bay, or attach an image to the slot via iDRAC with virtual media.
2. Choose the language, time and currency, and keyboard input. Click Next.
3. Click Install Now.
4. Choose Windows Server 2012 R2 Datacenter (Server with a GUI), 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. Connect to the Internet, and install all available Windows updates. Restart as necessary.
12. Enable remote desktop access.
13. Change the hostname and reboot when prompted.
14. Set up networking for the data network:
 - a. Click Start→Control Panel, right-click Network Connections, and choose Open.
 - b. Right-click the Testing traffic NIC, and choose Properties.
 - c. Select TCP/IP (v4), and choose Properties.
 - d. Assign a static IP address.

Installing the Hyper-V Role and Failover Clustering feature

1. From Server Manager, click Manage→Add Roles and Features.
2. At the Before You Begin screen, click Next.
3. At the Installation Type screen, click Next.

4. At the Server Roles screen, check the box for Hyper-V, and click Add Features in the pop-up that appears.
5. Click Next.
6. At the Features screen, click the box for Failover Clustering, click Add Features in the window that pops up, and click Next.
7. At the Hyper-V screen, click Next.
8. At the Virtual Switches screen, click Next.
9. At the Migration screen, leave the defaults, and click Next.
10. At the Default Stores screen, click Next.
11. At the Confirmation screen, click Install.
12. When the installation finishes, click Close.

Allowing RAID bus types in a failover cluster

For more information on the registry edit, see support.microsoft.com/kb/2839292.

1. Press the Windows key and type `regedit` and press Enter.
2. Navigate to `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\ClusDisk\Parameters` in the Registry Editor.
3. Click Edit → New → DWORD (32-bit) Value.
4. Enter `AllowBusTypeRAID` as the name.
5. Right-click the new DWORD and click Modify.
6. In the Value data field, enter 1 and click OK.
7. Close the Registry Editor.

Validating and creating the failover cluster

1. On either Dell PowerEdge server, click Tools → Failover Cluster Manager.
2. At the Before You Begin screen, click Next.
3. In the Select Servers or a Cluster screen, enter the names of each Dell PowerEdge VRTX server node in the Enter name field, clicking the Add button after each. Click Next when finished.
4. At the Testing Options screen, click Next.
5. At the Confirmation page, click Next.
6. After the testing completes successfully, make sure the Create a cluster now using the validated nodes box is checked.
7. Click Finish.
8. At the Before You Begin screen, click Next.
9. At the Access Point for Administering the Cluster screen, give the cluster an appropriate name, an appropriate IP address, and click Next. We used the name `TestCluster` and an IP address of `192.168.1.50`.
10. Click Next.
11. At the Confirmation screen, make sure the Add all eligible storage to the cluster box is checked, and click Next.
12. At the Summary screen, click Finish.
13. Open Failover Clustering Manager.
14. Navigate to Storage → Disks, and click Add Disk.
15. Select all the available disks, and click OK.
16. In the Disks pane in FCM, right-click each Cluster Disk, and select Add to Cluster Shared Volumes.

17. Close Failover Clustering Manager.
18. Acquire Update for Windows Server 2012 R2 (KB2803748) from www.microsoft.com/en-us/download/confirmation.aspx?id=36468.
19. Launch the standalone update installer file in both Dell PowerEdge VRTX server nodes.
20. When the update installer completes its operations, click Restart Now.

Configuring the virtual network

1. In Hyper-V Manager, right-click the server name in the list on the left side of Hyper-V, and choose Virtual Network Manager...
2. Choose External, and click Add.
3. Name the Virtual Network, and choose the appropriate NIC for your VM network from the drop-down menu.
4. Click OK.

Configuring the first VM

1. On the first host, within Failover Cluster Manager, select Roles.
2. On the right pane, click Action→Virtual Machines→ New Virtual Machine.
3. On the Before You Begin window, click Next.
4. Enter the name of the VM, and click Next.
5. Assign 12 GB of memory, and click Next.
6. Choose the virtual network you created from the drop-down menu, and click Next.
7. Choose to attach a virtual hard drive later and click Next.
8. Choose to install on operating system later.
9. Click Finish.
10. Create the following fixed size VHDs by right-clicking on the virtual machine and selecting Settings. Choose the following:
 - 60GB VHD for the VM OS and Logging data
 - 30GB VHD for SQL Server data
11. Add the VM OS VHD and the VM SQL VHD to the SCSI controller.
12. Click Processors, and adjust the number of virtual processors to 12.
13. Start the VM.

Installing the VM operating system on the first VM

1. Connect to the ISO image of the installation DVD for Windows Server 2012 R2 from the VM console. If the ISO image is not stored on the host, start the VM first and then connect to the ISO image.
2. Start the VM.
3. At the Language Selection Screen, click Next.
4. Click Install Now.
5. Select Windows Server 2012 R2 (Full Installation), and click Next.
6. Click the I accept the license terms check box, and click Next.
7. Click Custom.
8. Click Next.
9. At the User's password must be changed before logging on warning screen, click OK.

10. Enter the desired password for the administrator in both fields, and click the arrow to continue.
11. At the Your password has been changed screen, click OK.
12. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary. We configured each VM on the Dell PowerEdge VRTX with all available Windows Updates as of January 12, 2014.
13. Enable remote desktop access.
14. Change the hostname and reboot when prompted.
15. Create a shared folder to store test script files. Set permissions as needed.
16. Set up networking:
 - a. Click Start→Control Panel, right-click Network Connections, and choose Open.
 - b. Right-click the testing traffic NIC, and choose Properties.
 - c. Select TCP/IP (v4), and choose Properties.
 - d. Set the IP address and subnet, click OK, and click Close.
17. Shut down the VM and export it to the same volume as the original.
18. Import the VM, copying files and generating a new ID, for each additional VM needed.

SETTING UP THE LEGACY SYSTEM

We configured an HP ProLiant DL380 G7 with Windows Server 2008 R2. We detail our legacy setup configuration steps below.

Configuring the internal disks on the legacy system

1. Power on the server.
2. Enter the setup for the onboard RAID controller.
3. Create a RAID1 using the first two installed hard drives.
4. Create a RAID10 using the remaining six hard drives.
5. Begin initialization on the newly created virtual disks, then reboot the server.

Installing the operating systems on the legacy system

1. Insert installation DVD for Windows Server 2008 R2 Enterprise.
2. Power on the system.
3. At the Language Selection Screen, click Next.
4. Click Install Now.
5. Select Windows Server 2008 Enterprise (Full Installation), and click Next.
6. Click the I accept the license terms check box, and click Next.
7. Click Custom.
8. Click Next.
9. At the User's password must be changed before logging on warning screen, click OK.
10. Enter the desired password for the administrator in both fields, and click the arrow to continue.
11. At the Your password has been changed screen, click OK.
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 and reboot when prompted.

15. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary. We configured the HP ProLiant DL380 G7 with all available Windows Updates as of January 12, 2014.
16. Click Start→Control Panel, right-click Network Connections, and choose Open.
17. Right-click the testing network NIC, and choose Properties.
18. Select TCP/IP (v4), and choose Properties.
19. Set the IP address, subnet, gateway, and DNS server for the NIC, which will handle outgoing testing traffic. Click OK, and click Close.

INSTALLING MICROSOFT SQL SERVER AND CONFIGURING THE WORKLOAD

We installed Microsoft SQL Server 2012 R2 on the VMs residing on the Dell PowerEdge M520s and Microsoft SQL Server 2008 R2 on the HP ProLiant DL3800 G7.

Configuring the SQL Server VM on the VMs

After cloning, modify the SQL VMs to contain the following settings:

- Memory: 12GB
- Virtual Processors: 12
- Additional virtual disks:
 - 1 × 30GB virtual disk for SQL database data
- In the VM, configure the VM storage:
 - Click the Server Manager icon in the taskbar.
 - In the left pane, expand Storage, and click Disk Management.
 - Right-click the uninitialized volume, and choose Initialize Disk.
 - In the right pane, right-click the volume, and choose New Simple Volume...
 - At the welcome window, click Next.
 - At the Specify Volume Size window, leave the default selection, and click Next.
 - At the Assign Drive Letter or Path window, choose a drive letter, and click Next.
 - At the Format Partition window, choose NTFS, and click Next.
 - At the Completing the New Simple Volume Wizard window, click Finish.

Installing SQL Server 2012 on the VMs

1. Open the console for the VM or connect to the VM with RDP.
2. Mount the installation ISO to the VM.
3. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2012 DVD, and double-click.
4. If the installer prompts you with a .NET installation prompt, click Yes to enable the .NET Framework Core role.
5. In the left pane, click Installation.
6. Click New SQL Server stand-alone installation or add features to an existing installation.
7. At the Setup Support Rules screen, wait for the rule check to complete. If there are no failures or relevant warnings, click OK.
8. Select the Specify a free edition, and select Evaluation from the drop-down menu. Click Next.

9. Click the checkbox to accept the license terms, and click Next.
10. If no failures are displayed after the setup support files are installed, click Next.
11. At the Setup Role screen, choose SQL Server Feature Installation.
12. At the Feature Selection screen, select Database Engine Services, Full-Text and Semantic Extractions for Search, Client Tools Connectivity, Client Tools Backwards Compatibility, Management Tools – Basic, and Management Tools – Complete. Click Next.
13. At the Installation Rules screen, click Next after the check completes.
14. At the Instance configuration screen, leave the default selection of default instance, and click Next.
15. At the Disk Space Requirements screen, click Next.
16. At the Server Configuration screen, check that NT AUTHORITY\SYSTEM is selected for SQL Server Agent and SQL Server Database Engine. Click Next.
17. Assuming there are no failures, click Next.
18. At the Database Engine Configuration screen, select Mixed Mode.
19. Enter and confirm a password for the system administrator account.
20. Click Add Current user. This may take several seconds.
21. Click the Data Directories tab and enter the appropriate drive and folders for database and logs.
22. Click Next.
23. At the Error and usage reporting screen, click Next.
24. At the Installation Configuration Rules screen, check that there are no failures or relevant warnings, and click Next.
25. At the Ready to Install screen, click Install.
26. After installation completes, click Close.
27. Create a SQL Server login for the ds2user (see the [Data generation overview](#) section for the specific script to use).
28. Copy the pre-created DVD Store backup to the specified backup volume.
29. Download and install any available updates for Microsoft SQL Server 2012.

Configuring the legacy machine

1. Log into Windows using the appropriate credentials.
2. Open the Start menu, type `Hard Disk Partitions`, select Settings on the right, and click the displayed tile.
3. Right-click the disk, and select Online.
4. Right-click the disk, select Initialize Disk, and click Ok.
5. Right-click the volume space, and select Create Simple Volume.
6. At the Specify Volume Size window, leave the default selection, and click Next.
7. At the Assign Drive Letter or Path window, choose a drive letter, and click Next.
8. At the Format Partition window, choose NTFS, and click Next.
9. At the Completing the New Simple Volume Wizard window, click Finish.

Installing SQL Server 2008 R2 on the legacy machine

1. Open the console for the VM or connect to the VM with RDP.
2. Mount the installation ISO to the VM.
3. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2008 R2 DVD, and double-click.
4. If the installer prompts you with a .NET installation prompt, click Yes to enable the .NET Framework Core role.
5. In the left pane, click Installation.
6. Click New SQL Server stand-alone installation or add features to an existing installation.
7. At the Setup Support Rules screen, wait for the rule check to complete. If there are no failures or relevant warnings, click OK.
8. Select the Specify a free edition and select Evaluation from the drop-down menu. Click Next.
9. Click the checkbox to accept the license terms, and click Next.
10. If no failures are displayed after the setup support files are installed, click Next.
11. At the Setup Role screen, choose SQL Server Feature Installation.
12. At the Feature Selection screen, select Database Engine Services, Full-Text and Semantic Extractions for Search, Client Tools Connectivity, Client Tools Backwards Compatibility, Management Tools – Basic, and Management Tools – Complete. Click Next.
13. At the Installation Rules screen, click Next after the check completes.
14. At the Instance configuration screen, leave the default selection of default instance, and click Next.
15. At the Disk Space Requirements screen, click Next.
16. At the Server Configuration screen, check that NT AUTHORITY\SYSTEM is selected for SQL Server Agent and SQL Server Database Engine. Click Next.
17. Assuming there are no failures, click Next.
18. At the Database Engine Configuration screen, select Mixed Mode.
19. Enter and confirm a password for the system administrator account.
20. Click Add Current user. This may take several seconds.
21. Click the Data Directories tab and enter the appropriate drive and folders for database and logs.
22. Click Next.
23. At the Error and usage reporting screen, click Next.
24. At the Installation Configuration Rules screen, check that there are no failures or relevant warnings, and click Next.
25. At the Ready to Install screen, click Install.
26. After installation completes, click Close.
27. Create a SQL Server login for the ds2user (see the next section for the specific script to use).
28. Copy the pre-created DVD Store backup to the specified backup volume.
29. Download and install any available updates for Microsoft SQL Server 2008 R2.

CONFIGURING THE DATABASE

Data generation overview

We generated the data using the Install.pl script included with DVD Store version 2.1 (DS2), providing the parameters for our 10GB database size and the database platform on which we ran: Microsoft SQL Server. We ran the Install.pl script on a utility system running Linux. The database schema was also generated by the Install.pl script.

After processing the data generation, we transferred the data files and schema creation files to a Windows-based system running SQL Server 2012. We built the 10GB database in SQL Server 2012, and then performed a full backup, storing the backup file on the C: drive for quick access. We used that backup file to restore the server between test runs.

The only modification we made to the schema creation scripts were the specified file sizes for our database. We set the file sizes higher than necessary to ensure that no file-growth activity would affect the outputs of the test. Besides this file size modification, the database schema was created and loaded according to the DVD Store documentation. Specifically, we followed the steps below:

1. We generated the data and created the database and file structure using database creation scripts in the DS2 download. We made size modifications specific to our 10GB database and the appropriate changes to drive letters.
2. We transferred the files from our Linux data generation system to a Windows system running SQL Server.
3. We created database tables, stored procedures, and objects using the provided DVD Store scripts.
4. We set the database recovery model to bulk-logged to prevent excess logging.
5. We loaded the data we generated into the database. For data loading, we used the import wizard in SQL Server Management Studio. Where necessary, we retained options from the original scripts, such as Enable Identity Insert.
6. We created indices, full-text catalogs, primary keys, and foreign keys using the database-creation scripts.
7. We updated statistics on each table according to database-creation scripts, which sample 18 percent of the table data.
8. On the SQL Server instance, we created a ds2user SQL Server login using the following Transact SQL (TSQL) script:

```
USE [master]
GO
CREATE LOGIN [ds2user] WITH PASSWORD=N'',
    DEFAULT_DATABASE=[master],
    DEFAULT_LANGUAGE=[us_english],
    CHECK_EXPIRATION=OFF,
    CHECK_POLICY=OFF
GO
```

9. We set the database recovery model back to full.
10. We created the necessary full text index using SQL Server Management Studio.
11. We created a database user and mapped this user to the SQL Server login.
12. We then performed a full backup of the database. This backup allowed us to restore the databases to a pristine state relatively quickly between tests.

Figure 5 shows our initial file size modifications.

Logical name	Filegroup	Initial size (MB)
Database files		
primary	PRIMARY	3.25
cust1	DS_CUST_FG	5,767
cust2	DS_CUST_FG	5,767
ind1	DS_IND_FG	2,621
ind2	DS_IND_FG	2,621
ds_misc	DS_MISC_FG	2,621
orders1	DS_ORDERS	2,621
orders2	DS_ORDERS	2,621
Log files		
ds_log	N/A	20,480

Figure 5: Our initial file size modifications.

RUNNING THE TEST

Test start and run times

We ran all workloads concurrently in order to start and record all performance counters for this report. The specific testing parameters we used are included in the setup section, and specifics for launching these tests are described below.

About running the DVD Store tests

We created a series of batch files, SQL scripts, and shell scripts to automate the complete test cycle. DVD Store outputs an orders-per-minute metric, which is a running average calculated through the test. In this report, we report the last OPM reported by each client/target pair.

Each complete test cycle consisted of the general steps listed below.

1. Clean up prior outputs from the target system and the client driver system.
2. Drop the database from the target.
3. Restore the database on the target.
4. Shut down the target.
5. Reboot the host and client system.
6. Wait for a ping response from the server under test (the hypervisor system), the client system, and the target.
7. Let the test server idle for 20 minutes.
8. Start the DVD Store driver on the client.

We used the following DVD Store parameters for testing:

```
ds2sqlserverdriver.exe --target=<target_IP> --ramp_rate=10 --  
run_time=30 --n_threads=12 --db_size=10GB --detailed_view=Y --  
warmup_time=15
```

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