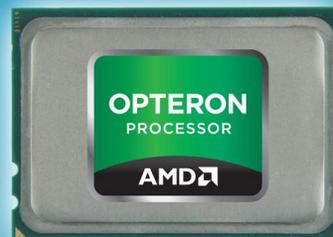# PERFORMANCE PER DOLLAR COMPARISON: DELL POWEREDGE R715 VS. HP PROLIANT DL380P GEN8



## Dell™ PowerEdge™ R715 server powered by the AMD Opteron™ 6200 Series Processor

## up to 23.2% greater database performance per dollar
*versus HP ProLiant DL380p Gen8*

The database performance your servers deliver is important, but how much are you spending to get it? By building your data center on servers that not only deliver excellent performance but also do so at a lower cost, you can potentially reduce the capital you spend on hardware and improve your bottom line.

In the Principled Technologies labs, we compared the database performance and cost of two servers hosting varying numbers of virtual machines (VMs)—the AMD Opteron 6200 Series processor -powered Dell PowerEdge R715 and the Intel® Xeon® processor E5-2665-powered HP ProLiant DL380p Gen8—and determined that the Dell PowerEdge R715 increased performance per dollar by as much as 23.2 percent over its competitor in a real-world, 70 percent processor utilization scenario.[1] When we then fully subscribed the processor cores, and pushed utilization to nearly 100 percent, the AMD Opteron 6200 Series processor -powered Dell PowerEdge R715 exceeded the database performance of the HP Gen8 server, which resulted in an increased performance per dollar of up to 26.8 percent.[2]

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[1] See Figure 1 below.
[2] See Figure 2 below.

# GET MORE FOR YOUR MONEY

Stretching capital is an important part of building a data center—getting the most performance for the money you spend on hardware is an intelligent strategy to maximize value.
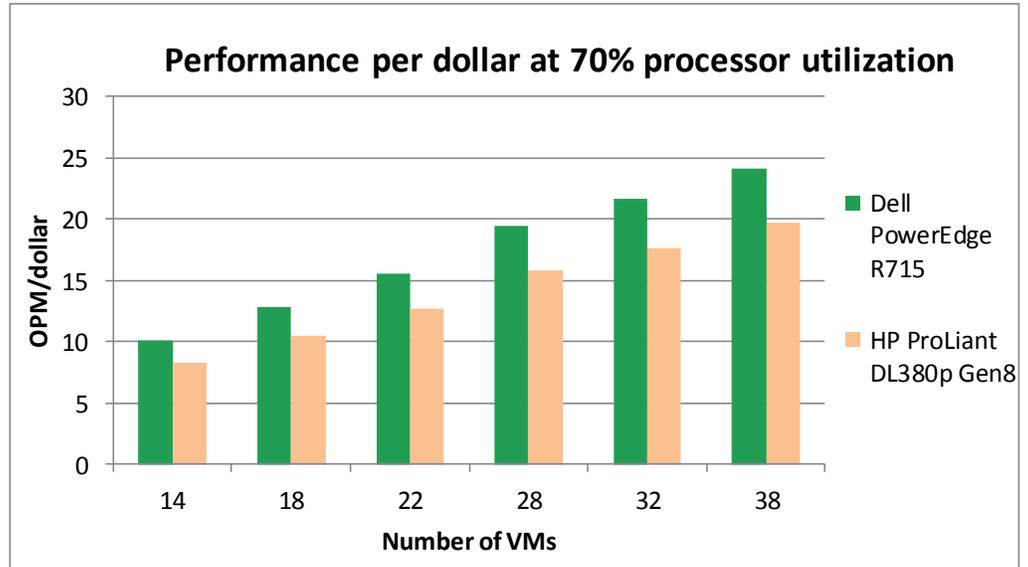
We tested the database performance per dollar of two servers using varying numbers of Microsoft® Windows Server® 2008 R2 Hyper-V™ VMs: the Dell PowerEdge R715, powered by the AMD Opteron 6200 Series processor (retail price: $11,567) and the Intel Xeon processor E5-2665-based HP ProLiant DL380p Gen8 (retail price: $14,424).[3]

To test database performance, we used the DVD Store Version 2.1 benchmark (DS2), which reports results in the orders per minute (OPM) that the servers could produce. We then determined the price of the servers from the Dell and HP Web sites, and calculated the performance per dollar the servers delivered based on our test results. For detailed server configuration information, see Appendix A. To see our detailed test results, see Appendix B. For step-by-step details on how we tested, see Appendix C.

For our real-world scenario, we tested the servers at 70 percent processor utilization, which is a typical resource allocation in data centers. As Figure 1 shows, the AMD Opteron 6200 Series processor -powered Dell PowerEdge R715 increased performance per dollar over the HP ProLiant DL380p Gen8 by an average of 22.94 percent. At 32 VMs, which fully subscribed the processor by using all 32 threads, the PowerEdge R715 delivered 23.2 percent more performance per dollar spent, and at 38 VMs, which oversubscribed the processor, delivered 22.6 percent more performance per dollar.

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[3] See Appendix B, Figure 4 below for pricing details.

Performance per dollar comparison: Dell PowerEdge R715 vs. HP ProLiant DL380p Gen8

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**Figure 1: At 70 percent processor utilization, the Dell PowerEdge R715 powered by the AMD Opteron 6200 Series processor delivered up to 23.2 percent more performance per dollar than the HP ProLiant DL380p Gen8 using 32 VMs.**

To further demonstrate the performance-per-dollar benefits that the AMD Opteron 6200 Series processor -powered Dell PowerEdge R715 server can provide, we next ramped up the processor utilization to nearly 100 percent and tested the systems with 32 VMs and with 38 VMs. The Dell PowerEdge R715 exceeded the database performance of the HP ProLiant DL380p Gen8 server by over 1.7 percent at 100 percent processor utilization. As Figure 2 shows, the performance win of the Dell PowerEdge R715, coupled with its lower cost, increased performance per dollar over the HP ProLiant DL380p Gen8 by 25.41 percent when fully subscribed, and 26.8 percent when oversubscribed.



**Figure 2: The Dell PowerEdge R715 powered by the AMD Opteron 6200 Series processor delivered up to 26.8 percent more performance per dollar at 100 percent processor utilization using 38 VMs.**

Performance per dollar comparison: Dell PowerEdge R715 vs. HP ProLiant DL380p Gen8

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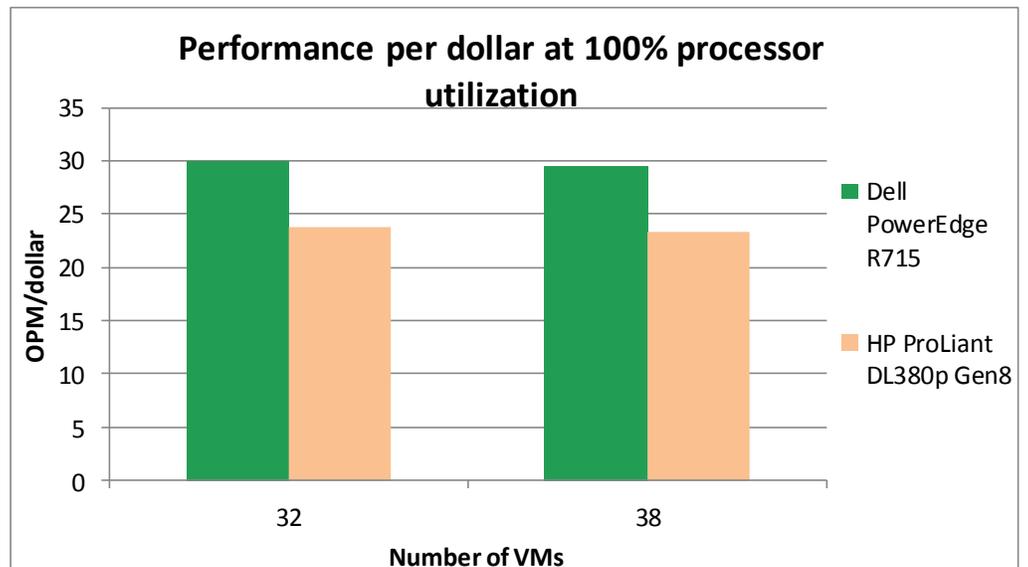
## WHAT WE TESTED
### About DVD Store Version 2.1

To create our real-world ecommerce 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 (OPM) 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 information about the DS2 tool, see http://www.delltechcenter.com/page/DVD+Store.

## IN CONCLUSION

Servers that deliver high performance at lower costs are a smart choice for any IT department building or refreshing a data center. In our tests, we found that the AMD Opteron 6200 Series processor -powered Dell PowerEdge R715 increased performance per dollar by as much as 23.27 percent in our real-world 70 percent processor utilization scenario, and as much as 26.84 percent at maximum processor utilization.

Performance per dollar comparison: Dell PowerEdge R715 vs. HP ProLiant DL380p Gen8

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# APPENDIX A – SYSTEM CONFIGURATION INFORMATION

Figure 3 provides detailed configuration information for the test systems.

| System | Dell PowerEdge R715 | HP ProLiant DL380p Gen8 |
|---|---|---|
| **Power supplies** | | |
| Total number | 1 | 1 |
| Vendor and model number | Dell D750P-S0 | HP DPS-750RB A |
| Wattage of each (W) | 750 | 750 |
| **Cooling fans** | | |
| Total number | 6 | 6 |
| Vendor and model number | Dell PFR0612UHE | HP PFR0612XHE |
| Dimensions (h x w) of each | 1.5" x 1.5" | 1.5" x 1.5" |
| Volts | 12 | 12 |
| Amps | 1.5 | 3.3 |
| **General** | | |
| Number of processor packages | 2 | 2 |
| Number of cores per processor | 16 | 8 |
| Number of hardware threads per core | 1 | 2 |
| System power management policy | Max Performance | Max Performance |
| **Processor** | | |
| Vendor | AMD | Intel |
| Name | AMD Opteron 6200 Series Processor | Xeon |
| Model number | 6278 | E5-2665 |
| Stepping | B2 | C2 |
| Socket type | G34 | LGA2011 |
| Core frequency (GHz) | 2.4 | 2.4 |
| Bus frequency | 6.4 GT/s | 8.0 GT/s |
| L1 cache | 8 x 64 KB instruction caches<br>16 x 16 KB data caches | 8 x 32 KB instruction caches<br>8 x 32 KB data caches |
| L2 cache | 8 x 2 MB | 8 x 256 KB |
| L3 cache (MB) | 16 | 20 |
| **Platform** | | |
| Vendor and model number | Dell PowerEdge R715 | HP ProLiant DL380p Gen8 |
| BIOS name and version | Dell 2.8.2 (6/26/2012) | HP P70 (2/25/2012) |
| BIOS settings | Power profile set to Max Performance | Power profile set to Max Performance |
| **Memory module(s)** | | |
| Total RAM in system (GB) | 256 | 256 |
| Vendor and model number | Hynix HMT-42GR7MFR4C-PB | Hynix HMT-42GR7MFR4C-PB |
| Type | PC3-12800R | PC3-12800R |
| Speed (MHz) | 1,600 | 1,600 |
| Speed running in the system (MHz) | 1,600 | 1,600 |
| Timing/Latency (tCL-tRCD-tRP-tRASmin) | 11-11-11-35 | 11-11-11-35 |
| Size (GB) | 16 | 16 |

Performance per dollar comparison: Dell PowerEdge R715 vs.
HP ProLiant DL380p Gen8

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| System | Dell PowerEdge R715 | HP ProLiant DL380p Gen8 |
|---|---|---|
| Number of RAM module(s) | 16 | 16 |
| Chip organization | Double-sided | Double-sided |
| Rank | Dual | Dual |
| **Operating system** | | |
| Name | Windows Server 2008 R2 SP1 | Windows Server 2008 R2 SP1 |
| Build number | 7601 | 7601 |
| File system | NTFS | NTFS |
| Kernel | ACPI x64-based PC | APCI x64-based PC |
| Language | English | English |
| **Graphics** | | |
| Vendor and model number | Matrox® G200eW | Matrox G200eH (HP) |
| Graphics memory (MB) | 8 | 16 |
| Driver | Microsoft 6.1.7600.16385 (6/21/2006) | Matrox 1.2.1.0 (7/29/2011) |
| **RAID controller** | | |
| Vendor and model number | PERC H700 | Smart Array P420i |
| Firmware version | 12.10.4-0001 | V2.14 |
| Driver version | Dell 4.31.1.64 (8/9/2010) | HP 6.24.0.64 (2/1/2012) |
| Cache size (MB) | 512 | 512 |
| **Hard drive** | | |
| Vendor and model number | Dell ST9146853SS | HP ST9146853SS |
| Number of disks in system | 2 | 2 |
| Size (GB) | 146 | 146 |
| Buffer size (MB) | 16 | 16 |
| RPM | 15,000 | 15,000 |
| Type | SAS | SAS |
| **Ethernet adapters** | | |
| Vendor and model number | Broadcom® BCM5709C NetXtreme® II GigE Network Adapter | HP Ethernet 1Gb 331FLR Network Adapter |
| Type | Integrated | Integrated |
| Driver | Broadcom Corp 7.2.80 (3/13/2012) | HP 15.2.0.5 (2/20/2012) |
| **Optical drive(s)** | | |
| Vendor and model number | TSSTcorp DVD+-RW TS-L633C | HP DVD D DS8D3SH |
| Type | DVD-ROM | DVD-ROM |
| **USB ports** | | |
| Number | 4 external, 1 internal | 4 external, 1 internal |
| Type | 2.0 | 2.0 |

**Figure 3: Configuration details for the two test servers.**

Performance per dollar comparison: Dell PowerEdge R715 vs.
HP ProLiant DL380p Gen8

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# APPENDIX B – DETAILED TEST RESULTS

Figure 4 shows the list prices of the servers we tested, as of August 13, 2012. Prices do not include any discounts, tax, or shipping costs. We priced comparable servers from the Dell Web site and the HP Web site, respectively.

| | Server price ($US) |
|---|---|
| Dell PowerEdge R715 | $11,567.00 |
| HP ProLiant DL380p Gen8 | $14,424.00 |

**Figure 4: Server prices for the two servers as of August 13, 2012.**

## 70% processor utilization results

Figure 5 details the performance results, in OPM, for the servers at various VM counts in our real-world scenario using 70 percent processor utilization.

| OPM – 70% processor utilization | | | | | | |
|---|---|---|---|---|---|---|
| Number of VMs | 14 | 18 | 22 | 28 | 32 | 38 |
| Dell PowerEdge R715 | 117,185 | 148,651 | 179,665 | 224,798 | 250,870 | 278,681 |
| HP ProLiant DL380p Gen8 | 119,247 | 150,641 | 182,268 | 227,551 | 253,772 | 283,370 |

**Figure 5: Detailed OPM results for the servers at 70 percent processor utilization.**

Figure 6 details the OPM/dollar the servers delivered at various VM counts in our real-world scenario using 70 percent processor utilization.

| OPM per dollar – 70% processor utilization | | | | | | |
|---|---|---|---|---|---|---|
| Number of VMs | 14 | 18 | 22 | 28 | 32 | 38 |
| Dell PowerEdge R715 | 10.13 | 12.85 | 15.53 | 19.43 | 21.69 | 24.09 |
| HP ProLiant DL380p Gen8 | 8.27 | 10.44 | 12.64 | 15.78 | 17.59 | 19.65 |
| **Dell win %** | **22.5%** | **23.0%** | **22.9%** | **23.19%** | **23.2%** | **22.6%** |

**Figure 6: OPM per dollar results for the servers at 70 percent processor utilization.**

## 100% processor utilization results

Figure 7 details the performance results, in OPM, at VM counts that fully subscribed and over-subscribed the servers in our scenario using 100 percent processor utilization.

| OPM – 100% processor utilization | | |
|---|---|---|
| Number of VMs | 32 | 38 |
| Dell PowerEdge R715 | 345,412 | 341,559 |
| HP ProLiant DL380p Gen8 | 343,442 | 335,789 |

**Figure 7: Detailed OPM results for the servers at 100 percent processor utilization.**

Performance per dollar comparison: Dell PowerEdge R715 vs.
HP ProLiant DL380p Gen8

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Figure 8 details the OPM/dollar the servers delivered at VM counts that fully subscribe and over-subscribed the servers in our scenario using 100 percent processor utilization.

| OPM per dollar – 100% processor utilization | | |
|---|---|---|
| Number of VMs | 32 | 38 |
| Dell PowerEdge R715 | 29.86 | 29.53 |
| HP ProLiant DL380p Gen8 | 23.81 | 23.28 |
| Dell win % | 25.41% | 26.84% |

Figure 8: OPM per dollar results for the servers at 100 percent processor utilization.

Performance per dollar comparison: Dell PowerEdge R715 vs. HP ProLiant DL380p Gen8

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# APPENDIX C - HOW WE TESTED

Figure 9 illustrates our test bed setup. For comparison purposes, we configured each VM as a standalone SQL Server 2012 environment with all roles included on each. This approach allowed us a modular method to determine an exact increase in identical virtual machines. Results in your specific environment will vary. In Figure 9, VM 2 uses client 2, VM 3 uses client 3, and so forth. A physical client was used in place of the virtualized client 1 to ensure the results were consistent. The physical client is not shown in Figure 9.
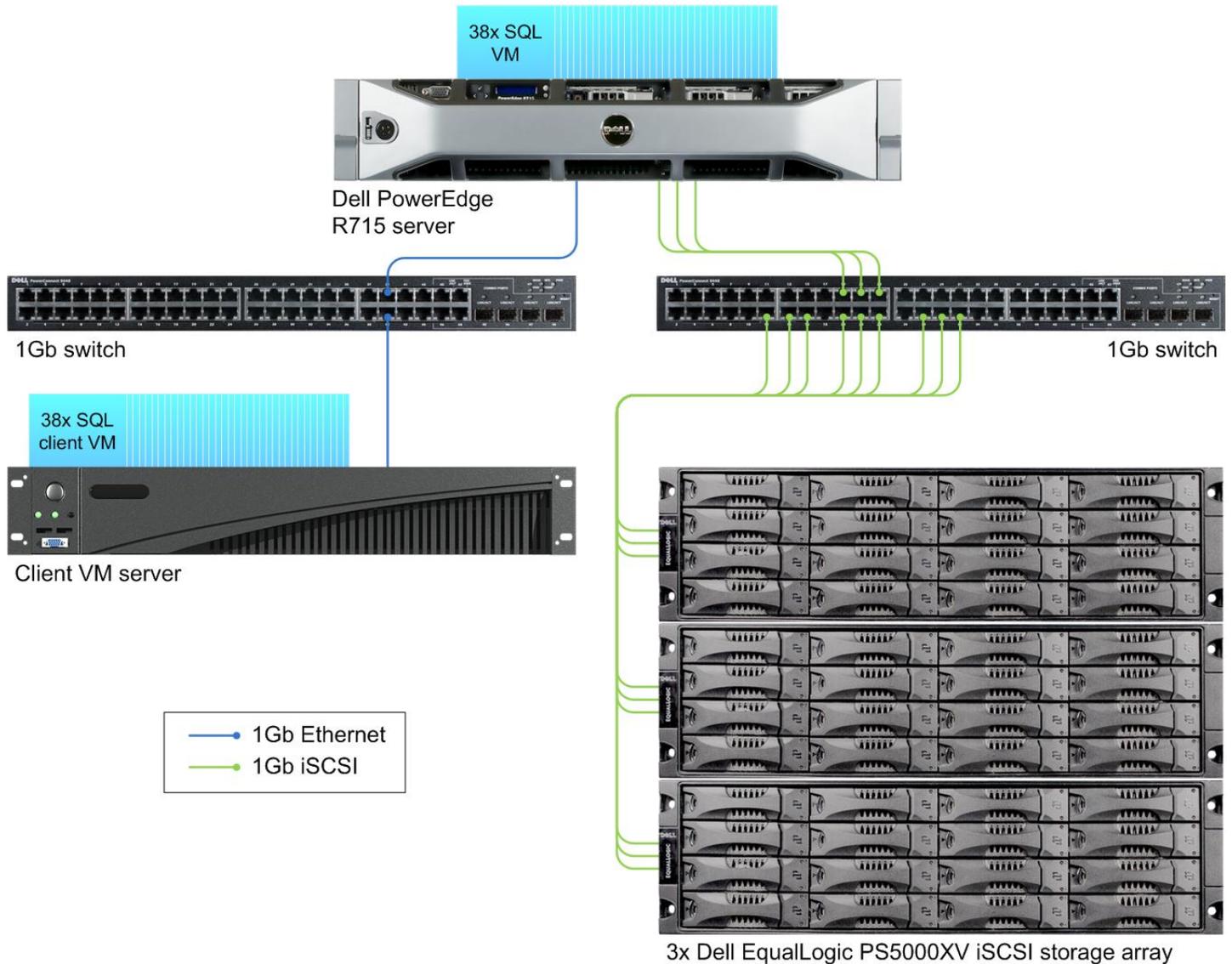


**Figure 9: The test bed setup we used.**

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Performance per dollar comparison: Dell PowerEdge R715 vs.
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## Storage configuration overview

Our complete storage infrastructure consisted of two internal drives in the server, one internal RAID controller, three onboard NICs dedicated to iSCSI traffic, one NETGEAR ProSafe JGS524 24 Port Gigabit switch for iSCSI traffic, and three Dell EqualLogic™ PS5000XV storage arrays.

We configured the internal drives on each server in a RAID 1 volume. For external storage, we used the three Dell EqualLogic PS5000XV arrays, each containing 16 drives. We cabled each Dell EqualLogic PS5000XV array to a NETGEAR switch via all three available ports, and we cabled the server to the same switch using the three onboard server NICs assigned to iSCSI traffic.

We configured the group of Dell EqualLogic PS5000XV arrays in RAID 10 mode. We then created a single storage pool, using all three drive arrays. Within the storage pool, we created a single 2.66TB volume to hold both the SQL Server database and log data.

### Setting up the external storage

1. Using the command-line console, via serial cable, reset the Dell EqualLogic PS5000XV by using the `reset` command.
2. Supply a group name, group IP address, and IP address for eth0.
3. After group creation, using a computer connected to the same subnet as the storage, use the Dell EqualLogic Web interface to do the following:
   a. Assign IP addresses on the remaining NICs (eth1 and eth2) on each array. Enable the NICs.
   b. Create a single storage pool, by right-clicking Storage pools, and choosing Create storage pool.
   c. Click on each array, and choose Yes when prompted to configure the member. Choose RAID 10.
   d. Assign all 16 drives for each array to the storage pool.
   e. Create a single volume using all available space.
   f. Disable shared access to all iSCSI targets from multiple initiators on the volume.
   g. Create an access control record for the volume without specifying any limitations.

## Setting up the server – Hyper-V

### Adjusting BIOS settings

We used the latest released BIOS updates on all systems, and adjusted the default BIOS settings. We changed the power profile to Max Performance.

### Installing Windows Server 2008 R2 SP1 Enterprise Edition

Following the operating system installation, we installed all recommended Windows Updates through 7/24/2012.

1. Boot the server, and insert the Windows Server 2008 R2 SP1 installation DVD in the DVD-ROM drive.
2. At the Language Selection screen, click Next.
3. Click Install Now.
4. Select Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
5. Click the I accept the license terms check box, and click Next.
6. Click Custom.
7. Click Next.
8. At the User's password must be changed before logging on warning screen, click OK.
9. Enter the desired password for the administrator in both fields, and click the arrow to continue.
10. At the Your password has been changed screen, click OK.
11. Enable remote desktop access.
12. Change the hostname, and reboot when prompted.

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13. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
14. Download and install these two AMD-specific hotfixes to ensure Turbo Core and virtualization are working as intended in Windows:
    - Windows6.1-KB2568088-x64.msu - http://support.microsoft.com/kb/2568088
    - Windows6.1-KB2645594-x64.msu - http://support.microsoft.com/kb/2645594

## Setting up networking

1. Click Start→Control Panel, right-click Network Connections, and choose Open.
2. Right-click the testing network NIC, and choose Properties.
3. Select TCP/IP (v4), and choose Properties.
4. Set the IP address and subnet for the testing network NIC, which will handle testing network traffic. Click OK, and click Close.
5. Right-click each iSCSI NIC, and choose Properties.
6. Select TCP/IP (v4), and choose Properties.
7. Set a set of IP addresses and subnets that is isolated from your testing network for each iSCSI NIC.
8. Click OK, and click Close.

## Installing iSCSI multipathing

1. Open Server Manager, and click Features.
2. Click Add Feature.
3. On the Before You Begin page, check the Skip this page by default box, and click Next.
4. Select Multipath I/O, and click Next.
5. On the Introduction page, click Next.
6. Confirm installation selections, and click Install.
7. Once the installation is complete, click Close.
8. When the system prompts a restart, click Yes.
9. Allow the system to fully reboot, and log in using the administrator credentials.
10. Once the desktop loads, the Multipath I/O Installation Results window will finish the installation.
11. Click Close. The Multipath I/O feature will now be available in Server Manager under Features.
12. Download and install the Dell EqualLogic Host Integration Tools to enable iSCSI multipathing.

## Configuring iSCSI multipathing

1. Run the EqualLogic Remote Setup Wizard.
2. Select Configure MPIO settings for this computer, and click Next.
3. Ensure the subnet you assigned to the iSCSI NICs is in the Subnets included for MPIO box.
4. Ensure the subnet you assigned to the testing network is in the Subnets excluded from MPIO box.
5. Set Max Sessions per volume slice to 3, Max sessions per entire volume to 9, and click Finish.
6. Restart the machine to ensure settings are in effect.

## Configure the storage

1. Click the Server Manager icon in the taskbar.
2. In the left pane, expand Storage, and click Disk Management.
3. Right-click the first volume, and choose Initialize Disk.
4. In the right pane, right-click the volume, and choose New Simple Volume…
5. At the welcome window, click Next.
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 64K allocation unit size, and click Next.
9. At the Completing the New Simple Volume Wizard window, click Finish.
10. Repeat steps c through i for the second volume.

Performance per dollar comparison: Dell PowerEdge R715 vs. HP ProLiant DL380p Gen8

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### Adding the Hyper-V R2 SP1 role
1. Open Server Manager, and click Roles.
2. Click Add Roles.
3. On the Before You Begin page, check the Skip this page by default box, and click Next.
4. Select Hyper-V, and click Next.
5. On the Hyper-V Introduction page, click Next.
6. On the Create Virtual Networks page, click Next.
7. Confirm installation selections, and click Install.
8. Once the installation is complete, click Close.
9. When the system prompts a restart, click Yes.
10. Allow the system to fully reboot, and log in using the administrator credentials.
11. Once the desktop loads, the Hyper-V Installation Results window will finish the installation.
12. Click Close. The Hyper-V role will now be available in Server Manager under Roles.

### Configuring Virtual Network Manager
1. At the Hyper-V Manager screen, in the right pane, click Virtual Network Manager.
2. At the Virtual Network Manager screen, select Internal, and click Add.
3. At the Virtual Network Manager screen, click Apply, and click OK.

## Setting up and configuring the VMs

### Creating the first VM

1. In Hyper-V, right-click the server→ New virtual machine, enter VM1 for the name, and click Next.
2. On the Assign Memory screen, select 6500, and click Next.
3. On the Configure networking screen, select the network you set up, and click Next.
4. At the connect Virtual Hard Disk screen, name the VHD and set the size to 30 GB.
5. At the Installation Options screen, leave the default option and click Finish.
6. Right-click the VM you just created and select Options.
7. Click on Processor, and ensure that the Number of logical processors is set to 1.
8. Click on SCSI Controller and add two additional VHD drives, and set their size to 13 GB.
9. Click Apply and then close the window.

### Installing the VM operating system on the first VM
1. Connect to the ISO image of the installation DVD for Windows Server 2008 R2 SP1 Enterprise 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 2008 R2 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.

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### Setting up networking on the first VM
1. Click Start→Control Panel, right-click Network Connections, and choose Open.
2. Right-click the VM traffic NIC, and choose Properties.
3. Select TCP/IP (v4), and choose Properties.
4. Set the IP address, subnet, gateway, and DNS server for the virtual NIC, which will handle outgoing server traffic. Click OK, and click Close.

### Configure the storage on the first VM
1. Click the Server Manager icon in the taskbar.
2. In the left pane, expand Storage, and click Disk Management.
3. Right-click the first volume, and choose Initialize Disk.
4. In the right pane, right-click the volume, and choose New Simple Volume…
5. At the Welcome window, click Next.
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 64K allocation unit size, and click Next.
9. At the Completing the New Simple Volume Wizard window, click Finish.
10. Repeat steps 3 through 9 for the second VM volume.
11. Copy the pre-created DVD Store backup file to the backup virtual disk inside the first VM.

### Installing SQL Server 2012 RC0 on the first VM
1. Open the Hyper-V console for the VM or connect to the VM with RDP.
2. Log into the virtual machine.
3. Connect to the ISO image of the installation DVD for SQL Server 2012 RC0 Enterprise from the VM console or the menu in the Hyper-V Client.
4. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2012 RC0 DVD, and double-click.
5. If the installer prompts you with a .NET installation prompt, click Yes to enable the .NET Framework Core role.
6. In the left pane, click Installation.
7. Click New installation or add features to an existing installation.
8. At the Setup Support Rules screen, wait for the check to complete. If there are no failures or relevant warnings, click OK.
9. Select the Enter the product key radio button, and enter the product key. Click Next.
10. Click the checkbox to accept the license terms, and click Next.
11. Click Install to install the setup support files.
12. If there are no failures displayed, click Next. You may see a Computer domain controller warning and a Windows Firewall warning. For now, ignore these.
13. At the Setup Role screen, choose SQL Server Feature Installation.
14. At the Feature Selection screen, select Database Engine Services, Full-Text Search, Client Tools Connectivity, Client Tools Backwards Compatibility, Management Tools –Basic, and Management Tools – Complete. Click Next.
15. At the Installation Rules screen, click Next once the check completes.
16. At the Instance configuration screen, leave the default selection of default instance, and click Next.
17. At the Disk space requirements screen, click Next.
18. At the Server configuration screen, choose NT AUTHORITY\SYSTEM for SQL Server Agent, and choose NT AUTHORITY\SYSTEM for SQL Server Database Engine. Click Next.
19. At the Database Engine Configuration screen, select Mixed Mode.
20. Enter and confirm a password for the system administrator account.
21. Click Add Current user. This may take several seconds.

Performance per dollar comparison: Dell PowerEdge R715 vs. HP ProLiant DL380p Gen8

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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 Next.
27. Click Close.
28. Create a SQL Server login for the ds2user (see the Configuring the database server (DVD Store) section for the specific script to use).
29. Copy the pre-created DVD Store backup to the specified backup VHD volume.

### Configuring additional VMs on Hyper-V
1. In Hyper-V, ensure VM1 is powered down.
2. Navigate to where the VHD is stored, and duplicate the file 5 times.
3. In Hyper-V, right-click the server→ New virtual machine, enter `VM2` for the name, and click Next.
4. On the Assign Memory screen, select `6500`, and click Next.
5. On the Configure networking screen, select the network you set up, and click Next.
6. At the connect Virtual Hard Disk screen, select Use an Existing, and browse to where you duplicated the original VM's main VHD.
7. Repeat these steps for the remaining VMs.
8. Ensure in each VM that the necessary virtual disks are all online and the IP addressing is properly assigned.
9. Modify the SQL Server hostname of each VM using the instructions provided by Microsoft (http://msdn.microsoft.com/en-us/library/ms143799.aspx).
10. To configure automatic start for your specified number of VMs, right-click the VM, select settings, and click Virtual Machine Startup/Shutdown.

## Configuring the database (DVD Store)

### 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 5GB 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 Install.pl script also generated the database schema.

After processing the data generation, we transferred the data files and schema creation files to a Windows-based system running SQL Server 2012 RC0. We built the 5GB database in SQL Server 2012 RC0, 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 original database on the servers between test runs.

The only modification we made to the schema creation scripts were the specified file sizes for our database. We explicitly 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 5GB 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.

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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 10 shows our initial file size modifications.

| Logical name | File group | Initial size (MB) |
|---|---|---|
| **Database files** | | |
| primary | PRIMARY | 3 |
| cust1 | DS_CUST_FG | 2,560 |
| cust2 | DS_CUST_FG | 2,560 |
| ind1 | DS_IND_FG | 1,536 |
| ind2 | DS_IND_FG | 1,536 |
| ds_misc | DS_MISC_FG | 1,536 |
| orders1 | DS_ORDERS | 1,536 |
| orders2 | DS_ORDERS | 1,536 |
| **Log files** | | |
| ds_log | Not Applicable | 10,240 |

**Figure 10: Our initial file size modifications.**


**Editing the workload script – ds2xdriver.cs module**

A new feature of DVD Store version 2.1 is the ability to target multiple targets from one source client. We used this functionality, and in order to record the orders per minute output from each specific database target, we modified the ds2xdriver to output this information to log files on each client system. To do this, we used the StreamWriter method to create a new text file on the client system, and the WriteLine and Flush methods to write the relevant outputs to the files during the tests.

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After making these changes, we recompiled the ds2xdriver.cs and ds2sqlserverfns.cs module in Windows by following the instructions in the DVD Store documentation. Because the DS2 instructions were for compiling from the command line, we used the following steps on a system with Visual Studio installed:

1. Open a command prompt.
2. Use the `cd` command to change to the directory containing our sources.
3. Execute the following command:

```
csc /out:ds2sqlserverdriver.exe ds2xdriver.cs ds2sqlserverfns.cs
/d:USE_WIN32_TIMER /d:GEN_PERF_CTRS
```

### 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. For each scenario, we ran three test cycles, and chose the median outcome.

1. Clean up prior outputs from the host system and all client driver systems.
2. Drop all databases from all target VMs.
3. Restore all databases on all target VMs.
4. Shut down all VMs.
5. Reboot the host system and all client systems.
6. Wait for a ping response from the server under test (the hypervisor system), all client systems, and all VMs.
7. Let the test server idle for one hour.
8. Start the DVD Store driver on all respective clients.
   We used the following two DVD Store parameters for testing the virtual machines in this study:

70% processor utilization:

```
ds2sqlserverdriver.exe --target=<target_IP> --ramp_rate=10 --run_time=30 --
n_threads=32 --db_size=5GB --think_time=0.2 --detailed_view=Y --
warmup_time=15
```

100% processor utilization:

```
ds2sqlserverdriver.exe --target=<target_IP> --ramp_rate=10 --run_time=30 --
n_threads=32 --db_size=5GB --think_time=0 --detailed_view=Y --warmup_time=15
```

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# ABOUT PRINCIPLED TECHNOLOGIES



Principled Technologies, Inc.
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We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

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.

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