Dell™ PowerEdge™ R815 with AMD Opteron™ processors Model 6380

15.8% More OPM per watt

47.4% Lower cost per VM

and up to **28.8%** lower three-year TCO   *versus HP ProLiant DL560 Gen8 server*

Advances in server density and processing power allow today's four-socket servers to deliver powerful performance in only 2U of space, replacing older 4U servers from previous generations. When selecting a new virtualization platform, it's critical that your hardware can deliver the performance you need, but it's important to look at the price you pay to get that performance as well as factors that affect your operating costs, including power and cooling costs and space.

In our labs, we compared the 2U, four-socket AMD Opteron processor Model 6380-based Dell PowerEdge R815 to an Intel® Xeon® processor-based HP ProLiant DL560 Gen8, and found that the Dell PowerEdge R815 delivered performance comparable to the HP server while providing better value and power efficiency. The Dell PowerEdge R815 was more power efficient than the HP server, providing 15.8 percent more performance per watt of power, and cost 47.4 percent less per virtual machine (VM). We did a TCO analysis of the servers and found that the Dell PowerEdge R815 with AMD Opteron processors Model 6380 could deliver a 28.8 percent lower three-year TCO than the HP server.

Choosing a hardware solution that provides not only the performance you need to serve your customers but that can save you in acquisition and operating costs provides clear benefits to your organization.

GET MORE POWER EFFICIENCY AT A LOWER COST

The performance your servers deliver is important, but you must also consider how the hardware you purchase for your data center affects overall costs. Selecting power-efficient servers that maximize performance and space is a great strategy to reduce costs.

We found that in our tests the AMD Opteron processor Model 6380 processor-powered Dell PowerEdge R815 server did this better than the HP ProLiant DL560 Gen8. Both servers supported 16 Hyper-V™ VMs and delivered comparable performance in 2U of rack space, varying only by 1.4 percent, and we compared the power-efficiency, cost per VM, and three-year total cost of ownership (TCO) of the servers (see below for details).

To test performance, we used an OLTP workload that accesses databases and reports results in orders per minute (OPM) that systems can handle. We intended the workload to be indicative of a heavy load in order to stress the server. In our tests, both host servers and all VMs ran Microsoft Windows Server® 2012 (with the Hyper-V role on the hosts for the VMs) and Microsoft SQL Server® 2012 databases. For more information about the test systems, see Appendix A. For step-by-step details on how we tested, see Appendix B.

Get more performance out of each watt of power

Continual operating expenses such as power and cooling have a great impact on your bottom line. Finding a server that delivers the high performance you want while using less power to do so is a way to mitigate these soaring costs. In our tests, we found that the power-efficient Dell PowerEdge R815 with AMD Opteron processors Model 6380 delivered 15.8 percent more performance per watt of power consumed than did the HP ProLiant DL560 Gen8 (see Figure 1).
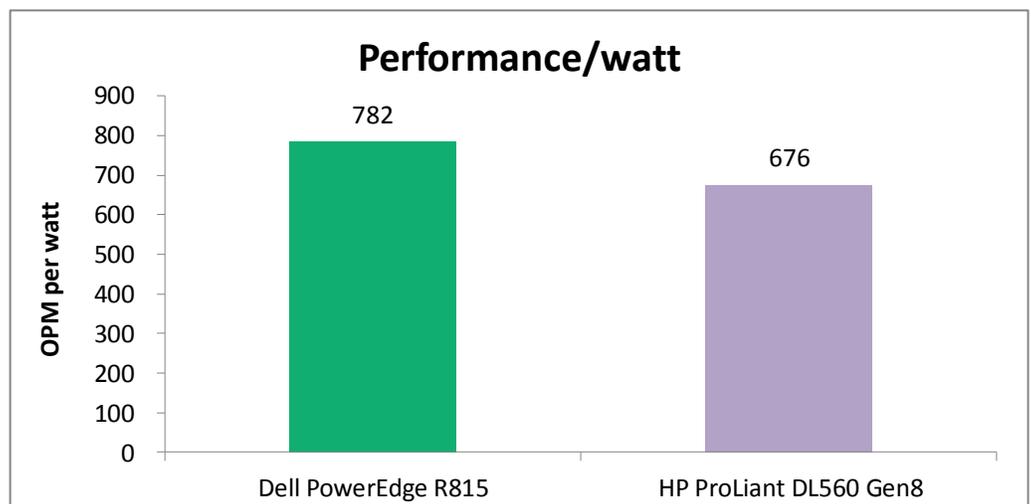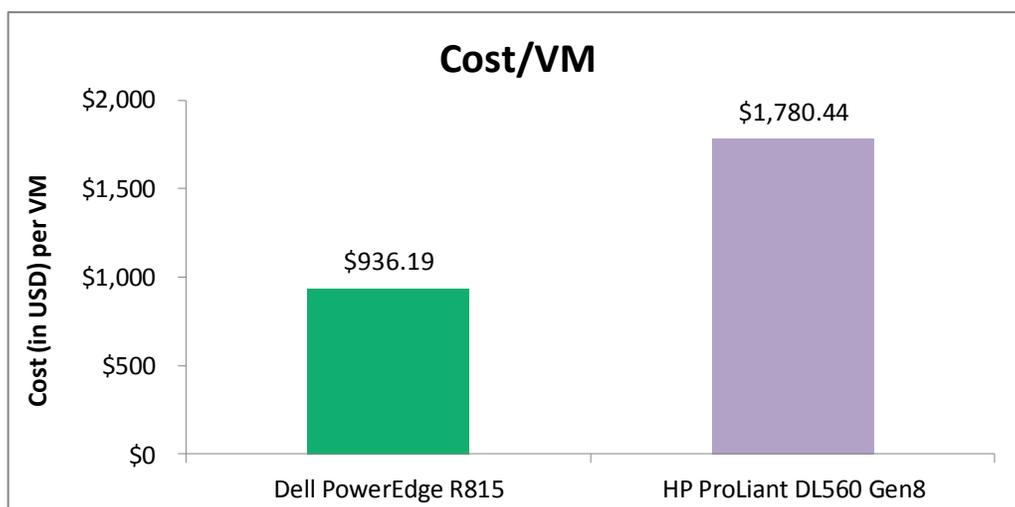
Figure 1: The Dell PowerEdge R815 delivered 15.8 percent more performance/watt than the HP ProLiant DL560 Gen8 did.

Performance/watt

OPM per watt

Dell PowerEdge R815	782
HP ProLiant DL560 Gen8	676

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report 2

Lower cost per VM

After you've targeted the amount of performance you require and can verify a server will deliver that for you, it's time to compare cost. As Figure 2 shows, the AMD Opteron processor Model 6380-powered Dell PowerEdge R815 cost up to 47.4 percent less per VM than the HP ProLiant DL560 Gen8.

Figure 2: The Dell PowerEdge R815 with AMD Opteron processors Model 6380 cost 47.7 percent less per VM than the HP ProLiant DL560 Gen8.

Cost/VM

Dell PowerEdge R815	$936.19
HP ProLiant DL560 Gen8	$1,780.44

Cost (in USD) per VM

Comparing TCO for the two servers

As Figure 3 shows, the Dell PowerEdge R815 with AMD Opteron processors Model 6380 can deliver up to a 28.8 percent lower three-year TCO than the Intel processor-based HP ProLiant DL560 Gen8.

Figure 3: The Dell PowerEdge R815 with AMD Opteron processors Model 6380 can deliver up to 28.8 percent lower three-year TCO than the HP ProLiant DL560 Gen8.

Three-year TCO

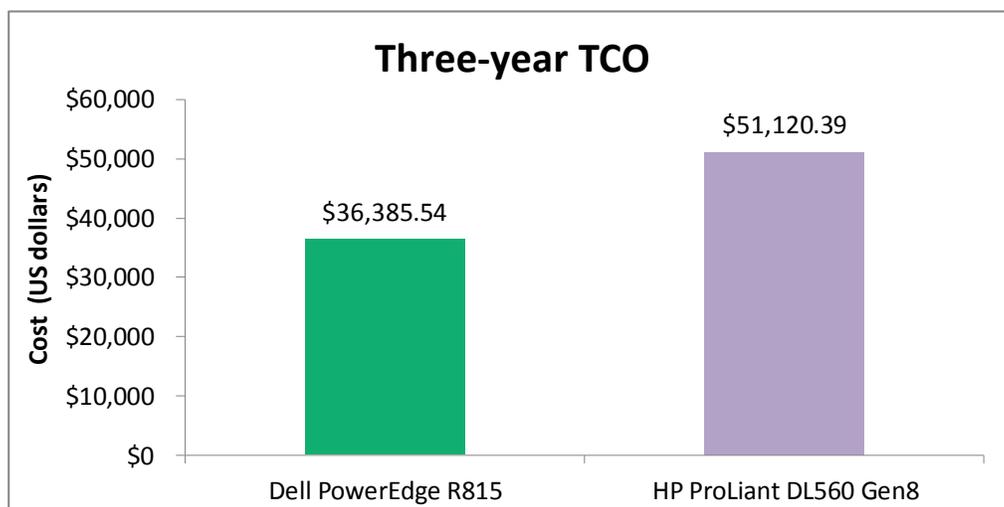|	
Dell PowerEdge R815	$36,385.54
HP ProLiant DL560 Gen8	$51,120.39

Cost (US dollars)

Figure 4 shows our estimate of key costs for the two configurations. We include the following capital expenses: the cost of the servers and three-year vendor support, the

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report **3**

cost of the operating system, and three-year software assurance. We also include three-year power and cooling costs based on the power utilization measured during the tests we ran. We used a SQL Server workload to stress the systems for this analysis but could have picked any heavy workload. We recognize that the typical enterprise would have a mix of underlying applications, therefore we do not include the price of the application (in this case SQL Server) in our cost analysis.

	Dell PowerEdge R815	HP ProLiant DL560 Gen8
Hardware	$14,979.00	$28,487.00
Windows Server 2012 Datacenter Edition with 3-year Software Assurance	$16,831.50	$16,831.50
3-year hardware support	$2,564.00	$3,094.00
3-year power and cooling costs (PUE=1.8)	$2,011.04	$2,707.89
Total	**$36,385.54**	**$51,120.39**

Figure 4: Key costs and total three-year TCO for the two servers.

Hardware prices are for the following configurations:
- One Dell PowerEdge R815 rack server with 4 x AMD 6380 processors (2.5 GHz, 16 core), 32 x 8GB PC3L-10600R memory, and 2 x 146GB 15K SAS HDDs.
- One HP ProLiant DL560 Gen8 rack server with 4 x Intel Xeon processors E5-4650 (2.7 GHz, 8 core), 32 x 8GB PC3L-10600R memory, and 2x 146GB 15K SAS HDDs.

All prices are list prices before any discounts, and do not include shipping or handling costs or taxes.

Hardware support prices are from the stores on the Dell and HP Web sites. For the Dell PowerEdge R815 server, we include the price for 3-Year ProSupport and Mission Critical 4HR 7x24 Onsite Pack. For the HP server, we include the price for 3-Year, 4-Hour 24x7 DL560 ProCare Service.

For the OS price, we include the price on the Microsoft site for two license packs of Windows Server 2012 Data Center Edition and include three years Software Assurance at 25 percent of the license cost per year.

We calculated the power and cooling costs using the average power (power under load) and idle power we measured while running our performance tests (see Figure 5). We averaged the two power measurements for each server to create a typical power result. We then calculated kWh for that result over the course of a year (8766

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report 4

hours), and multiplied by the average US commercial cost per kWh of $.0988[1] to yield an annual energy cost for power. We multiplied that by 3 for the three-year cost. We assumed a Power Usage Effectiveness (PUE) of 1.8 and used that to calculate a three-year energy cost that included both power and cooling.

	Average power (W)	Idle power (W)	Typical power (W)	kWh	Annual energy cost for power	3-year energy cost for power	3-year energy cost for power and cooling
Dell PowerEdge R815	630	230	430	3,769.38	$372.41	$1,117.24	$2,011.04
HP ProLiant DL560 Gen8	740	418	579	5,075.51	$501.46	$1,504.38	$2,707.89

Figure 5: Energy cost calculations for the two servers.

WHAT WE FOUND

We completed three test runs on both servers, and report the median result. Figure 6 details the performance, in orders per minute, that the servers achieved, broken down by VM. While running 16 database VMs, the Dell PowerEdge R815 performed comparably to the HP ProLiant DL560 Gen8, with only a 1.4 percent difference in performance.

	Dell PowerEdge R815	HP ProLiant DL560 Gen8
VM 1	30,289	31,402
VM 2	31,127	31,154
VM 3	30,943	31,076
VM 4	30,594	31,307
VM 5	30,703	31,276
VM 6	31,105	31,223
VM 7	30,844	31,324
VM 8	30,392	31,231
VM 9	30,913	31,282
VM 10	30,670	31,202
VM 11	31,087	31,416
VM 12	31,015	31,206
VM 13	30,931	30,971
VM 14	31,053	31,305
VM 15	30,674	31,390
VM 16	30,523	31,269
Total OPM	**492,863**	**500,034**

Figure 6: Performance, in OPM, that the servers delivered.

---

[1] http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_06_a

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report 5

Figure 7 shows the average processor utilization, power in watts that the servers consumed during our tests, and the performance (OPM)/watt that they delivered. The processor utilization shows that our test workload is adequately stressing the host servers.

	Dell PowerEdge R815	HP ProLiant DL560 Gen8
Average processor utilization	86.1%	85.8%
Average power(W)	630	740
Performance/watt	782	676

Figure 7: Average processor utilization, power in watts, and OPM/watt for the servers during our tests.

Figure 8 compares the cost of the two servers. Prices are taken from the Dell and HP Web sites, respectively, and do not include discounts, tax, or shipping prices.

	Dell PowerEdge R815	HP ProLiant DL560 Gen8
Total cost	$14,979.00	$28,487.00
Cost/VM	$936.19	$1,780.44

Figure 8: Cost comparison for the two servers.

WHAT WE TESTED
About the Dell PowerEdge R815

The Dell PowerEdge R815 is a four-socket server that takes up just 2U of rack space to maximize rack density. According to Dell, the PowerEdge R815 offers a combination of value and performance by using AMD Opteron 6300 Series processors, up to 1TB of memory in 32 DIMM slots, and energy-efficient technologies including high capacity fans that spin with regard to workload demand and volt regulators. The PowerEdge R815 supports a number of hot-plug hard drive options, including SAS and SATA SSDS and SAS, SATA, and near-line SAS HDDs, holding up to 6TB internally.

For more information about the Dell PowerEdge R815, visit http://www.dell.com/us/enterprise/p/poweredge-r815/pd.

About the AMD Opteron 6300 Series

The AMD Opteron 6300 Series seeks to deliver performance for demanding workloads while reducing costs for organizations purchasing servers. The AMD Opteron 6380 processor, part of the 6300 series, features 16 cores, clocks at up to 3.4GHz with AMD Turbo CORE Max Frequency, and has 16MB L3 cache. The AMD Opteron 6380 processor also supports AMD Virtualization Technology and AMD-P (Power Management).

To learn more about AMD Opteron 6300 Series processors, visit http://www.amd.com/us/products/server/processors/6000-series-platform/6300/pages/6300-series-processors.aspx#1.

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 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.

IN CONCLUSION

With advances in processing power, it's now possible to upgrade your older 4U, four-socket servers to newer and more powerful 2U, four-socket servers and achieve powerful performance. Additionally, the servers you select should provide the high performance levels you expect while simultaneously providing great purchase cost value and maximizing performance per watt, in an effort to keep your data center costs low.

In our tests, we found that the AMD Opteron processor Model 6380-powered Dell PowerEdge R815 provided similar performance to its competitor, the HP ProLiant DL560 Gen8, while providing benefits in the realms of power-efficiency and value. The Dell PowerEdge R815 delivered a 47.4 percent lower per-VM cost than the HP ProLiant DL560 Gen8, while delivering 15.8 percent more OPM per watt than the HP server did.

Due to these possible savings with the Dell solution, we found that the AMD Opteron processor Model 6380-powered Dell PowerEdge R815 could deliver up to an 28.8 percent lower three-year TCO than the HP ProLiant DL560 Gen8.

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report **7**

APPENDIX A – SYSTEM CONFIGURATION INFORMATION

Figure 9 provides detailed configuration information for the test servers, and Figure 10 details the configuration of the storage arrays we used for testing.

System	Dell PowerEdge R815	HP ProLiant DL560 Gen8
General		
Number of processor packages	4	4
Number of cores per processor	16	8
Number of hardware threads per core	1	2
CPU		
Vendor	AMD	Intel
Name	Opteron	Xeon
Model number	6380	E5-4650
Socket type	G34	FCLGA2011
Core frequency (GHz)	2.50	2.70
Bus frequency	6.4 GT/s	8 GT/s
L1 cache	8 x 64 KB instruction 16 x 16 KB data	8 x 32 KB instruction 8 x 32 KB data
L2 cache	16 MB	8 x 256 KB
L3 cache	16 MB (shared)	20 MB (shared)
Platform		
Vendor and model number	Dell PowerEdge R815	HP ProLiant BL560 Gen8
Motherboard model number	G53V4	346920-001
BIOS name and version	Dell 3.0.4 (12/19/2012)	HP P77 (12/14/2012)
BIOS settings	Maximum performance	Maximum performance
Memory module(s)		
Total RAM in system (GB)	256	256
Vendor and model number	Hynix HMT31GR7BFR4A-H9	Samsung M393B1K70DH0-YH9
Type	PC3L-10600R	PC3L-10600R
Speed (MHz)	1,333	1,333
Speed running in the system (MHz)	1,333	1,333
Timing/Latency (tCL-tRCD-tRP-tRASmin)	9-9-9-36	9-9-9-36
Size (GB)	8	8
Number of RAM module(s)	32	32
Chip organization	Double-sided	Double-sided
Rank	Dual	Dual
OS/hypervisor		
Name	Windows Server 2012 Datacenter	Windows Server 2012 Datacenter
Build number	9200	9200
File system	NTFS	NTFS
Kernel	ACPI x64-based PC	ACPI x64-based PC
Language	English	English

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report **8**

System	Dell PowerEdge R815	HP ProLiant DL560 Gen8
RAID controller		
Vendor and model number	Dell PERC H200	HP Smart Array P420i
Firmware version	7.01.09.00	3.22
Driver version	2.0.55.84 (3/12/2012)	64.24.2.64 (9/5/2012)
Hard drives		
Vendor and model number	Dell ST9146852SS	HP EH0146FAWJB
Number of drives	2	2
Size (GB)	146	146
RPM	15K	15K
Type	SAS	SAS
Ethernet adapter		
Vendor and model number	Broadcom® BCM5709c NetXtreme® II GigE	HP NC375T Gigabit Ethernet
Number of ports	4	4
Type	PCIe	PCIe
Driver version	7.4.23.0 (9/6/2012)	14.8.1.13 (2/23/2012)
USB ports		
Number	4	4
Type	2.0	2.0

Figure 9: Detailed configuration information for the test servers.

Storage array	Dell EqualLogic PS6010XV
Arrays	2
Number of active storage controllers	2
Number of active storage ports	6
Firmware revision	6.0.2
Switch number/type/model	Dell PowerConnect™ 6248
First disk type	
Disk vendor and model number	Seagate ST3300655SS
Disk size (GB)	300
Disk buffer size (MB)	16
Disk RPM	15K
Disk type	SAS
Second disk type	
Disk vendor and model number	Seagate ST3600057SS
Disk size (GB)	600
Disk buffer size (MB)	16
Disk RPM	15K
Disk type	SAS
EqualLogic Host Software for Windows version	4.5.0

Figure 10: Detailed configuration information about our test storage.

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report **9**

APPENDIX B - HOW WE TESTED

Configuring the Dell PowerEdge R815 and the HP ProLiant DL560 Gen8

The Dell PowerEdge R815 and the HP ProLiant DL560 Gen8 used Windows Server 2012 Datacenter Edition and Microsoft Hyper-V to host 16 VMs with Microsoft SQL Server 2012 installed. The guest OS was also Windows Server 2012 Datacenter Edition.

Installing Microsoft Windows Server 2012 Datacenter Edition

1. Insert the installation media into the CD/DVD drive, and restart the server.
2. When the option appears, press F11 to enter the Boot Manager.
3. Select SATA Optical Drive, and press Enter.
4. When the installation prompts you to boot from DVD, press any key.
5. When the installation screen appears, click My language is English.
6. Leave language, time/currency format, and input method as default, and click Next.
7. Click Install now.
8. When the Windows Setup window appears and the installation prompts you to go online to install updates, click No thanks.
9. Select Windows Server 2012 Datacenter (Server with a GUI), and click Next.
10. Check I accept the license terms, and click Next.
11. Click Custom: Install Windows only (advanced).
12. Press Alt+A to open advanced partition options. Delete any partitions until there is only Drive 0 Unallocated Space.
13. Select Drive 0 Unallocated Space, and click Next, at which point Windows installation begins. After installation completes, Windows restarts automatically.
14. When the Settings page appears, fill in the Password and Reenter Password fields with the same password.
15. Log in with the password you set up earlier.

Creating New Disks in Windows Server 2012 Datacenter Edition

1. In the Server Manager window, click Tools, and click Computer Management.
2. In the left pane, click Disk Management.
3. On the unallocated disk, right-click the disk name, and click Online. Right-click the disk name again, and click Initialize Disk. When the Initialize Disk window pops up, select MBR (Master Boot Record), and click OK.
4. After the disk initializes, right-click the shaded area, and click New Simple Volume.
5. On the New Simple Volume Wizard pop-up, click Next.
6. Select a size (we selected Maximum), and click Next.
7. Assign a drive letter, and click Next.
8. Select Format this volume with the following settings, and leave the default settings. Click Next.
9. Click Finish.

Configuring Windows Update

1. In the left pane of the Server Manager window, click Local Server.
2. In the main frame, next to Windows Update, click Not configured.
3. In the main pane of the Windows Update window, click Let me choose my settings.
4. Under Important updates, select Never check for updates (not recommended), and click OK.

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report **10**

5. In the left pane, click Check for updates, and install all available updates.
6. Close the Windows Update window.

Configuring Windows Firewall
1. In Server Manager, click Tools→Windows Firewall with Advanced Security.
2. In the Overview section, click Windows Firewall Properties.
3. In the Domain Profile tab, for Firewall state, click Off.
4. In the Private Profile tab, for Firewall state, click Off.
5. In the Public Profile tab, for Firewall state, click Off.
6. Click OK.
7. Close the Windows Firewall Properties window.

Setting up Remote Desktop
1. In the Local Server tab of the Server Manager window, next to Remote Desktop, click Disabled.
2. In the System Properties window that appears, in the Remote Desktop section, select the Allow remote connections to this computer radio button, and click OK when the warning message appears.
3. Uncheck Allow connections only from computers running Remote Desktop with Network Level Authentication (recommended), and click OK.

Disabling IE Enhanced Security Configuration
1. In the Local Server tab of the Server Manager window, next to IE Enhanced Security Configuration, click On.
2. In the Internet Explorer Enhanced Security Configuration window, select the Off radio buttons for both Administrators and Users, and click OK.

Adding the Hyper-V role
1. In Server Manager, click Manage→Add Roles and Features.
2. At the Before you begin screen, click Next.
3. At the Select installation type, leave the default selection of Role-based or feature-based installation, and click Next.
4. At the Select destination server screen, leave the default selection, and click Next.
5. At the Select server roles screen, check the box for Hyper-V, and click Next.
6. When the Add Roles and Features Wizard window pops up, click Add Features.
7. Click Next.
8. At the Select features screen, click Next.
9. At the Hyper-V screen, click Next.
10. At the Create Virtual Switches screen, leave the NICs unselected, and click Next.
11. At the Virtual Machine Migration screen, leave the checkbox unselected, and click Next.
12. At the Default Stores screen, leave the default locations, and click Next.
13. At the Confirm installation selections screen, check Restart the destination server automatically if required, and click Install.
14. When the installation completes, click Close.

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report **11**

Configuring the iSCSI storage area network

For our shared storage solution, we used two Dell EqualLogic PS6010 arrays, each containing 16 drives in a RAID 10. We cabled each Dell EqualLogic PS6010 and each server NIC dedicated to storage to a Dell PowerConnect 6248 switch. We enabled jumbo frames on all applicable devices.

Enabling jumbo frames on the Dell PowerConnect 6248

Using the command-line console, via serial cable, log in using appropriate credentials and enter the following commands:

```
console> enable
console# configure
console(config)# interface range ethernet all
console(config-if)# mtu 9216
console(config-if)# end
console# copy running-config startup-config
console# exit
```

Configuring the Dell EqualLogic PS6010 storage arrays

1. Using the command-line console, via serial cable, reset the first Dell EqualLogic PS6010 by using the reset command.
2. Supply a group name, group IP address, and IP address for eth0 on the first of the two arrays.
3. Reset the second array in the same manner, supplying the group name to join and IP address created in Step 2, and supply an IP address in the same subnet for eth0.
4. 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 in the same subnet on two of the remaining NICs. Assign an IP address in a separate management subnet on the fourth NIC. Enable all NICs.
   b. Verify matching firmware levels and MTU size of 9,000 on each array.
   c. Click each member array, and choose Yes when prompted to configure the member. Choose RAID 10 for each array.
   d. Create two 2TB volumes for VM virtual hard-drive storage.
   e. Enable shared access to the iSCSI targets from each initiator.

Enabling jumbo frames on the server NICs

Complete the following steps on each host:

1. Click Start and type ncpa.cpl, then press Enter.
2. Right-click the first storage-connected adapter, and click Properties.
3. Click Configure.
4. Click Advanced.
5. Click Jumbo Frame, and in the Value field, enter 9000.
6. Click OK.
7. Click OK.
8. Repeat steps 2-7 for each storage-connected adapter.

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report 12

Adding the MPIO feature

1. In Server Manager, click Manage→Add Roles and Features.
2. At the Before you begin screen, click Next.
3. At the Select installation type, leave the default selection of Role-based or feature-based installation, and click Next.
4. At the Select destination server screen, leave the default selection, and click Next.
5. At the Select server roles screen, click Next.
6. When the Add Roles and Features Wizard window pops up, click Add Features.
7. Click Next.
8. At the Select features screen, check the box for Multipath I/O, and click Next.
9. At the Confirm installation selections screen, click Install.
10. When the installation completes, click Close.

Installing Dell EqualLogic Host Integration Tools

1. Insert the disk, and click Setup64.exe.
2. At the Welcome screen, click Next.
3. At the License Agreement screen, review and accept the terms of the license agreement, and click Next.
4. At the Destination Folder screen, click Next.
5. At the Select Type screen, select Custom, and click Next.
6. At the Custom Setup screen, disable the Auto-Snapshot Manager/Microsoft Edition feature, and click Next.
7. At the Ready to Install the Program screen, click Install.
8. At the Installation Complete screen, click Finish.
9. In the pop-up window that follows to restart the system, click Yes.

Connecting to the volume with Microsoft iSCSI Initiator

1. To launch iSCSI Initiator, select Tools from the Server Manager menu, and click iSCSI Initiator.
2. Select the Discovery Tab, and click Discover Portal.
3. Enter the IP Address for the Dell EqualLogic Storage Group, and click OK.
4. Select the Targets tab, and click Refresh.
5. Select the first Inactive Target listed, and click Connect.
6. Select Add this connection to the list of Favorite Targets, check the Enable multi-path check box, and click OK.

Building the Hyper-V VMs

Complete the following steps on each host.

Creating a virtual switch

1. Open Server Manager, and click Tools→Hyper-V Manager.
2. In the right pane, click Virtual Switch Manager.
3. Under type of virtual switch, leave External highlighted, and click Create Virtual Switch.
4. Enter a name (we chose VMSwitch), and select the Microsoft Network Adapter Multiplexor Driver from the drop-down menu under External Network to select the teamed NIC. Check the Allow management operating system to share this network adapter, and click Apply.
5. When the warning pops up, click Yes.
6. Click OK.

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report 13

Creating a virtual machine

1. Open Server Manager, and on the left-hand side, click Hyper-V.
2. Right-click the local server, and click Hyper-V Manager.
3. Click New, and select Virtual Machine.
4. Enter a name for the VM, and click Next.
5. For Startup Memory, enter 8192, and click Next.
6. On the Configure Networking screen, to use the virtual switch, select VMSwitch, and click Next.
7. On the Connect Virtual Hard Disk screen, select the radio button for Create a virtual hard disk. Enter a name for the VHD and a size of 50 GB. Click Finish.
8. After the VM is created, right-click the VM, and click Settings.
9. Click Processor, and increase Number of virtual processors to 4.
10. Click OK.

Creating a virtual hard disk

We created two more VHDs per VM for Microsoft SQL Server 2012 data and logs. We stored these VHDs on the associated storage arrays.

1. Open Server Manager, and on the left-hand side, click Hyper-V.
2. Right-click the local server, and click Hyper-V Manager.
3. Click New, and select Hard Disk.
4. Click Next.
5. Select VHDX, and click Next.
6. Select Fixed size, and click Next.
7. Give the hard disk a name and location, and click Next.
8. Select Create a new blank virtual hard disk, and enter a size.
9. Click Finish.

Installing the guest OS (Windows Server 2012 Datacenter Edition)

1. In Hyper-V Manager, right-click the VM, and click Settings.
2. Click DVD Drive, and select the radio button for Physical CD/DVD drive.
3. Click OK.
4. Insert the Windows Server 2012 Datacenter DVD into the optical drive on the host.
5. Start the VM, and follow the steps outlined above to install Windows Server 2012 Datacenter Edition. The VMs do not require the Hyper-V role.

Installing SQL Server 2012 on VM 1

1. Connect and log into the virtual machine.
2. Insert the installation DVD for SQL Server 2012 into the appropriate Hyper-V host server's DVD drive and attach it to the virtual machine.
3. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2012 DVD, and double-click it.
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.

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report 14

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. Enter your product key, and 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 the features that your organization requires. We chose the following features for this guide: 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, enter the appropriate details for your configuration. For a default instance, leave the defaults selected. For a named instance, enter a new instance name and adjust the file paths as necessary. Click Next.
15. At the Disk Space Requirements screen, click Next.
16. At the Server Configuration screen, choose the service account, preferably an Active Directory domain account, fill in a password if necessary, and click Next.
17. At the Database Engine Configuration screen, choose Mixed Mode and enter the system administrator password. Click Add Current User.
18. Click Next.
19. At the Error reporting screen, click Next.
20. At the Installation Configuration Rules screen, check that there are no failures or relevant warnings, and click Next.
21. At the Ready to Install screen, click Install.
22. After installation completes, click Close.
23. Close the installation window.

Cloning the VMs
1. Shut down the guest OS on the base VM.
2. Browse to the folder containing the VHDs.
3. Make 16 new copies of the OS, Data, and Log VHDs, so that there are 17 of each. One of each will be for the base VM, and the remaining 16 will be for the target VMs.
4. Rename the VMs appropriately.
5. Open Hyper-V Manager, and select Create a new virtual machine.
6. Using the same vRAM and vCPU specifications outlined above, create a new virtual machine using one of the copied OS VHDs.
7. After completing the wizard, attach the Data and Log VHDs.
8. Repeat steps 6-7 for the remaining 15 VMs.
9. In each VM, assign a static IP address.

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report **15**

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 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 5GB 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 to the servers between test runs. We performed this procedure once.

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.
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 set the database recovery interval to 1440 minutes.
11. We created the necessary full text index using SQL Server Management Studio.

---

12. We created a database user and mapped this user to the SQL Server login.
13. 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.

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 result 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 reported the median outcome.

1. Clean up prior outputs from the server and all client driver systems.
2. Drop all databases from the test servers.
3. Restore all databases on all test servers.
4. Reboot the server and all client systems.
5. Let the test server idle until the power utilization settled.
6. Start the DVD Store driver on all respective clients.
7. We used the following DVD Store parameters for testing the servers in this study:

```
ds2sqlserverdriver.exe --target=<target_IP> --ramp_rate=10 –
warmup_time=10 --run_time=30 --n_threads=32 --db_size=5GB --think_time=0
--detailed_view=Y --database_name=DS2
```

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report **17**

ABOUT PRINCIPLED TECHNOLOGIES

![Principled Technologies® logo]

Principled Technologies, Inc.
1007 Slater Road, Suite 300
Durham, NC, 27703
www.principledtechnologies.com

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.

Power efficiency and cost: AMD Opteron 6300 Series processor-powered Dell PowerEdge R815 vs. HP ProLiant DL560 Gen8

A Principled Technologies test report 18