DELL POWEREDGE R820 AND R910 SERVERS: PERFORMANCE AND RELIABILITY

High performance Dell™ PowerEdge™ servers

Dell PowerEdge R820 Rack Server

- High performance
- Dense 2U footprint
- Dell Express Flash PCIe SSD support

Dell PowerEdge R910 Rack Server

- Maximum expansion
- Full RAS support
- Maximum processor core count

When planning your data center, it's important to know what roles you need your hardware to fill. Some applications need pure performance, and require only servers that can handle a large number of transactions or users. Other applications are so vital to keeping your business going that you can't afford to have them go down, even for a few minutes. For servers handling these mission-critical applications, high performance alone isn't enough – you need to consider reliability, availability, and serviceability (RAS) features first and foremost.

Dell designed its PowerEdge server line to meet the specific needs of many different kinds of data center applications. We tested two servers from this line, the Dell PowerEdge R820 and the Dell PowerEdge R910.

The Dell PowerEdge R820 is a four-socket server designed for data center configurations that require the highest levels of performance per rack unit. The PowerEdge R820 also offers support for the latest power management and PCIe Dell Express Flash PCIe SSD technologies. In our tests, the Dell PowerEdge R820 was able to handle up to 382,397 database orders per minute (OPM).

The Dell PowerEdge R910 is designed to deliver peak database performance—up to 440,475 OPM in our tests—while offering high memory capacity, large processor core count, and maximum PCIe expansion support. The PowerEdge R910 takes full advantage of advanced Intel® RAS features, and is designed to be a full-fledged mission-critical server capable of replacing the big iron of the past.

Whether your priority is peak performance or ensuring the highest levels of reliability for critical applications, Dell has a PowerEdge server to meet your needs.

SEPTEMBER 2012

A PRINCIPLED TECHNOLOGIES TEST REPORT

Commissioned by Dell Inc.

CHOOSING THE RIGHT FIT FOR YOUR DATA CENTER

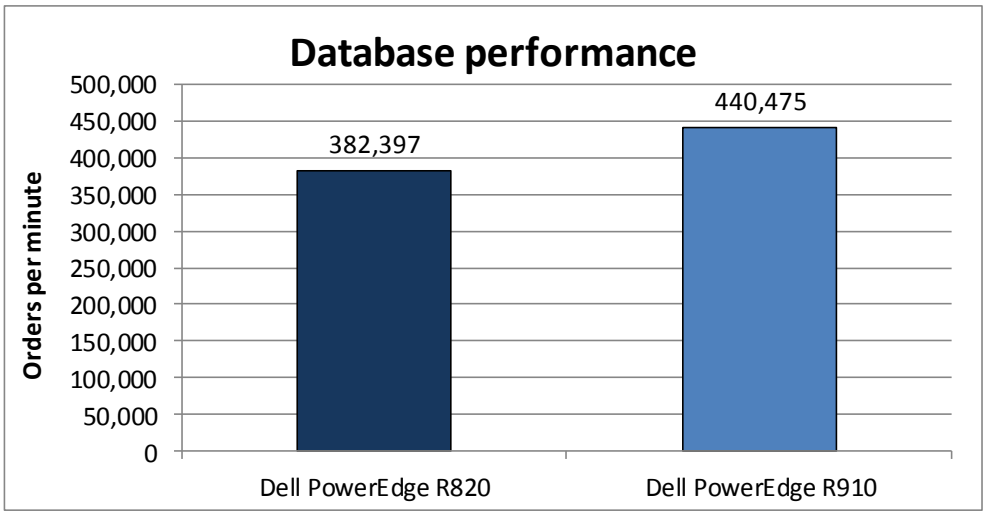
Every organization has its own set of highly specialized needs. The same goes for their data centers. For many businesses, a reliable server with the highest possible performance is the right choice to meet customer demand. For others, where even seconds of downtime over a year can cost tens of thousands of dollars, high-performing servers with special RAS features are essential. In addition to virtualized performance and RAS capabilities, you should consider how much performance you can get per rack in your data center, expansion possibilities, and different flash storage options that you might employ to expand performance as your business grows.

We used the DVD Store Version 2 (DS2) benchmark to test the database performance of two specialized servers, the Dell PowerEdge R820 and the Dell PowerEdge R910, to show how each might fit into your data center. We determined the number of virtual machines (VMs) for testing by counting all logical processors and assigning eight vCPUs to each VM– the PowerEdge R820 had 64 logical processors, for 8 VMs, while the PowerEdge R910 had 80 logical processors, for 10 VMs. Each VMware® vSphere 5® VM ran the Microsoft® Windows Server® 2008 R2 operating system and supported its own 40GB Microsoft SQL Server® 2012 database. Each server used 512 GB of RAM, which we split between the respective number of VMs. For complete configuration information, see Appendix A. For details on how we tested, see Appendix B.

Virtualized performance

Dell designed the Dell PowerEdge R820 to provide high performance for compute-intensive tasks, making it capable of supporting expanding virtual environments, and the Dell PowerEdge R910 to provide peak performance through its higher number of logical processor cores. As Figure 1 shows, the Dell PowerEdge R820 handled an impressive 382,397 OPM over 8 VMs in our tests, while the Dell PowerEdge R910 running 10 VMs handled 440,475 OPM. For detailed performance results, see Appendix C.

Figure 1: The Dell PowerEdge R820 and Dell PowerEdge R910 with RAS enabled both achieved high performance scores in our database tests.

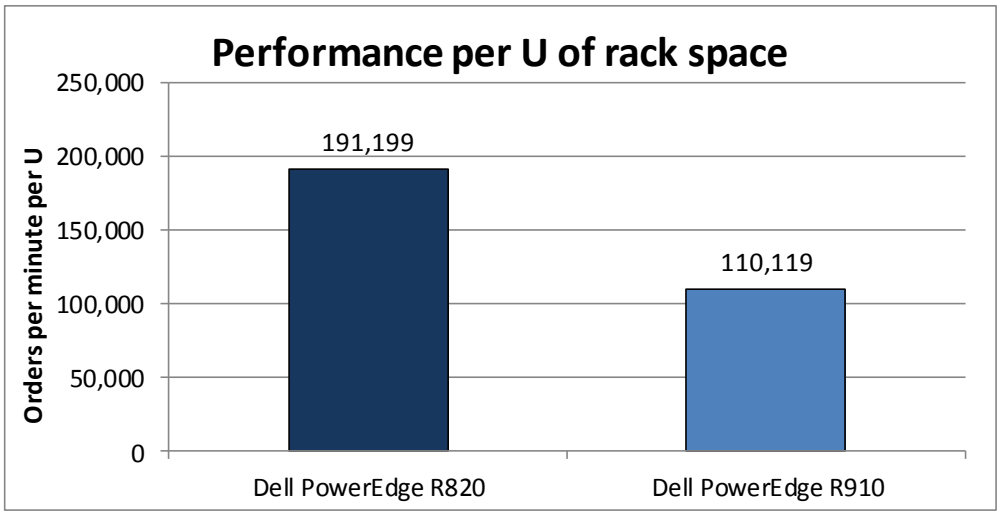


Assessing rack space and performance per rack

Data center costs are a major factor to consider when you're deciding what servers will power your infrastructure. Whether or not you aim to maximize rack density to reduce data center costs can drive your choice of server.

In a sleek 2U form factor, the Dell PowerEdge R820 can provide up to 73.6 percent more performance than a 4U PowerEdge R910 server in the same amount of rack space (see Figure 2). The Dell PowerEdge R910 has up to 40 cores, or 160 cores per rack, while the PowerEdge R820 has up to 32 cores per server, for 256 cores per rack.

Figure 2: The Dell PowerEdge R820 provided more performance per U of rack space than the RAS-enabled Dell PowerEdge R910.



Is fault tolerance necessary?

Many organizations function normally and efficiently by using reliable servers with typical redundancies and scheduled downtime for maintenance. The Dell PowerEdge R820 offers reliable high performance for such businesses.

For other organizations, such as large financial institutions, the financial cost of server downtime is so devastating that servers much meet stringent high availability guidelines to ensure that they never go down. Meeting the "five 9's" of availability, or 99.999 percent uptime, leaves only seconds of server downtime per year, which minimizes costs related to outages. For those companies with mission-critical applications, the Dell PowerEdge R910 harnesses the fault-tolerant RAS features of the Intel Xeon processor E7 family to help maintain high levels of availability. Designed to replace RISC-based systems, the four-socket PowerEdge R910 comes with redundant power supplies, remote iDRAC6 connectivity, and embedded diagnostics to increase reliability.

At the processor level, the Intel Xeon processor E7-4870 uses numerous technologies to keep the server up and running, including:[1]

- **Enhanced Double Device Data Correction (DDDC +1)**, which corrects up to two sequential DRAM errors.
- **Machine Check Architecture Recovery (MCA recovery)**, which allows the server to certain detect and recover from faults of system components, allowing the OS to continue operation even in the face of some unrecoverable errors.
- **Intel Quick Path Interconnect (QPI) Self-Healing**, which reduces the width of QPI links (which connect the processor to other processors and the I/O hub) to allow the system to maintain operation until repair can be made.

If you need RAS features for a more fault tolerant infrastructure, such as SAP® HANA, the Dell PowerEdge R910 can meet your needs. If you need a very reliable, denser rack server for 4-socket HPC or virtual database environments but can live with less-stringent fault protection, the Dell PowerEdge R820 may be a better choice.

Expansion capabilities

As your business grows, an effective way to increase the performance of your servers is to add memory. Though we tested both servers with 512 GB of RAM, the Dell PowerEdge R820 supports up to 1.5 TB in 48 DIMM slots. For maximum memory expansion, the Dell PowerEdge R910 supports up to a whopping 2 TB of memory.

The Dell PowerEdge R820 has seven PCIe slots to help expand the server's capabilities, while the Dell PowerEdge R910 has up to 10 PCIe G2 slots, offering maximum flexibility for expansion options.

[1] For a more complete look at the RAS features the Intel Xeon processor E7 family offers, visit http://www.intel.com/content/www/us/en/processors/xeon/xeon-e7-family-ras-server-paper.html.

Flash storage options

As demand for retrieving data quickly increases, the need for faster storage options increases as well. Flash storage is one of the latest storage options offering fast read and write performance. The Dell PowerEdge R820 offers a high-performance flash storage option: Dell Express Flash PCIe SSDs. You can configure the R820 with up to four internal 350GB PCIe SSDs, providing fast internal storage without the need for additional drive enclosures.

You can also configure the PowerEdge R910 with other forms of flash storage, including Fusion-io ioDrive® PCIe cards available directly from Dell.

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

Whether you're looking for the highest possible performance per rack unit or the strongest RAS-enabled server to run your mission-critical databases, Dell has a server to meet your needs. Factors such as performance per rack, expansion capabilities, and flash storage options will also drive your server decision.

In our hands-on tests, we found that the Dell PowerEdge R820 server could handle up to 382,397 database orders per minute and had 73.6 percent greater performance per U of rack space than the R910.

The Dell PowerEdge R910 processed 440,475 OPM. Its high number of logical processors, maximum expansion capabilities, and support for RAS technologies make the Dell PowerEdge R910 an excellent choice for your mission-critical data center applications.

APPENDIX A – SYSTEM CONFIGURATION INFORMATION

Figure 3 provides detailed configuration information for the test systems.

System	Dell PowerEdge R820	Dell PowerEdge R910
Power supplies		
Total number	2	4
Vendor and model number	Dell E1100E-S0	Dell L1100A-S0
Wattage of each (W)	1,100	1,100
Cooling fans		
Total number	6	6
Vendor and model number	San Ace 60 9GA0612P1J611	Delta Electronics PFC1212DE
Dimensions (h x w) of each	2.5" x 2.5"	5-1/4" x 1-3/4"
Volts	12	12
Amps	1.50	4.80
General		
Number of processor packages	4	4
Number of cores per processor	8	10
Number of hardware threads per core	2	2
System power management policy	Balanced	Balanced
CPU		
Vendor	Intel	Intel
Name	Xeon	Xeon
Model number	E5-4650	E7-4870
Stepping	7	F2
Socket type	LGA2011	LGA1567
Core frequency (GHz)	2.70	2.40
Bus frequency (GT/s)	8.0	6.4 GT/s
L1 cache (KB)	32	32 + 32 (per core)
L2 cache (KB)	256	256 (per core)
L3 cache (MB)	20	30
Platform		
Vendor and model number	Dell PowerEdge R820	Dell PowerEdge R910
Motherboard model number	Dell UL94V-0	OP658H
BIOS name and version	Dell 1.1.5	Dell Inc 2.7.4
BIOS settings	Default	Default
Memory module(s)		
Total RAM in system (GB)	512	512
Vendor and model number	Samsung M393B2G70BH0-YH9	Samsung M393B2K70CM0-CF8
Type	PC3L-10600R	PC3-8500R
Speed (MHz)	1,333	1,066
Speed running in the system (MHz)	1,333	1,066

System	Dell PowerEdge R820	Dell PowerEdge R910
Timing/Latency (tCL-tRCD-tRP-tRASmin)	9-9-9-36	7-7-7-20
Size (GB)	16	16
Number of RAM module(s)	32	32
Chip organization	Dual sided	Dual sided
Rank	Dual	Dual
Operating system		
Name	VMware ESXi 5.0.0 Update 1	VMware ESXi 5.0.0 Update 1
Build number	721882	721882
File system	VMFS	VMFS
Kernel	5.0.0	5.0.0
Language	English	English
Graphics		
Vendor and model number	Matrox® G200eR	Matrox G200eW
Graphics memory (MB)	16	8
RAID controller		
Vendor and model number	Dell PERC H710P Adapter	Dell PERC H700
Firmware version	21.0.2-0001	12.0.1-0091
Cache size	1GB	512MB
Ethernet adapter 1		
Vendor and model number	Intel Gigabit 4P I350-t	Broadcom® BCM5709C NetXtreme® II GigE
Type	Integrated	Integrated
Ethernet adapter 2		
Vendor and model number	Intel 10 Gigabit Server Adapter X520-SR2	Intel 10 Gigabit Server Adapter X520-SR2
Type	PCI-Express	PCI-Express
Optical drive(s)		
Vendor and model number	PLDS DVD+-RW DS-8A5SH	TEAC DV-28S-W ATA Device
Type	Internal	DVD-ROM
USB ports		
Number	4 external, 1 internal	4 external, 1 internal
Type	2.0	2.0

Figure 3: System configuration information for the two test systems.

APPENDIX B - HOW WE TESTED

Figure 4 shows our test bed setup. We configured the system under test with VMware ESXi 5.0 running Microsoft SQL Server 2012 VMs. We connected two shelves of Dell EqualLogic™ PS6010XV storage, each with 16 x 600GB 15,000 rpm SAS hard disk, via 10Gb iSCSI. We configured the two PS6010XV shelves in a single RAID 10 LUN. We installed an Intel Server Adapter X520-SR2 dual-port adapter in the server under test for the 10Gb iSCSI traffic. We used a Dell PowerConnect™ 8024F switch for all 10Gb connections.

We used a four-socket server running VMware ESXi 5.0 for virtualized clients. Each client VM ran Microsoft Windows Server 2008 R2 Enterprise Edition, and each had 2 vCPUs and 4 GB of memory. We connected all client traffic through a 1GB network switch. We used the same number of virtual clients as test VMs so there was a one-to-one configuration.

Figure 4 shows the test bed with the Dell PowerEdge R820 running 8 VMs. For PowerEdge R910 testing we used the same configuration replaced the R820 with the R910 running 10 VMs and used 10 client VMs.

The methodology below gives the steps we used to configure the test servers.

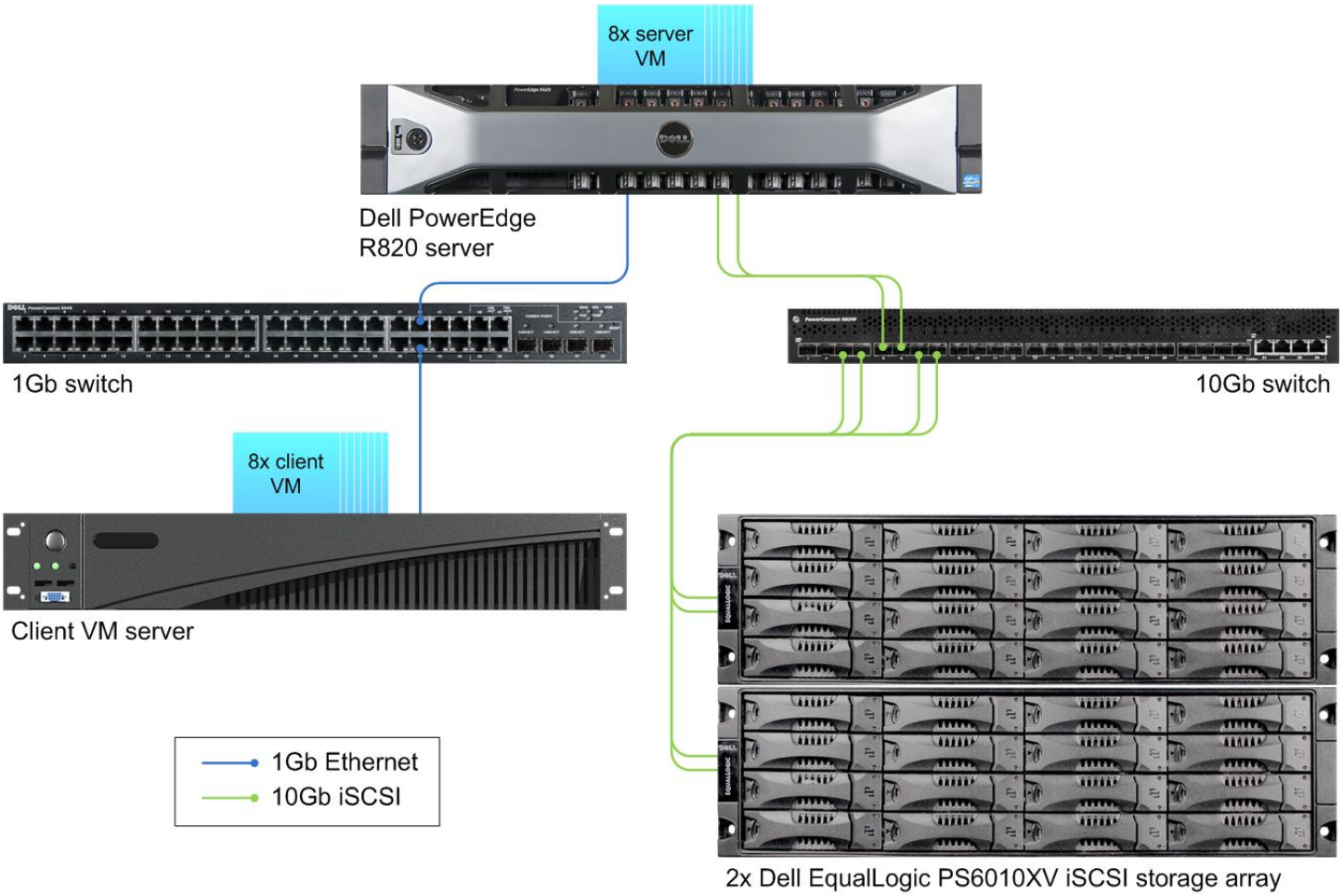


Figure 4: Our test bed setup.

Setting up the servers – VMware vSphere 5

Adjusting BIOS settings

We used the latest released BIOS updates on all systems, and used default BIOS settings.

Installing VMware vSphere 5 (ESXi)

1. Insert the disk, and select Boot from disk.
2. On the Welcome screen, press Enter.
3. On the End User License Agreement (EULA) screen, press F11.
4. On the Select a Disk to Install or Upgrade Screen, select the relevant volume to install ESXi on, and press Enter.
5. On the Please Select a Keyboard Layout screen, press Enter.
6. On the Enter a Root Password Screen, assign a root password and confirm it by entering it again. Press Enter to continue.
7. On the Confirm Install Screen, press F11 to install.
8. On the Installation complete screen, press Enter to reboot.

Configuring ESXi after Installation

1. On the 5.0.0 ESXi screen, press F2, enter the root password, and press Enter.
2. On the System Customization screen, select Troubleshooting Options, and press Enter.
3. On the Troubleshooting Mode Options screen:
   a. Select Enable ESXi Shell, and press Enter.
   b. Select Enable SSH, press Enter, and press ESC.
4. On the System Customization screen, select Configure Management Network.
5. On the Configure Management Network screen, select IP Configuration.
6. On the IP Configuration screen, select set static IP, enter an IP address, subnet mask, and default gateway, and press Enter.
7. On the Configure Management Network screen, press Esc.
8. When asked if you want to apply the changes, press Y.

Configuring VM networking

1. Using the vSphere client from another machine, connect to the ESXi server.
2. Add the necessary vSwitch for the network that DVD Store traffic will use:
   a. Click the host, click the Configuration tab, and click Networking.
   b. Click Add Networking.
   c. Choose Virtual Machine, and click Next.
   d. Choose create a vSphere standard switch.
   e. Choose the NIC associated with VM traffic.
   f. Assign the network label and assign IP settings.
   g. Click Finish.

Configuring the external volumes

1. In the vSphere client, select the host.
2. Click the Configuration tab.
3. Click Storage, and click Add Storage…
4. Choose Disk/LUN.
5. Select the disk, and click Next.
6. Accept the default of VMFS-5 for the file system.
7. Review the disk layout, and click Next.
8. Enter the datastore name, and click Next.
9. Accept the default of using maximum capacity, and click Next.

10. Click Finish.

Creating the first VM

1. In the vSphere client, connect to the ESXi host.
2. Click the Virtual Machines tab.
3. Right-click, and choose New Virtual Machine.
4. Choose Custom, and click Next.
5. Assign a name to the virtual machine, and click Next.
6. Select the first assigned OS Datastore on the external storage, and click Next.
7. Choose Virtual Machine Version 8, and click Next.
8. Choose Windows, and choose Microsoft Windows Server 2008 R2 (64-bit), and click Next.
9. Choose 1 virtual socket, and 8 virtual processors per core, and click Next.
10. Choose 60GB RAM, and click Next.
11. Click 1 for the number of NICs, select vmxnet3, and click Next.
12. Leave the default virtual storage controller, and click Next.
13. Choose to create a new virtual disk, and click Next.
14. Make the OS virtual disk size 65 GB, choose thick-provisioned lazy zeroed, specify the OS/Logs datastore on the external storage, and click Next. (We configured a 200 GB database volume and a 30 GB log volume)
15. Keep the default virtual device node (0:0), and click Next.
16. Click Finish.
17. Right-click the VM, and choose Edit Settings.
18. On the Hardware tab, click Add…
19. Click Hard Disk, and click Next.
20. Click Raw Device Mappings, and click Next.
21. Select the first database LUN, and click Next.
22. Select Store with Virtual Machine, and click Next.
23. Select Physical compatibility mode, and click Next.
24. Choose SCSI(1:0) for the device node, and click Next.
25. On the Hardware tab, click Add…
26. Click Hard Disk, and click Next.
27. Click Raw Device Mappings, and click Next.
28. Select the first log LUN, and click Next.
29. Select Store with Virtual Machine, and click Next.
30. Select Physical compatibility mode, and click Next.
31. Choose SCSI(1:1) for the device node, and click Next.
32. Click SCSI Controller 1, and choose Change Type.
33. Choose VMware Paravirtual, and click OK.
34. Click Finish, and click OK.
35. Start the VM.
36. Attach the Windows Server 2008 R2 SP1 ISO image to the VM and install Windows Server 2008 R2 on your VM.

Configuring the VMs

See the above sections regarding the initial creation of the virtual machines. We provide steps below for installing the operating system, Microsoft SQL Server 2012, and configuring the VMs.

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. Install the latest VMware tools package on the VM. Restart as necessary.
13. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
14. Enable remote desktop access.
15. Change the hostname and reboot when prompted.
16. Create a shared folder to store test script files. Set permissions as needed.
17. Set up networking:
    a. Click Start→Control Panel, right-click Network Connections, and choose Open.
    b. Right-click the VM traffic NIC, and choose Properties.
    c. Select TCP/IP (v4), and choose Properties.
    d. Set the IP address, subnet, gateway, and DNS server for the virtual NIC, which will handle outgoing server traffic. Click OK, and click Close.
18. In the VM, configure the VM storage:
    a. Click the Server Manager icon in the taskbar.
    b. In the left pane, expand Storage, and click Disk Management.
    c. Right-click the first volume, and choose Initialize Disk.
    d. In the right pane, right-click the volume, and choose New Simple Volume…
    e. At the welcome window, click Next.
    f. At the Specify Volume Size window, leave the default selection, and click Next.
    g. At the Assign Drive Letter or Path window, choose a drive letter, and click Next.
    h. At the Format Partition window, choose NTFS and 64K allocation unit size, and click Next.
    i. At the Completing the New Simple Volume Wizard window, click Finish.
    j. Repeat steps c through i for the remaining VM volumes.
19. Copy the pre-created DVD Store backup file to the backup virtual disk inside the first VM.

Installing SQL Server 2012 on the first VM

1. Open the vSphere 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 Enterprise from the VM console or the menu in the vSphere Client.
4. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2012 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 SQL Server stand-alone installation or add features to an existing installation.
8. At the Setup Support Rules screen, wait for the rule check to complete. If there are no failures or relevant warnings, click OK.
9. Select the Specify a free edition and select Evaluation from the drop-down menu. Click Next.
10. Click the checkbox to accept the license terms, and click Next.
11. If no failures are displayed after the setup support files are installed, click Next.

12. At the Setup Role screen, choose SQL Server Feature Installation.
13. 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.
14. At the Installation Rules screen, click Next once the check completes.
15. At the Instance configuration screen, choose a named instance, specify an instance name, and click Next.
16. At the Disk Space Requirements screen, click Next.
17. At the Server Configuration screen, choose system accounts, such as NT Service\MSSQLSERVER, for SQL Server services. Click Next.
18. At the next error-checking screen, 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.
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 Configuring the database (DVD Store) section for the specific script to use).
28. Copy the pre-created DVD Store backup to the specified backup VM volume.

Configuring additional VMs on VMware vSphere 5

1. Add the host to a vCenter Server, and login to vCenter Servers.
2. Right-click the first VM, and choose Clone.
3. Name the new VM.
4. Choose the cluster, and select the host.
5. For the storage screen, choose the OS LUN.
6. Choose to customize using the customization wizard. Save the clone details as a new customization specification.
7. Continue cloning each VM, modifying the customization specification as necessary for IP addressing and so on.
8. Ensure in each VM that the necessary virtual disks are all online, the hostname is renamed, and the IP addressing was properly assigned by the customization wizard.
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, click the Host configuration tab in the vSphere client, 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 40GB 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 40GB 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 on both servers

between test runs. We performed this procedure once, and used the same backup file for all VMware vSphere 5 virtual machines.

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 40GB 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	4
cust1	DS_CUST_FG	12,288
cust2	DS_CUST_FG	12,288
cust3	DS_CUST_FG	12,288
cust4	DS_CUST_FG	12,288
ind1	DS_IND_FG	6,000

Logical name	Filegroup	Initial size (MB)
ind2	DS_IND_FG	6,000
ind3	DS_IND_FG	6,000
ind4	DS_IND_FG	6,000
ds_misc	DS_MISC_FG	200
orders1	DS_ORDERS	6,144
orders2	DS_ORDERS	6,144
orders3	DS_ORDERS	6,144
orders4	DS_ORDERS	6,144
		Log files
ds_log	Not Applicable	20,480

Figure 5: 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.

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 1 hour.
8. Start the DVD Store driver on all respective clients.

We used the following DVD Store parameters for testing the virtual machines in this study:

```
ds2sqlserverdriver.exe --target=<target_IP> --ramp_rate=10 --run_time=30 --
n_threads=16 --db_size=40GB --think_time=0 --detailed_view=Y --
warmup_time=30
```

APPENDIX C – DETAILED TEST RESULTS

We completed three DS2 test runs on each server, and report the median run as our final result. Figure 6 presents the results for the Dell PowerEdge R820, and Figure 7 presents the results for the Dell PowerEdge R910. Median runs are presented in bold.

Dell PowerEdge R820 results			
VM	**Run 1**	**Run 2**	**Run 3**
VM 1	44,765	**48,124**	49,563
VM 2	48,016	**49,600**	47,671
VM 3	48,644	**46,113**	49,499
VM 4	50,774	**48,521**	49,169
VM 5	46,798	**47,590**	45,159
VM 6	48,257	**46,570**	48,176
VM 7	46,246	**49,346**	47,914
VM 8	47,279	**46,533**	46,655
Total OPM	380,779	**382,397**	383,806

Figure 6: Orders per minute that Dell PowerEdge R820 handled over three test runs, broken down by VM.

Dell PowerEdge R910 results			
VM	**Run 1**	**Run 2**	**Run 3**
VM 1	**44,299**	39,414	41,746
VM 2	**47,895**	41,335	43,672
VM 3	**43,735**	44,714	41,798
VM 4	**40,313**	45,159	47,160
VM 5	**46,374**	43,736	42,786
VM 6	**44,045**	40,872	46,366
VM 7	**42,212**	45,187	43,859
VM 8	**41,933**	48,630	48,615
VM 9	**45,909**	46,446	44,335
VM 10	**43,760**	44,281	44,893
Total OPM	**440,475**	439,774	445,230

Figure 7: Orders per minute that Dell PowerEdge R910 handled over three test runs, broken down by VM.

ABOUT PRINCIPLED TECHNOLOGIES

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

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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.