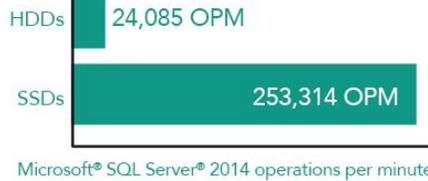


DELL™ POWEREDGE™ R630 SERVER

Step up to 1.8" SSDs and get

10.5X

the database performance of an HDD-equipped R630, plus almost 60% lower response time



71% lower
cost per
transaction



PowerEdge R630 server with 24 SATA SSDs

POWERED BY INTEL® XEON® PROCESSORS E5-2660 V3

When selecting a server for running your applications, a number of factors come into play, such as performance, response time, reliability, and available rack space. Those businesses seeking a space-efficient platform that provides excellent performance and mirrored resiliency would do well to consider the new Dell PowerEdge R630, a dense, 1U server designed to handle your complex and demanding enterprise applications.

In the Principled Technologies labs, we tested the performance of the Dell PowerEdge R630 server, powered by Intel Xeon E5-2660 v3 processors. We tested the server in two storage configurations: one configuration with hard disk drives (HDDs) and one configuration with 1.8-inch SATA solid-state drives (SSDs). Each configuration employed a pair of servers in a resilient cluster utilizing direct-attached storage, and ran Microsoft Windows Server 2012 R2 and SQL Server 2014.

The slim, 1U PowerEdge R630 delivered excellent performance in its HDD configuration. Upgrading to the SSD configuration, while still fitting within a 1U form factor, boosted orders-per-minute (OPM) performance to 10.5 times that of the HDD configuration and lowered application response time by 59 percent. The upgrade also reduced the cost per transaction by 71 percent.



SAVE SPACE, GAIN PERFORMANCE + RELIABILITY

The PowerEdge R630 is a space-saving, 1U server designed by Dell to be capable of supporting complex and demanding enterprise applications. With two or more of these servers in a cluster running database software, such as our solution that ran SQL Server 2014, the Dell solution can bring database resiliency and high availability to your datacenter. We set out to test database performance with these features in place and with different storage configurations.

To configure the servers for high availability, we set up a resilient two-node cluster running Windows Server 2012 R2 and SQL Server 2014, using the AlwaysOn technology from Microsoft SQL Server. AlwaysOn is a high-availability and disaster-recovery feature available in SQL Server 2014.

To learn about the application performance the Dell PowerEdge R630, powered by Intel Xeon E5-2660 v3 processors, can deliver on the cluster with the servers configured with HDDs, we created and ran an online transaction processing (OLTP) database workload with the benchmark DVD Store 2.1. We then repeated same test with two additional Dell PowerEdge R630 servers, configured with 1.8-inch SATA SSDs. The results of our test follow. For information on the server, software, and benchmark, see [Appendix A](#). For detailed system configuration information, see [Appendix B](#). For specifics of our testing, see [Appendix C](#). For a cost comparison of our configurations, see [Appendix D](#).

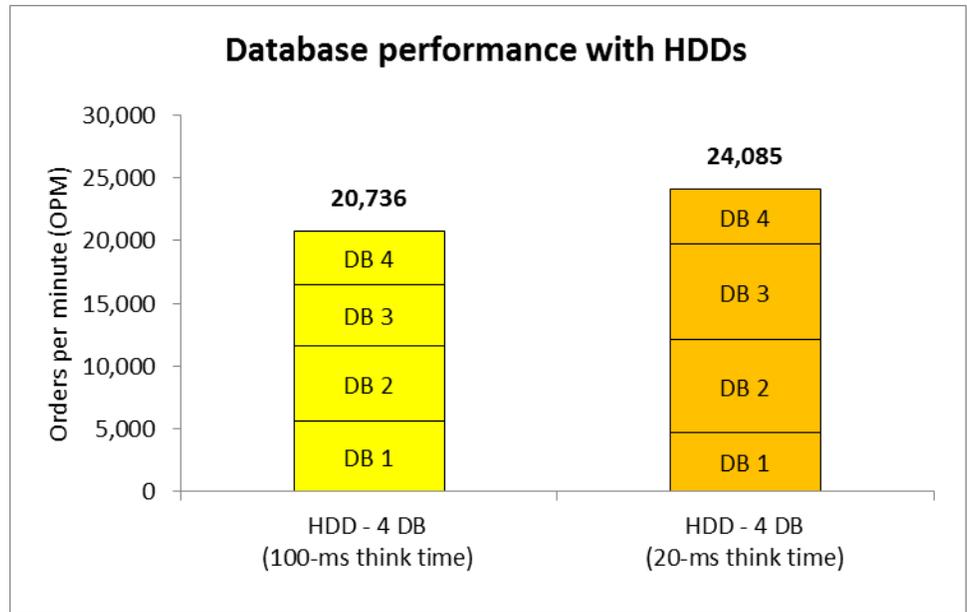
WHAT WE FOUND

HDD configuration

Think time refers to the length of time the virtual users pause between transactions, simulating user pauses during real transactions.

We tested the HDD configuration of the server at medium and heavy OLTP workload levels. First, we used a think time of 100 milliseconds, to represent a moderate database workload. We configured a single SQL Server instance to host four databases and then found that the Intel-powered Dell PowerEdge R630 HDD configuration delivered a solid output of 20,736 orders per minute. Next, we increased the intensity of the workload by changing the parameters to reflect an application with higher utilization. As Figure 1 shows, decreasing the think time to 20 milliseconds, representing a more difficult workload, boosted performance a modest 16.2 percent.

Figure 1: SQL Server 2014 performance for the HDD server configuration with two different think times.



Note that the bars in [Figure 1](#) are more uniform in size with the longer think time and less uniform with the shorter think time. [Figure 2](#) shows the specific number of OPM each client achieved. With the more intense workload due to shorter think time, variability increased. In other words, because of higher variability, application service for the users degraded.

Scenario	HDD – 4 DB (100 ms)	HDD - 4 DB (20 ms)
Client 1	5,567	4,719
Client 2	6,055	7,376
Client 3	4,823	7,628
Client 4	4,291	4,362
Total OPM	20,736	24,085
Variability	29.1%	42.8%

Figure 2: Performance and variability for the 100-ms and 20-ms scenarios with HDDs.

SSD configuration

As [Figure 3](#) shows, replacing the Dell PowerEdge R630 HDDs with SSDs boosted performance dramatically. Compared to the 20-ms think time HDD scenario with four databases, the SSD configuration with four databases delivered 7.7 times as many OPM. We ran multiple SQL Server instance and database count combinations to see which combinations would deliver the best performance. Fewer SQL Server instances are more common in practice, so first we ran eight databases with two SQL Server instances. The eight-database SSD configuration using two SQL Server instances delivered 10.1 times as many and the 24-database configuration with four SQL Server instances delivered 10.5

times as many OPM, with each database providing many more OPM than the original HDD-configuration databases provided.

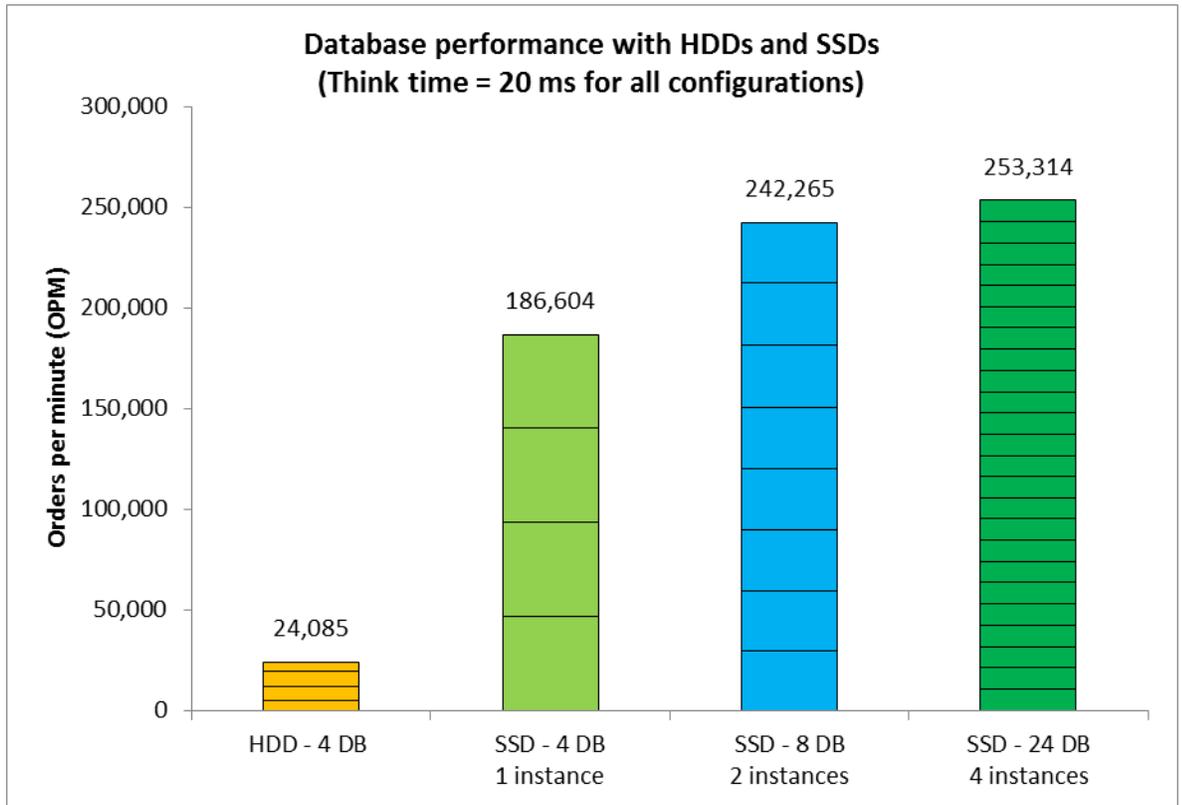


Figure 3: SQL Server 2014 performance for the 20-ms think HDD server configuration and four 20-ms think time SSD configurations.

We found that by using multiple SQL Server instances when using more databases at the eight-database and 24-database configurations, we were able to achieve higher OPM.

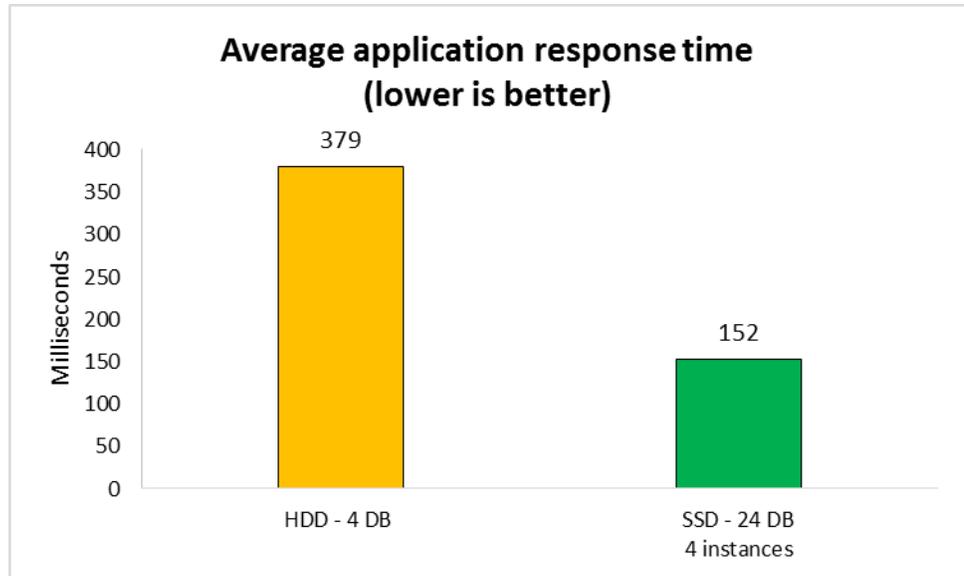
When we looked at the variability with SSDs, we found it to be significantly lower than with HDDs—under 5 percent with all database counts. Having a balanced service level shows that the database server had sufficient performance capacity on the storage to be able to service all our test clients equally (see [Figure 4](#)).

Scenario	HDD - 4 DB (1 SQL instance)	SSD - 4 DB (1 SQL instance)	SSD - 8 DB (2 SQL instances)	SSD - 24 DB (4 SQL instances)
Client 1	4,719	46,627	29,443	10,642
Client 2	7,376	46,597	30,184	10,614
Client 3	7,628	46,819	30,283	10,623
Client 4	4,362	46,561	30,325	10,596
Client 5			30,517	10,678
Client 6			30,722	10,466
Client 7			30,711	10,567
Client 8			30,080	10,320
Client 9				10,611
Client 10				10,580
Client 11				10,565
Client 12				10,407
Client 13				10,528
Client 14				10,599
Client 15				10,550
Client 16				10,638
Client 17				10,631
Client 18				10,360
Client 19				10,578
Client 20				10,570
Client 21				10,393
Client 22				10,627
Client 23				10,655
Client 24				10,516
Total OPM	24,085	186,604	242,265	253,314
Variability	29.1%	0.6%	4.2%	3.4%

Figure 4: Performance and variability for SSD scenarios we tested.

Another factor in application service quality is the length of the delay between the user making a request and receiving the requested data. This delay, referred to as latency or response time, is measured in milliseconds, and is another useful metric for showing the performance difference between the SSD- and HDD-based solutions. We used the average of return trip (total) over all orders in milliseconds, called `rt_tot_avg_msec` counter, in the DVD Store 2.1 benchmark to determine the average round-trip latency for the test run on a sample client. In our testing, we found that the SSD-based solution was almost 60 percent lower in response time as reported by the benchmark tool than the HDD-based solution (see [Figure 5](#)).

Figure 5: Application response time comparison for the SSD server configuration versus the HDD server configuration, as reported by the `rt_tot_avg_msec` counter. Lower numbers are better.



In addition, when we compared the costs and performance of the server configurations against each other, we found that the hard drive-based R630 had a cost per OPM of \$0.45, versus the \$0.13 per OPM of the SSD-based configuration, a 71 percent improvement. See [Appendix D](#) for further details on pricing.

CONCLUSION

We tested the OLTP performance of a 1U Dell PowerEdge R630, powered by Intel Xeon E5-2660 v3 processors, running SQL Server 2014 in a two-node cluster that was replicating the changes to the secondary node to show resiliency. While the server delivered strong performance in its standard HDD configuration, this performance improved dramatically when we tested the SSD configuration. Depending on the number of databases in our configuration, the SSDs delivered from 7.7 times to 10.5 times as many total OPM as the HDD configuration with the same think time, with an even level of service and reduced response times for users, while improving the cost-per-transaction.

Companies will appreciate the 1U form factor of the Intel-powered Dell PowerEdge R630, which lets it pack great performance into limited rack space. In addition, when the Dell PowerEdge R630 is deployed as part of a cluster, its resiliency features paired with Microsoft technologies enable a business to easily provide a safety net for their critical data in a small form factor.

APPENDIX A – ABOUT THE COMPONENTS

About the Dell PowerEdge R630

Fitting into just 1U of rack space, the Dell PowerEdge R630 features two Intel E5v3 processors to deliver high compute performance. Dell designed the PowerEdge R630 with cloud applications, virtualization environments, and high performance computing (HPC) infrastructures in mind. The PowerEdge R630 has 24 DIMM slots to support up to 1.5 TB of memory, supports an optional internal GPU processing accelerator, and can support up to two optional NVMe Express Flash PCIe SSDs to reduce storage bottlenecks.

In addition to the features above, the distinguishing flexibility feature of the Dell PowerEdge R630 is the choice of storage options. In addition to more traditional 2.5-inch hard disk drive (HDD) options, the Dell PowerEdge R630 includes 1.8-inch SATA SSD options. [Figure 6](#) shows the 1.8-inch SATA SSD capacities and use types available on the Dell PowerEdge R630.

Capacity	Usage
60GB	Boot
120GB	Boot
480GB	Read Intensive
960GB	Read Intensive
100GB	Mix Use
200GB	Mix Use
400GB	Mix Use

Figure 6: 1.8-inch SSD options on the Dell PowerEdge R630.

With redundant power supply units, hot-swappable hardware, and Dual SD card for Failsafe Hypervisors, the Dell PowerEdge R630 supports hardware high availability. The PowerEdge R630 comes standard with iDRAC7 with Lifecycle Controller and Dell OpenManage, which all work to streamline management.

Learn more at www.dell.com/us/business/p/poweredge-r630/pd.

About Microsoft SQL Server 2014

SQL Server 2014 includes the AlwaysOn features introduced in SQL Server 2012, along with a number of advances over previous versions. The in-memory columnstore is now updatable, and a new in-memory OLTP engine boosts transactional performance dramatically. According to Microsoft, “SQL Server 2014’s in-memory OLTP technology delivers blistering performance for mission-critical applications while minimizing additional cost by only requiring the hot tables of the database to be put in memory vs. the entire database, like other solutions on the market. When these hot tables are memory optimized, they automatically transform into a new data structure that eliminates locking and latching, further increasing performance. SQL Server 2014 will also identify which stored procedures can be recompiled to further improve throughput. All this is built directly into SQL Server 2014, so there is no need to buy specialized hardware, expensive add-ons or learn new skills to achieve breakthrough performance.”

Learn more at www.microsoft.com/en-us/server-cloud/products/sql-server/

About DVD Store Version 2.1

To create our real-world OLTP workload, we used the DVD Store Version 2.1 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.

Learn more at www.delltechcenter.com/page/DVD+Store.

APPENDIX B – SYSTEM CONFIGURATION INFORMATION

Figure 7 provides detailed configuration information for the test systems.

System	Dell PowerEdge R630	Dell PowerEdge R630
Power supplies		
Total number	2	2
Vendor and model number	Dell D750E-S6	Dell D750E-S6
Wattage of each (W)	750	750
General		
Number of processor packages	2	2
Number of cores per processor	10	10
Number of hardware threads per core	2	2
System power management policy	Balanced	Balanced
CPU		
Vendor	Intel	Intel
Name	Xeon®	Xeon
Model number	E5-2660 v3	E5-2660 v3
Stepping	2	2
Socket type	LGA 2011-3	LGA 2011-3
Core frequency (GHz)	2.60	2.60
Bus frequency	5 GT/s DMI	5 GT/s DMI
L1 cache	10 × 32 KB	10 × 32 KB
L2 cache	10 × 256 KB	10 × 256 KB
L3 cache	25 MB	25 MB
Platform		
Vendor and model number	Dell PowerEdge R630	Dell PowerEdge R630
Motherboard model number	OCNCJW X36	OCNCJW X36
Motherboard chipset	Haswell-E / ID2F00 Rev2	Haswell-E / ID2F00 Rev2
BIOS name and version	0.3.23	0.3.23
BIOS settings	Default	Default
Memory module(s)		
Total RAM in system (GB)	128	128
Vendor and model number	Hynix® HMA41GR7MFR8N-TF	Samsung® M393A1G43DB0-CPB
Type	DDR4-2133 ECC	DDR4-2133 ECC
Speed (MHz)	2,133	2,133
Speed running in the system (MHz)	2,133	2,133
Timing/Latency (tCL-tRCD-tRP-tRASmin)	15-15-15-36	15-15-15-36
Size (GB)	8	8

System	Dell PowerEdge R630	Dell PowerEdge R630
Number of RAM module(s)	16	16
Chip organization	512Mb × 8	512Mb x 8
Rank	Dual	Dual
Disks		
Vendor and model number	LITEON® IT EBE-400NAS	Seagate ST300MM0006
Number of disks in system	24	8
Size (GB)	2 × 60, 22 × 400	300
Type	SSD	HDD
Firmware	110A / 11X7	LS08
Disk controller		
Vendor and model	Dell PERC H730P Mini	Dell PERC H730P Mini
Controller cache (MB)	2048	2048
Controller driver	6.602.7.0	6.602.7.0
Controller firmware	25.2.1.0037	25.2.1.0037
RAID configuration	(1) RAID 1, (2) RAID 10	(1) Raid 1, (1) RAID 10
Settings	Default	Default
Operating system		
Name	Microsoft Windows Server® 2012 R2 Datacenter	Microsoft Windows Server 2012 R2 Datacenter
Build number	9600	9600
File system	NTFS	NTFS
Kernel	NT	NT
Language	English	English
Ethernet		
Vendor and model number	Broadcom® GbE 4P 5720-t rNDC	Broadcom GbE 4P 5720-t rNDC
Type	Integrated	Integrated
Driver	15.6.1.3 (Microsoft)	15.6.1.3 (Microsoft)
Optical drive(s)		
Vendor and model number	N/A	N/A
Type	N/A	N/A
USB ports		
Number	4	4
Type	2.0	2.0

Figure 7: Detailed configuration information for the test systems.

APPENDIX C – HOW WE TESTED

Installing Microsoft Windows Server 2012 Datacenter Edition on the Dell PowerEdge R630 and DVD Store load generation server

1. Insert the installation USB drive into the rear USB 3.0 port, and restart the server.
2. When the option appears, press F11 to enter the Boot Manager.
3. Select BIOS Boot Menu.
4. Select the USB drive, and press Enter.
5. Press any key when prompted to boot from DVD.
6. When the installation screen appears, leave language, time/currency format, and input method as default, and click Next.
7. Click Install now.
8. When the installation prompts you, enter the product key.
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. Select Drive 0 Unallocated Space, and click Next, at which point Windows begins automatically, and restarts automatically after completing.
13. When the Settings page appears, fill in the Password and Reenter Password fields with the same password.
14. Log in with the password you set up previously.

Installing .Net Framework 3.5 on Dell PowerEdge R630

1. Click on Start→Server Manager→Manage→Add Roles and Features.
2. Select Role-based or feature-based installation, and click Next.
3. Select the local server under Server Pool, and click Next twice.
4. Under Features, select .NET Framework 3.5 Features, and click Next.
5. Click Install.
6. Click Close upon completion.

Installing SQL Server 2014 on Dell PowerEdge R630

1. Browse to the installation media for SQL Server 2014.
2. Run SETUP.EXE.
3. In the left pane, click Installation.
4. Click New SQL Server stand-alone installation or add features to an existing installation.
5. Select the Enter the product key radio button, and enter the product key. Click Next.
6. Click the checkbox to accept the license terms, and click Next.
7. Click Use Microsoft Update to check for updates, and click Next.
8. Click Install to install the setup support files.
9. If there are no failures displayed, click Next.
10. At the Setup Role screen, choose SQL Server Feature Installation, and click Next.

11. 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.
12. At the Installation Rules screen, after the check completes, click Next.
13. At the Instance configuration screen, leave the default selection of default instance, and click Next.
14. At the Server Configuration screen, choose NT Service\SQLSERVERAGENT for SQL Server Agent, and choose NT Service\MSSQLSERVER for SQL Server Database Engine. Change the Startup Type to Automatic. Click Next.
15. At the Database Engine Configuration screen, select the authentication method you prefer. For our testing purposes, we selected Mixed Mode.
16. Enter and confirm a password for the system administrator account.
17. Click Add Current user. This may take several seconds.
18. Click Next.
19. At the Error and usage 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.

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 Windows Update window, in the main pane, click Let me choose my settings.
4. Under Important updates, select Never check for updates (not recommended), and click OK.
5. In the left pane, click Check for updates, and install all available updates.
6. Close the Windows Update window.

Configuring a SQL Server 2014 AlwaysOn availability group

Installing the Windows Failover Cluster Feature

1. Open the Server Manager console and select Add roles and features. This will launch the Add Roles Features Wizard.
2. Click Next until you reach the Select Features dialog box. Select the Failover Clustering checkbox. When prompted with the Add features that are required for Failover Clustering dialog box, click Add Features. Click Next.
3. Click Install to install the Failover Clustering feature.

Windows Failover Clustering Configuration for SQL Server 2012 AlwaysOn Availability Groups

1. Launch Failover Cluster Manager from within the Server Manager console.
2. Within Failover Cluster Manager, click the Validate Configuration... link.
3. In the Validate a Configuration Wizard dialog box, click Next.

4. In the Select Servers or a Cluster dialog box, add the server hostnames of the SQL Server instances that you want to configure as replicas in your Availability Group. Click Next.
5. In the Testing Options dialog box, make sure that the option Run all tests (recommended) is selected. Click Next.
6. In the Confirmation dialog box, click Next.
7. In the Summary dialog box, click Finish to create the Windows Failover Cluster.
8. In the Access Point for Administering the Cluster dialog box, enter the virtual server name and virtual IP address of your Windows Server Failover Cluster.
9. In the Confirmation dialog box, click Next. This will create the Windows Failover Cluster using the servers as nodes of the cluster, and add DNS and Active Directory entries for the cluster hostname.
10. In the Summary dialog box, verify that the configuration is successful.
11. To configure the cluster quorum configuration to use a file share, right-click on the cluster name, select More Actions and click Configure Cluster Quorum Settings... We will be configuring a file share witness for our cluster quorum setting. By default, the wizard will configure the cluster to use Node Majority.
12. Click Next.
13. In the Select Quorum Configuration page, select the Add or change the quorum witness option. Click Next.
14. In the Select Quorum Witness page, select the Configure a file share witness (recommended for special configuration) option. Click Next.
15. In the Configure File Share Witness page, type path of the file share that you want to use in the File Share Path: text box. Click Next.
16. In the Confirmation page, click Next.
17. In the Summary page, click Finish.

Enable SQL Server 2012 AlwaysOn Availability Groups Feature

1. Open SQL Server Configuration Manager. Double-click the SQL Server (MSSQLSERVER) service to open the Properties dialog box.
2. In the Properties dialog box, select the AlwaysOn High Availability tab. Check the Enable AlwaysOn Availability Groups check box. This will prompt you to restart the SQL Server service. Click OK.
3. Restart the SQL Server service.

Create and Configure SQL Server 2012 AlwaysOn Availability Groups

1. Open SQL Server Management Studio. Connect to the SQL Server instance
2. In Object Explorer, expand the AlwaysOn High Availability folder. Right-click the Availability Groups folder and select the New Availability Group Wizard... option. This will launch the New Availability Group Wizard.
3. In the Introduction page, click Next.
4. In the Specify Availability Group Name page, enter the name of the Availability Group in the Availability group name: field. Click Next.
5. In the Select Databases page, select the checkbox beside the database that you want to include in your Availability Group. The databases have to be in Full recovery model prior to joining them in the Availability group. Click Next.

6. In the Specify Replicas page, under the Replicas tab, click the Add Replicas button and connect to the other SQL Server instances that you joined as nodes in your Windows Server Failover Cluster. Configure the following options:
 - Automatic Failover (Up to 2): Checked
 - Synchronous Commit (Up to 3): Checked
 - Readable Secondary: No
7. In the Endpoints tab, verify that the port number value is 5022.
8. In the Listener tab, select the Create an availability group listener option. Enter the following details.
 - Listener DNS name: Name that you will use in your application connection string
 - Port: 1433
9. Click the Add... button to provide an IP address. In the Add IP Address dialog box, enter your preferred virtual IP address in the IPv4 Address field. Click OK. Click Next.
10. In the Select Initial Data Synchronization page, select the Full option. Provide a shared folder that is accessible to the replicas and that the SQL Server service account used by both replicas has Write permissions to. This is just a temporary file share to store the database backups that will be used to initialize the databases in an Availability group. If you are dealing with large databases, it is recommended that you manually initialize the databases prior to configuring them, as your network bandwidth may not be able to accommodate the size of the database backups. Click Next.
11. In the Validation page, verify that all validation checks return successful results. Click Next.
12. In the Summary page, verify all configuration settings and click Finish. This will create and configure the AlwaysOn Availability Group and join the databases.
13. In the Results page, verify that all tasks have been completed successfully.

Configuring the database workload client

For our testing, we used a virtual client for the Microsoft SQL Server client. To create this client, we installed Windows Server 2008 R2, assigned a static IP address, and installed .NET 3.5.

Configuring the database

Data generation overview

We generated the data using the Install.pl script included with DVD Store version 2.1 (DS2), providing the parameters for our 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 2014. We built the 40GB database in SQL Server 2014, and then performed a full backup, storing the backup file on the C: drive for quick access. We used that backup file to restore the server between test runs.

The only modification we made to the schema creation scripts were the specified file sizes for our database. We 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 performed the following steps:

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 8](#) 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	4,628
ind2	DS_IND_FG	4,628
ind3	DS_IND_FG	4,628
ind4	DS_IND_FG	4,628
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 8: Our initial file size modifications.

Running the test

Test start and run times

We ran the workloads separately and recorded all performance counters for this report. The specific testing parameters we used for the benchmark are included below.

About running the DVD Store tests

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

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

1. Clean up prior outputs from the target system and the client driver system.
2. Drop the database from the target servers.
3. Restore the database on the target servers.
4. Shut down the target.
5. Reboot the host and client systems.
6. Wait for a ping response from the server under test (the hypervisor system), the client system, and the target.
7. Let the test server idle for 10 minutes.
8. Start the DVD Store driver on the client.

We used the following DVD Store parameters for testing:

```
ds2sqlserverdriver.exe --target=<target_IP> --ramp_rate=10 --run_time=30 --
n_threads=32 --db_size=40GB --think_time=20 --detailed_view=Y --
warmup_time=5 --report_rate=1 --csv_output=<drive path>
```

APPENDIX D – COST COMPARISON INFORMATION

Using the hardware details from [Appendix B, Figure 7](#), we performed a cost analysis of the two server configurations. We summarize of this analysis in [Figure 9](#).

System	Dell PowerEdge R630 HDD configuration	Dell PowerEdge R630 SSD configuration	Increase/decrease with SDD configuration
Chassis			
Components needed	8x 2.5" HDD 2x PCIe slots	24x 1.8" SSD 3x PCIe slots	
Cost	Base cost	\$374.20	+ \$374.20
Disks			
Components needed	8x 2.5" 300GB 10k RPM SAS 6Gbps	22x 1.8" 400GB uSATA 6Gbps 2x 1.8" 60GB uSATA 6Gbps	
Cost	\$1,790.16	\$22,509.06	+ \$20,718.90
Totals			
Total configuration cost	\$10,994.88	\$32,013.19	+ \$21,018.31
Total number of OPM	24,433	246,255	+ 221,822 (908%)
Cost per OPM	\$0.45	\$0.13	\$0.32 (-71%)

Figure 9: Cost analysis of the two server configurations.

We found that the SSD configuration cost less than three times as much as the HDD configuration, while yielding over 10 times the database performance. This significant difference in cost per orders per minute yielded a difference of \$0.13 per OPM for the SSD configuration versus \$0.45 per OPM for the HDD configuration.

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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