

# DATABASE PERFORMANCE COMPARISON: LENOVO THINKSERVER RD630 VS. HP PROLIANT DL380P GEN8

## Lenovo® ThinkServer® RD630 with Lenovo ThinkServer RAID 700 Adapter

Delivered greater database performance  
than the HP ProLiant DL380p Gen8

▶ **20.4% greater**  
IOPS performance on average  
for OLTP-like workloads

▶ **15.0% more**  
performance per dollar on  
real-world database tests



**lenovo** FOR  
THOSE  
WHO DO.

Today's database workloads like online transaction processing (OLTP) drive a need for increasingly powerful servers. In the Principled Technologies labs, we compared the OLTP database performance of the new Lenovo ThinkServer RD630, powered by the ThinkServer RAID 700 controller, to that of an HP ProLiant DL380p Gen8 server powered by the HP Smart Array P420i. We found that the Lenovo ThinkServer RD630 delivered an average of 20.4 percent greater IOPS in an OLTP-like I/O workload and 15.0 percent greater performance per dollar in our real-world database tests.

These results show that the Lenovo ThinkServer RD630 is an excellent choice for any business wanting to get top database performance out of their new server.



A PRINCIPLED TECHNOLOGIES TEST REPORT

Commissioned by Lenovo

APRIL 2013

## GREATER PERFORMANCE AND VALUE WITH LENOVO

To learn how our two test servers compared on performance and cost, we used two benchmarks to stress the servers.

First, we ran several workload simulations using Iometer, including four OLTP-like workloads at different block sizes, and max IOPS sequential read and sequential write workloads. As Figure 1 shows, the Lenovo ThinkServer RD630, powered by the ThinkServer RAID 700 controller, delivered the following advantages over the HP ProLiant DL380p Gen8:

- 20.4 percent greater IOPS performance on average for the OLTP-like workloads
- 21.1 percent greater max IOPS sequential write performance
- 8.4 percent greater max IOPS sequential read performance

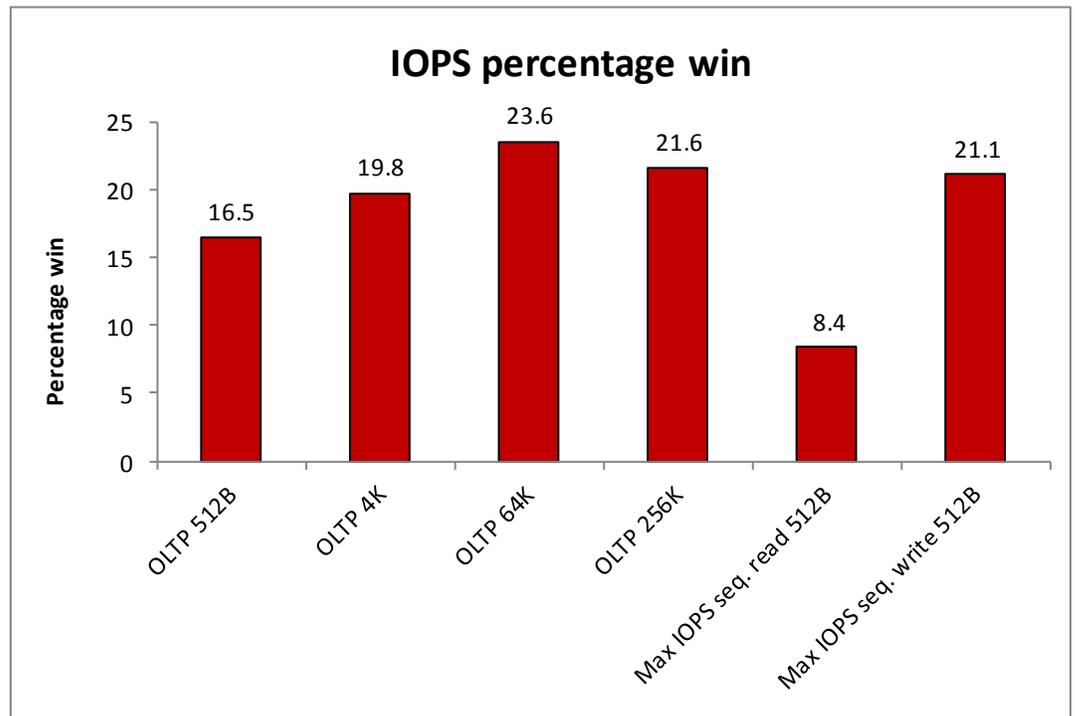
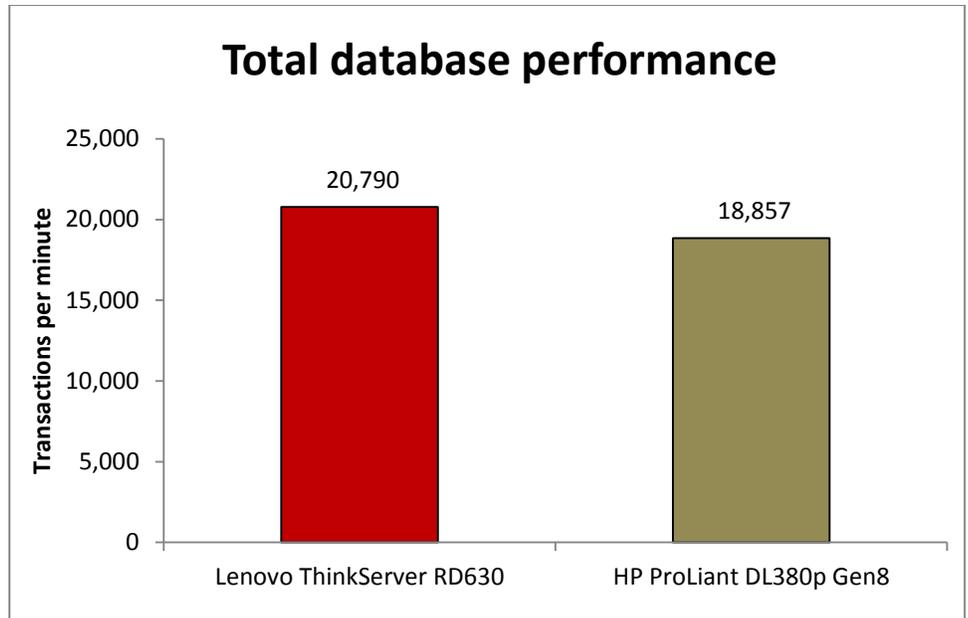


Figure 1: Iometer percentage win of the Lenovo ThinkServer RD630 over the HP DL380p Gen8.

For our real-world database performance tests, we used the DVD Store benchmark with a Microsoft® SQL Server 2012 database, configuring the workload to stress the servers, in particular the I/O subsystem, and establish comparable results between the two. To put appropriate stress on the I/O subsystem, we used a large database and configured the benchmark clients to generate many simultaneous connections or threads to the database server. As Figure 2 shows, the Lenovo ThinkServer RD630, powered by the ThinkServer RAID 700 controller, delivered 10.3 percent greater transactions per minute over the HP ProLiant DL380p Gen8.

Figure 2: Total database performance, in transactions per minute, for the two servers. Higher numbers are better.



When we took the cost of the servers into account, this translates to 15.0 percent greater performance per dollar, as Figure 3 shows. We obtained all pricing data from CDW as of May 10, 2013.

	Lenovo ThinkServer RD630	HP ProLiant DL380p Gen8	Percentage win for Lenovo ThinkServer RD630
Total OPM	20,790	18,857	10.25%
Cost	\$4,870.91	\$5,079.88	4.11%
Performance/dollar	4.27	3.71	14.98%

Figure 3: Performance-per-dollar calculations.

## ABOUT THE LENOVO THINKSERVER RD630

Lenovo describes its server as follows: “The all-new Lenovo ThinkServer RD630 mainstream rack server provides powerful new choices to meet your demanding enterprise needs while offering outstanding value. Supporting two of the latest Intel® Xeon® E5-2600 processors, the ThinkServer RD630 can provide outstanding database and virtualization performance for deployments large or small. Nicely configured, these servers come standard with Web-based remote management, rail kits, hardware RAID, and EasyManage tool-suite for unbeatable value. You enjoy enterprise-grade performance, built-in redundancy, and world-class reliability you expect from the makers of Think products.”

Below, we highlight some of the Lenovo ThinkServer RD630’s key features.

- **Performance and storage capacity.** The Intel Xeon processor E5-2600 family has up to 16 cores, providing a significant performance improvement over previous-

generation processors. Storage choices for the ThinkServer RD630 include up to eight 3.5-inch or sixteen 2.5-inch SATA, SAS and SSD hot-swap drives.

- **Reliability.** The ThinkServer RD630 comes with redundant power supplies, fans, and a selection of RAID adapters to prevent data loss.
- **Power efficiency.** The power-efficient ThinkServer RD630 features the Lenovo ThinkServer Smart Grid Technology. This feature allows IT administrators the ability to monitor and intelligently manage power consumption, even making recommendations for optimal power settings, for a server or group of servers via a central console. This power management technology helps to reduce energy consumption and infrastructure costs. Additionally, the ThinkServer RD630 is ENERGY STAR® 1.1 certified and Climate Savers Computing® certified.
- **Ease of use and manageability.** ThinkServers are supported by a suite of management tools that enable you to easily install, maintain, and manage your ThinkServer RD630. Systems management based on open standards and protocols mean easy integration into your existing network.

Lenovo ThinkPlus® Productivity, ThinkPlus Priority Support and available 4-hour service response further assist you in installation and IT support.

## About the Lenovo ThinkServer RAID 700 adapter and battery

Lenovo has introduced a new ThinkServer RAID 700 adapter and battery to deliver high levels of reliability, availability, and performance to businesses whose data storage needs are rapidly expanding. With data transfer rates of up to 6Gb/s per port and 512MB 800MHZ DDR II SDRAM, the ThinkServer RAID 700 Adapter offers new features and improved performance, while continuing to support all the features of the previous 3Gbps SATA+SAS generation.

According to Lenovo, “6Gbps MegaRAID controllers will deliver significant performance improvements in both read and write applications as compared to their 3Gbps predecessors. Other new features of the 6Gbps MegaRAID SATA+SAS controllers include greater signal integrity using Decision Feedback Equalization, support for more sophisticated SAS topologies using Expander Self-discovery/Self-configuration, and additional safeguards to enhance data protection.”



Features of ThinkServer RAID 700 Adapter include the following:

- Eight internal SAS/SATA ports
- Two mini-SAS SFF-8087 x 4 connectors
- 6 Gb/s data transfer rate per port
- LSI SAS2108 RAID on Chip
- 512MB 800MHz DDR II SDRAM
- Low-profile form factor
- x8 lane PCI Express 2.0 Compliant
- RAID 0, 1, 5, and 6
- RAID spans 10, 50, and 60
- Battery backup for additional protection in the event of an unexpected power loss.

Learn more about the Lenovo ThinkServer RAID 700 adapter and battery at

[http://support.lenovo.com/en\\_US/product-and-parts/detail.page?&DocID=PD016463](http://support.lenovo.com/en_US/product-and-parts/detail.page?&DocID=PD016463)

For detailed information about the Lenovo ThinkServer RD630, visit the Lenovo server site at [www.lenovo.com](http://www.lenovo.com). For details on the specific configuration we tested, see [Appendix A](#).

## WHAT WE FOUND

Figure 4 presents the results of our DVD Store tests. DVD Store reports in orders per minute (OPM), which we refer to as transactions per minute for the purpose of this study. Note that we used a heavy, storage-intensive workload with a high queue depth to stress the controllers and drives and demonstrate the higher performance capacity of the Lenovo ThinkServer RD630.

Host server	Median run transactions per minute	Percentage win
Lenovo ThinkServer RD630	20,790	10.25%
HP ProLiant DL380p Gen8	18,857	

**Figure 4: Database performance results for the two servers.**

Figure 5 presents the results of our Iometer workloads, in IOPS. We used a high queue depth (256) for all of our tests since these saturated the I/O storage subsystem and delivered the highest IOPS from both servers.

Access specification	Block size	Lenovo RD630 Median Run IOPS	HP DL380p Gen8 Median Run IOPS	Percentage win
OLTP (100% Random, 67% Read, 33% Write)	512B	2,574	2,210	16.47%
	4K	2,536	2,117	19.79%
	64K	1,784	1,444	23.55%
	256K	940	773	21.60%
Max IOPS (100% Sequential Read)	512B	218,620	201,711	8.38%
Max IOPS (100% Sequential Write)	512B	249,552	206,022	21.13%

Figure 5: Database performance results for the two servers.

## WHAT WE TESTED

We configured each server with eight 146GB 15K 6Gb SAS internal drives, dedicating two drives in a RAID 1 for the OS and SQL database logs, and six drives in a RAID 10 for the data volume. Each server had one Intel Xeon Processor E5-2620 and 16GB of PC3-10600R RAM (2 x 8GB).

We used the DVD Store version 2.1 (DS2) benchmark to test the database performance of the servers. To stress the I/O storage subsystem and obtain an accurate performance comparison, we configured the workload with many threads to simulate concurrent connections from client machines (which raises the application and disk queue depth) and tested against a large (40GB) database that could not be fully cached in the server memory. We used two client machines to generate the workload for each server. Additionally, we used Iometer to generate a synthetic pure I/O-based workload to measure the IOPS of OLTP-like data streams as well as measure maximum throughput in sequential reads and writes. We tested multiple block sizes for the OLTP-like workloads and then used a very small block size for the sequential reads and writes to obtain the maximum IOPS. We generated data set size that occupied 60 percent of the available data volume (246 GB) and used a high queue depth (256) for all workloads to saturate the RAID controllers and drives.

For detailed configuration information on the servers we tested, see [Appendix A](#). For detailed test results, see [Appendix B](#). For detailed instructions on how we tested, see [Appendix C](#).

### About DVD Store Version 2.1

To create our real-world database 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, which equates to transactions per minute handled by the database server and shows 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.

## About Iometer

Iometer measures input/output (I/O) on single and clustered systems. Iometer performs I/O operations on a system in order to stress the system, and then records the performance of and system stress created by these I/O operations. Iometer can create and measure workloads on a single system or on networked systems. We used Iometer to simulate an OLTP workload at four block sizes (512B, 4K, 64K, and 256K) and max IOPS sequential read and write workloads on both servers.

For more details about Iometer, see <http://www.iometer.org/>.

## IN CONCLUSION

Selecting a powerful server with robust storage is an excellent business decision when looking for a solution that can handle demanding OLTP workloads. With a 15.0 percent greater performance per dollar, 20.4 percent greater IOPS in an OLTP-like workload, 8.4 percent greater max IOPS sequential read performance, and 21.1 percent greater max IOPS sequential write performance, the Lenovo ThinkServer RD630 delivers powerful performance to meet your business needs.

## APPENDIX A – SERVER CONFIGURATION INFORMATION

Figure 6 provides detailed configuration information for the test servers.

System	Lenovo ThinkServer RD630	HP ProLiant DL380p Gen8
<b>General</b>		
Number of processor packages	1	1
Number of cores per processor	6	6
Number of hardware threads per core	2	2
<b>CPU</b>		
Vendor	Intel	Intel
Name	Xeon	Xeon
Model number	E5-2620	E5-2620
Socket type	FCLGA2011	FCLGA2011
Core frequency (GHz)	2.00	2.00
Bus frequency	7.2 GT/s	7.2 GT/s
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	256 KB (per core)	256 KB (per core)
L3 cache	15 MB	15 MB
<b>Platform</b>		
Vendor and model number	Lenovo ThinkServer RD630	HP ProLiant DL380p Gen8
BIOS name and version	2.10 3/28/2013	P70 3/1/2013
BIOS settings	Maximum Performance	Maximum Performance
<b>Memory module(s)</b>		
Total RAM in system (GB)	16	16
Vendor and model number	Samsung® M393B1K70BH1-CH9	Samsung M393B1K70DH0-CH9
Type	PC3-10600R	PC3-10600R
Speed (MHz)	1,333	1,333
Speed running in the system (MHz)	1,333	1,333
Timing/Latency (tCL-tRCD-tRP-tRASmin)	9-9-9-24	9-9-9-24
Size (GB)	8	8
Number of RAM module(s)	2	2
Chip organization	Double-sided	Double-sided
Rank	Dual	Dual
<b>OS/Hypervisor</b>		
Name	Windows Server® 2012 Standard	Windows Server 2012 Standard
Build number	9200	9200
File system	NTFS	NTFS
Kernel	ACPI x64-based PC	ACPI x64-based PC
Language	English	English
<b>RAID controller</b>		
Vendor and model number	Lenovo ThinkServer RAID 700 Adapter	HP Smart Array P420i
Firmware version	2.130.383-2315 3/5/2013	3.42 2/19/2013

System	Lenovo ThinkServer RD630	HP ProLiant DL380p Gen8
Driver version	6.506.2.0 2/1/2013	62.26.0.64 2/19/2013
Cache size (MB)	512	512
<b>Hard drives</b>		
Vendor and model number	ST9146853SS	HP EH0146FBQDC
Number of drives	8	8
Size (GB)	146	146
RPM	15k	15k
Type	6Gb SAS	6Gb SAS
<b>Ethernet adapter</b>		
Vendor and model number	Intel I350 Gigabit	HP Ethernet 1Gb 4-port 331FLR
Number of ports	2	4
Driver version	12.1.76.0 7/9/2012	15.4.0.17 1/26/2013
<b>USB ports</b>		
Number	4 external	4 external
Type	2.0	2.0

Figure 6: System configuration information for the test servers.

## APPENDIX B – DETAILED TEST RESULTS

Figure 7 shows the detailed DVD Store test results for all three runs as well as the median run for each of the servers.

Host server	Lenovo ThinkServer RD630	HP ProLiant DL380p Gen8
Run 1	20,627	19,080
Run 2	20,875	18,857
Run 3	20,790	17,668
Median run	20,790	18,857

Figure 7: Database performance results in transactions per minute for the two servers.

Figures 8 and 9 show the Iometer test results for all three runs as well as the median run for each of the servers and workloads.

Access specification	Block size	Run 1	Run 2	Run 3	Median run
OLTP (100% Random, 67% Read, 33% Write)	512B	2,575	2,574	2,566	2,574
	4K	2,541	2,535	2,536	2,536
	64K	1,794	1,780	1,784	1,784
	256K	941	940	939	940
Max IOPS (100% Sequential Read)	512B	218,620	226,367	218,548	218,620
Max IOPS (100% Sequential Write)	512B	249,552	245,124	251,620	249,552

Figure 8: Iometer performance in IOPS for the Lenovo ThinkServer RD630.

Access specification	Block size	Run 1	Run 2	Run 3	Median Run
OLTP (100% Random, 67% Read, 33% Write)	512B	2,198	2,212	2,210	2,210
	4K	2,113	2,121	2,117	2,117
	64K	1,444	1,440	1,448	1,444
	256K	773	773	775	773
Max IOPS (100% Sequential Read)	512B	202,256	190,944	201,711	201,711
Max IOPS (100% Sequential Write)	512B	203,306	206,022	210,881	206,022

Figure 9: Iometer performance in IOPS for the HP ProLiant DL380p Gen8

## APPENDIX C - HOW WE TESTED

### Configuring the Lenovo ThinkServer RD630 and the HP ProLiant DL380p Gen8

The Lenovo ThinkServer RD630 and the HP ProLiant DL380p Gen8 all used Windows Server 2012 Standard Edition and Microsoft SQL Server 2012. The OS and SQL logs were placed on a two-disk RAID 1 volume, and the SQL database was placed on a six-disk RAID 10 volume.

#### Installing Microsoft Windows Server 2012 Standard Edition

1. Insert the installation media into the CD/DVD drive and restart the server.
2. Choose the CD/DVD drive as the boot device and boot to the installation media.
3. Press any key when prompted to boot from DVD.
4. When the installation screen appears, click My language is English.
5. Leave language, time/currency format and input method as default and click Next.
6. Click Install now.
7. When the Windows Setup window appears, click No thanks when prompted to go online to install updates.
8. Select Windows Server 2012 Standard (Server with a GUI), and click Next.
9. Check I accept the license terms, and click Next.
10. Click Custom: Install Windows only (advanced).
11. Press Alt+A to open advanced partition options. Delete any partitions until there is only Drive 0 Unallocated Space.
12. Select Drive 0 Unallocated Space, and click Next, at which point Windows will begin installing, and will restart 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 previously set up password.

#### Creating New Disks in Windows Server 2012 Standard Edition

1. In the Server Manager window, click Tools, then 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 that pops up, click Next.
6. Select a size (maximum, in our case) 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 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 then click OK.

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. Then 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.

### Installing SQL Server 2012

1. Insert the installation DVD for SQL Server 2012 into the DVD drive.
2. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2012 DVD, and double-click it.
3. If the installer prompts you with a .NET installation prompt, click Yes to enable the .NET Framework Core role.
4. In the left pane, click Installation.
5. Click New SQL Server stand-alone installation or add features to an existing installation.
6. At the Setup Support Rules screen, wait for the rule check to complete. If there are no failures or relevant warnings, click OK.
7. Enter your product key, and click Next.
8. Click the checkbox to accept the license terms, and click Next.
9. If no failures are displayed after the setup support files are installed, click Next.
10. At the Setup Role screen, choose SQL Server Feature Installation.
11. 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.
12. At the Installation Rules screen, click Next after the check completes.

13. 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.
14. At the Disk Space Requirements screen, click Next.
15. At the Server Configuration screen, choose the service account, preferably an Active Directory domain account, fill in a password if necessary, and click Next.
16. At the Database Engine Configuration screen, choose Mixed Mode and enter the system administrator password. Click Add Current User.
17. Click the Data Directories tab, and enter the appropriate drive and folder to which you eventually deploy the SharePoint databases.
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.
24. Restart the server.

## Setting up Iometer

### Installing and configuring Iometer

1. Download the Iometer 2006.07.27 package for Windows from [www.iometer.org/doc/downloads.html](http://www.iometer.org/doc/downloads.html).
2. Double-click the installer, and click Run.
3. At the Welcome window, click Next.
4. At the License Agreement window, click I Agree.
5. At the Choose Components window, leave the defaults selected, and click Next.
6. At the Choose Install Location window, change the Destination Folder to C:\Iometer 2006.07.27, and click Install.
7. When the installation completes, click Finish.

### Setting up the individual Iometer workloads

We used the following settings for each test:

1. Open Iometer.exe.
2. For each access specification:
  - a. Create the access specification to match the configurations in Figure 10.

Access specification name and block size	% read	% write	% random	% sequential
OLTP 512B	33	67	100	0
OLTP 4K	33	67	100	0
OLTP 64K	33	67	100	0
OLTP 256K	33	67	100	0
Sequential Read 512B	100	0	0	100
Sequential Write 512B	0	100	0	100

Figure 10: Access specification details for our Iometer tests.

- b. Verify that the access specification has the following additional settings:
    - i. Under Burstiness, set Transfer Delay to 0ms, and set Burst Length to 1 I/O.
    - ii. Under Align I/Os, select Sector Boundaries.
    - iii. Under Reply Size, select No Reply.
  - c. Under Topology, select the computer name, and click the Start a New Disk Worker on Selected Manager button until you have three workers assigned to each target volume.
  - d. Under Disk Targets, set the # of Outstanding I/Os to 256
  - e. Set the Maximum disk size to 60 percent (246 GB) of the target volume, using sectors as the unit of measurement.
  - f. Under Results Display, make sure that Iometer has selected Start of Test.
  - g. Under Test Setup, set the Run Time to 5 minutes and the Ramp Up Time to 60 seconds.
  - h. Save the configuration.
3. Exit Iometer.

### Running the test

1. Reboot the system.
2. After logging in, open a command prompt.
3. Type `cd c:\Iometer 2006.07.27` and press Enter.
4. Type `run.bat` and wait 10 minutes.
5. Press Enter.
6. After all access specifications finish running, remove the result files from the server.
7. Repeat steps 1 through 6 two more times for a total of three runs.

### Configuring the database (DVD Store)

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 servers.

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 11 details our initial file size modifications.

Logical name	Filegroup	Initial size (MB)
<b>Database files</b>		
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

Logical name	Filegroup	Initial size (MB)
orders3	DS_ORDERS	6,144
orders4	DS_ORDERS	6,144
<b>Log files</b>		
ds_log	Not Applicable	20,480

Figure 11: The file size modifications we used in our testing.

## Running the DVD Store tests

We created a series of batch files, SQL scripts, and shell scripts to automate the complete test cycle. We set up 2 desktop client machines to send outgoing requests to the servers. We used a separate controller server to run the automation tasks. All components communicated over an isolated 1Gbps network. 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 (as transactions per minute) 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 servers.
3. Restore all databases on all target servers.
4. Shut down all servers.
5. Reboot the host system and all client systems.
6. Wait for a ping response from the server under test and all client systems.
7. Let the test server idle for 5 minutes
8. Start the DVD Store driver on all respective clients.

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

```
ds2sqlserverdriver.exe --target=<target_IP> --ramp_rate=10 -warmup_time=8 --
run_time=20 --n_threads=96 --db_size=40GB --think_time=0 >
C:\outputresultsfile.txt
```

## ABOUT PRINCIPLED TECHNOLOGIES



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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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