

FILE SERVER PERFORMANCE ON THE INTEL PROCESSOR-POWERED DELL POWEREDGE R730XD WITH HYBRID STORAGE

DELL™ POWEREDGE™ R730XD SERVER

Supercharged performance with a hybrid drive configuration



UP TO
94.7%
BETTER
RESPONSE
TIMES



UP TO
17.5X
THE I/O
PERFORMANCE



POWERED BY
THE INTEL® XEON®
PROCESSOR E5-2600
V3 PRODUCT FAMILY



vs a previous-generation PowerEdge R720xd server

Storage constraints in your datacenter can put unnecessary limits on workload performance and affect user experience. To balance workload reliability, performance, and cost, IT admins must often configure a combination of hard-disk drives (HDDs) and solid-state drives (SSDs) in the datacenter. With software-defined storage offerings such as Microsoft® Windows® Storage Spaces, IT admins can pool these storage resources together using flexible storage options in the new Dell PowerEdge R730xd, powered by the Intel Xeon E5-2690 v3 processor. The result is a solution that, in our tests, delivered improved file server performance for a potentially better user experience than with prior generation solutions.

In the Principled Technologies labs, we tested file server-like performance of the new Intel processor-powered Dell PowerEdge R730xd hybrid chassis, which combines flash storage with high capacity HDDs, in conjunction with Microsoft Windows Storage Spaces. We found that the PowerEdge R730xd with Microsoft Storage Spaces achieved 17.5 times the I/O operations per second (IOPS) of a previous-generation PowerEdge R720xd server. In addition, the PowerEdge R730xd delivered up to 94.7 percent better response times than the PowerEdge R720xd server did. With better I/O performance than the previous-generation server and better response times for a better user experience, the Intel processor-powered Dell PowerEdge R730xd with Windows Storage Spaces can provide a reliable storage solution for your datacenter.



AUGUST 2014 (Revised)
A PRINCIPLED TECHNOLOGIES TEST REPORT
Commissioned by Dell

FINDING THE RIGHT STORAGE COMBINATION

There are many storage options to match the heavy movement of data in and out of your business' datacenter. SSDs have become popular for increasing performance without sacrificing storage space. No single solution fits every organization, however, so IT admins employ different strategies based on infrastructure design, function, and size. A key priority is to always maintain—or better yet increase—workload performance.

To help maintain or increase workload performance, Windows Server® 2012 offers Storage Spaces for storage pooling. Virtual drives can create these storage spaces by grouping storage, such as from HDDs and SSDs, together in a storage pool. This allows flexibility for the creation of large storage spaces when needed and, if pool capacity is low, the addition of drives. When admins group HDDs and SSDs together on the Intel processor-powered Dell PowerEdge R730xd, Microsoft Storage Spaces offers automatic storage tiering, optimizing performance by automatically rearranging data so that frequently accessed “hot” data is processed by the faster 1.8” SATA SSDs while the “cold” data remains stored on the slower HDDs.

To learn about how the Dell PowerEdge R730xd can improve file server performance, we conducted a series of tests using Iometer. The sections below review our tests and results in detail.

WHAT WE FOUND

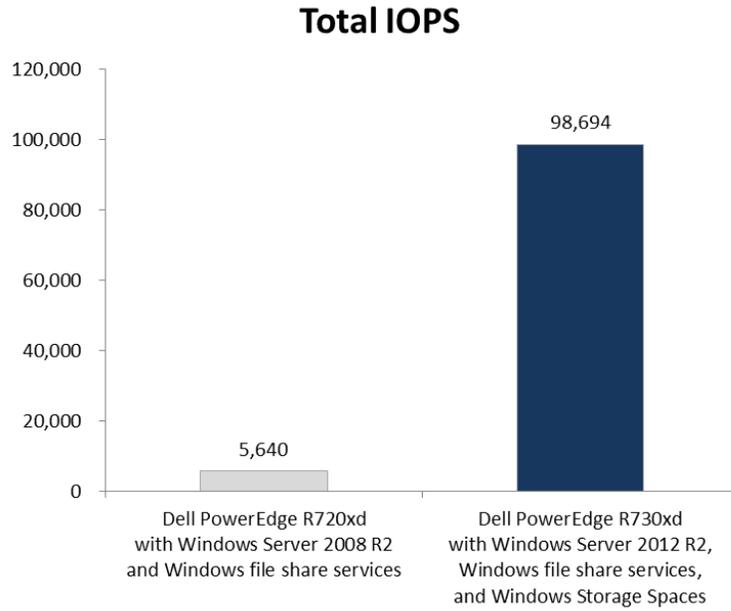
In simulating file server performance, we created a 1TB file with Iometer and tested the following:

- Dell PowerEdge R720xd with Windows Server 2008 R2 and Windows file share services with all 24 HDDs in a RAID10 volume
- Dell PowerEdge R730xd with Windows Server 2012 R2 with file share services and a tiered Windows Storage Spaces volume containing all eight front-plane 3.5” HDDs and 18 1.8” SATA SSDs

Each run had 2-minute ramp-up times and 20-minute run times, and each worker had a queue depth of four. We report the median results. For more information about our Iometer configuration and testing details, see [Appendix A](#) and [Appendix C](#).

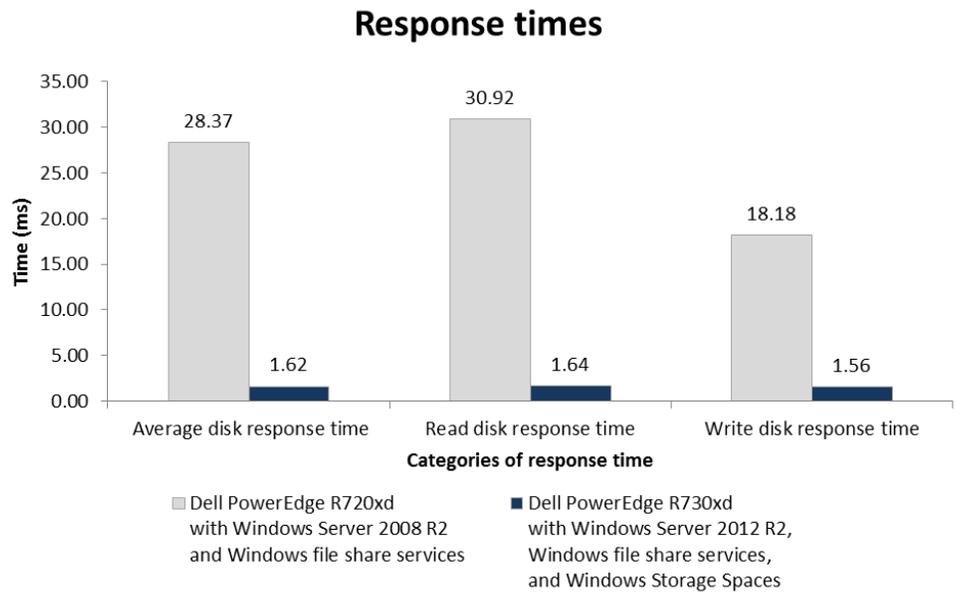
We found that the Dell PowerEdge R730xd with Windows Storage Spaces provided support for 17.5 times the file server operations per second of the PowerEdge R720xd. As Figure 1 shows, the Dell PowerEdge R730xd achieved 98,694 IOPS.

Figure 1: The total number of IOPS generated by each solution. Higher numbers are better.



We also found that the Dell PowerEdge R730xd with Windows Storage Spaces provided support for 94.3 percent better average disk response time, 94.7 percent better read disk response time, and 91.4 percent better write response time than the PowerEdge R720xd (Figure 2).

Figure 2: Average disk, read disk, and write disk response time achieved by each solution. Lower numbers are better.



CONCLUSION

Many growing businesses employ a combination of HDDs and SSDs in their datacenters to provide storage for users. Software-defined storage additions, such as Windows Storage Spaces, can help improve workload performance by using tiering and caching technologies with enabling hardware. When combined with this software, the new Intel processor-powered Dell PowerEdge R730xd can provide storage support for the increasing workload performance of your business. We found that the PowerEdge R730xd provided support for 17.5 times the file server IOPS of the PowerEdge R720xd, and up to 94.7 better response times than the PowerEdge R720xd did. If your business needs storage and performance to support its growth, consider the new Dell PowerEdge R730xd.

APPENDIX A – ABOUT THE COMPONENTS

About the Intel processor-powered Dell PowerEdge R730xd

Dell designed the two-socket, 2U Dell PowerEdge R730xd rack server to provide the scale-out storage efficiency needed by big data users, including the option for hybrid internal storage tiering and six distinct storage configurations. The configuration we tested had two 2.5" rear HDD bays, eight 3.5" front HDD bays, and 18 1.8" front SSD bays. Powered by the latest Intel® Xeon® processors E5-2690 v3, the PowerEdge R730xd has 24 DIMM slots to support up to 1.5 TB of memory, and supports up to four optional NVMe Express™ Flash PCIe® SSDs.

With redundant power supply units, hot-swappable hardware, and Dual SD™ card for Failsafe Hypervisors, the Dell PowerEdge R730xd supports hardware high availability. The PowerEdge R730xd comes standard with iDRAC8 with Lifecycle Controller and Dell OpenManage™, which all work to streamline management. For more details on the Dell PowerEdge R730xd, visit www.dell.com/us/business/p/poweredge-r730xd/pd.

About Microsoft Windows Storage Spaces

Storage Spaces is a technology in Windows Server 2012 that allows for the creation of virtualized storage by grouping industry-standard disks into storage pools, and the creation of virtual disks called *storage spaces* from the available capacity in the storage pools. Storage Spaces offers automatic storage tiering for volumes that include both HDDs and SSDs. This allows businesses to mix cheaper, slower HDDs for rarely accessed data with faster, more expensive SSDs that will handle frequently accessed data in one volume. Learn more at technet.microsoft.com/library/hh831739.aspx.

About Iometer

Iometer measures IOPS on single and clustered systems. Iometer performs I/O operations to stress a system, and then records the performance of these I/O operations and the system stress they create. We used Iometer version 1.1.0 on each solution to simulate the same file workloads on the solutions. For more details about Iometer, see www.iometer.org.

APPENDIX B – SYSTEM CONFIGURATION INFORMATION

Figure 3 provides detailed configuration information for the test systems.

System	Dell PowerEdge R730xd	Dell PowerEdge R720xd
Power supplies		
Total number	2	1
Vendor and model number	0TPJ2XX03	Dell E1100E-S0
Wattage of each (W)	750	1100
Cooling fans		
Total number	6	6
Vendor and model number	San Ace 60 9GA0612P1J651	San Ace 60 9GA0612P1J611
Dimensions (h × w) of each	2.5' × 2.25'	2.5' × 2.5'
Volts	12	12
Amps	1.2	1.5
General		
Number of processor packages	2	2
Number of cores per processor	12	8
Number of hardware threads per core	24	16
System power management policy	Balanced	Balanced
CPU		
Vendor	Intel	Intel
Name	Xeon	Xeon
Model number	E5-2690 v3	E5 2660
Socket type	LGA	2011 LGA
Core frequency (GHz)	2.6	2.2
Bus frequency	8.0 GT/s	8.0 GT/s
L1 cache	12 × 32 KB	8 × 32 KB
L2 cache	12 × 256 KB	8 × 256 KB
L3 cache	30720 KB	20480 KB
Platform		
Vendor and model number	Dell PowerEdge R730xd	Dell PowerEdge R720xd
Motherboard model number	0H21J3	0M1GCR
BIOS name and version	Dell 0.3.23	Dell 2.2.3
BIOS settings	Default	Default

System	Dell PowerEdge R730xd	Dell PowerEdge R720xd
Memory module(s)		
Total RAM in system (GB)	128	128
Vendor and model number	Hynix HMA41GR7MF8N-TF	HMT31GR7CFR4C-PB
Type	DDR4-2133P	DDR3-12800
Speed (MHz)	2,133	1,600
Speed running in the system (MHz)	2,133	1,333
Size (GB)	8	8
Number of RAM module(s)	16	16
Chip organization	Double-sided	Double-sided
Rank	Dual Rank	Dual Rank
Operating system		
Name	Windows Server 2012 R2 Datacenter	Windows Server 2008 R2 SP1
Build number	11.0.9600.17239	11.0.9600.17207
File system	NTFS	NTFS
Language	English	English
RAID controller		
Vendor and model number	Dell PERC H730p mini	Dell PERC H710p mini
Firmware version	25.2.1.0037_A02	21.3.0-0009
Driver version	6.602.7.0	5.2.220.64
Cache size (MB)	2GB	1GB
Vendor and model number	Dell SXBLE7	N/A
Number of drives	18	N/A
Size (GB)	200	N/A
Type	SATA	N/A
Vendor and model number	Dell ST2000NM0023	Dell ST9300653SS
Number of drives	8	24
Size (GB)	2 TB	300GB
RPM	7.2k	15k
Type	SAS	SAS
Vendor and model number	Seagate® ST300MM0006	ST9146852SS
Number of drives	2	2
Size (GB)	300 GB	146 GB
RPM	10k	15K
Type	SAS	SAS
Ethernet adapters #1		
Vendor and model number	Broadcom® NetXtreme® Gigabit Ethernet	Intel Gigabit 10G 4P X540/I350 Rndc
Type	LAN	10GB LAN
Driver	16.6.0.4	3.9.58.9101

System	Dell PowerEdge R730xd	Dell PowerEdge R720xd
Ethernet adapters #2		
Vendor and model number	Mellanox® ConnectX-3 Ethernet	Intel Gigabit 4P X540/I350 rNDC
Type	SFP	LAN
Driver	4.70.10126.0	12.11.97.0
Ethernet adapters #3		
Vendor and model number	N/A	Intel Ethernet Server Adapter X520-2
Type	N/A	10GB SFP
Driver	N/A	3.9.58.9101

Figure 3: Detailed configuration information of our test systems.

APPENDIX C – HOW WE TESTED

File server testing

lomometer RAID controller and drive configuration

On the R720xd, we created a RAID 1 on the two backplane HDDs to hold the OS. We then created a RAID 10 on all 24 of the frontplane HDDs to house the lomometer file. On the R730xd, we changed the RAID controller to HBA mode, putting all drives into passthrough mode. We then installed the OS on one of the two backplane drives. We created a software RAID in Windows using the second backplane drive to provide redundancy. We then used Storage Spaces to create a tiered volume using all of the frontplane HDDs and SSDs to house the lomometer file.

Installing Microsoft Windows Server 2012 Datacenter Edition on Dell PowerEdge R730xd

1. Insert the installation media into the CD/DVD drive, and restart the server.
2. When the option appears, press F11 to enter the Boot Manager.
3. Select BIOS Boot Menu.
4. Select SATA Optical Drive, and press Enter.
5. Press any key when prompted to boot from DVD.
6. When the installation screen appears, click My language is English (United States).
7. Leave language, time/currency format, and input method as default, and click Next.
8. Click Install now.
9. When the installation prompts you, enter the product key.
10. Select Windows Server 2012 Datacenter (Server with a GUI), and click Next.
11. Check I accept the license terms, and click Next.
12. Click Custom: Install Windows only (advanced).
13. Select Drive 0 Unallocated Space, and click Next, at which point Windows begins automatically, and restarts automatically after completing.
14. When the Settings page appears, fill in the Password and Reenter Password fields with the same password.
15. Log in with the password you set up previously.

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.

Installing the file server role

1. Open the Server Manager, and click Manage → Add Roles and Features.
2. On the Before You Begin screen, click Next.
3. Choose Role-based or feature-based installation, and click Next.
4. Choose the local server, and click Next.
5. Expand File and Storage Services → File and iSCSI services, and check File Server and Storage Services. Click Next.
6. Leave default features, and click Next.
7. Review the settings, and click Install.

Configuring Windows Storage Spaces

1. In the Server Manager windows, click File and Storage Services in the left pane.
2. Click Storage Pools.
3. Right-click the Primordial storage pool, and click New Storage Pool...

4. On the Before You Begin screen, click Next.
5. Enter a name for the new Pool, choose the group of disks, and click Next.
6. Check that all the disks have the correct Media Type (SSD or HDD), and choose all the available disks. Click Next.
7. Review your selections, and click Create.
8. Open Windows PowerShell.
9. Set the SSD tier variable:

```
PS C:\Users\Administrator> $SSDTier = Get-StoragePool <storage pool name> |
New-StorageTier -FriendlyName SSDTier -MediaType SSD
```
10. Set the HDD tier variable:

```
PS C:\Users\Administrator> $HDDTier = Get-StoragePool <storage pool name> |
New-StorageTier -FriendlyName HDDTier -MediaType HDD
```
11. Create the virtual disk with a 10GB cache and four columns:

```
PS C:\Users\Administrator> New-VirtualDisk -StoragePoolFriendlyName <storage
pool name> -FriendlyName KrisVDisk -StorageTiers $SSDTier,$HDDTier -
ResiliencySettingName Mirror -WriteCacheSize 10GB -NumberOfColumns 4 -
StorageTierSizes 1648GB,7448GB
```
12. Once the virtual disk has been created, click Run the Create Volume Wizard... link in the Volume section.
13. Choose the server and virtual disk you created, and click Next.
14. Set the volume size to the maximum capacity, and click Next.
15. Assign a drive letter, and click Next.
16. Set the File system to NTFS, the Allocation unit size to Default, and name the Volume. Click Next.
17. Review your selections, and click Create.

Installing Microsoft Windows Server 2008 R2 on R720xd and configuring the file server role

1. Boot the server, and insert the Windows Server 2008 R2 SP1 installation DVD in the DVD-ROM drive.
2. At the Language Selection screen, click Next.
3. Click Install Now.
4. Select Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
5. Click the I accept the license terms check box, and click Next.
6. Click Custom.
7. Click Next.
8. At the User's password must be changed before logging on warning screen, click OK.
9. Enter the desired password for the administrator in both fields, and click the arrow to continue.
10. At the Your password has been changed screen, click OK.
11. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
12. Enable remote desktop access.
13. Turn off all firewalls.
14. Change the hostname, and reboot when prompted.
15. Open Server Manager, and click Roles → Add Roles.
16. Click Next on the Before You Begin screen.
17. Choose File Services, and click Next.
18. Click Next.
19. Leave default role services, and click Next.
20. Click Install.
21. When the install is finished, expand File Services in Server Manager.
22. Click on Share and Storage Management.
23. In the right pane, click Provision share...
24. Browse to the share volume, and click Next.
25. Click Yes, change NTFS permissions, and click Edit Permissions...

26. Click Add, add the Everyone user, give full control to Everyone, and click OK.
27. Click Next.
28. Leave defaults, and click Next.
29. Click Next.
30. Choose Users and groups have custom share permissions, and click Permissions...
31. Choose Full Control for Everyone, and click OK. Click Next.
32. Click Next.
33. Click Create, and close Server Manager when finished.

Configuring and running Iometer

We used 20 Windows 7-based Virtual Machines to act as client computers, split evenly across two Intel Sandy-Bridge based servers, to drive the Iometer workload. Each client had two vCPUs and 4GB of RAM. Each client controlled two workers all managed by a single instance of Iometer on a controller VM. We used Iometer to create a 1TB test file in the shared folder created in Windows file services. The R720xd file was stored on a 24-disk hardware RAID 10, and the R730xd file was stored on the tiered Storage Spaces volume.

Configuring the controller

1. Download the Iometer benchmark from www.iometer.org/doc/downloads.html.
2. Copy the file to the controller, and unzip the contents.
3. Double click the Iometer.exe file to start Iometer.
4. Highlight the controller system listed in the Topology window, and click the Disconnect Selected Worker button at the top.
5. Click the Access Specifications tab, and click New.
6. Create the File Server access specification as shown in Appendix D.

Configuring the clients

1. Open Windows Explorer, right-click Computer, and choose Map Network Drive.
2. Click Browse, and navigate to the share folder you created on the SUT.
3. Click Finish.
4. Copy the Iometer directory to the client, and unzip the contents.
5. Open a command window to the Iometer directory.
6. Type `Dynamo -i <IP of controller> -m <IP of Client>` and hit Enter.
7. Repeat steps 1 through 4 on each client.

Executing the runs

1. On the controller VM, expand all the managers.
2. Highlight each worker, and check the box for the mapped drive you created that points to the SUT.
3. Highlight All Managers, and enter 4 as the queue depth.
4. With All Managers still highlighted, click the Access Specifications tab.
5. Choose the File Server specification you created previously, and click Add to move it to the left pane.
6. Click Test Setup.
7. Choose 20 minutes for the Run Time, and 2 minutes for the Ramp Up Time.
8. Leave the rest of the options as default, and click the Green flag to start the run.
9. Choose a name for the save file, and click OK.
10. Once the run is finished, reboot the SUT and all client and controller VMs.
11. We executed each run three times on each SUT.

lometer access specification

```
'Access specification name,default assignment
File Server,          ALL
'size,% of size,% reads,% random,delay,burst,align,reply
512, 10, 80, 100, 0, 1, 4096, 0
1024, 5, 80, 100, 0, 1, 4096, 0
2048, 5, 80, 100, 0, 1, 4096, 0
4096, 60, 80, 100, 0, 1, 4096, 0
8192, 2, 80, 100, 0, 1, 4096, 0
16384, 4, 80, 100, 0, 1, 4096, 0
32768, 4, 80, 100, 0, 1, 4096, 0
65536, 10, 80, 100, 0, 1, 4096, 0
```

ABOUT PRINCIPLED TECHNOLOGIES



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