



The science behind the report:

# Elevate your e-commerce business by upgrading to the Dell EMC PowerEdge R740xd with 2nd Generation Intel Xeon Scalable processors

This document describes what we tested, how we tested, and what we found. To learn how these facts translate into real-world benefits, read the report [Elevate your e-commerce business by upgrading to the Dell EMC PowerEdge R740xd with 2nd Generation Intel Xeon Scalable processors](#).

We concluded our hands-on testing on May 15, 2019. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on May 3, 2019 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

## Our results

Results	Orders per minute
Dell EMC™ PowerEdge™ R740xd cluster with 2nd Generation Intel® Xeon® Scalable processors	660,117
Dell EMC PowerEdge R740xd cluster with 1st Generation Intel Xeon Scalable processors	472,722
Legacy Dell PowerEdge R720 solution	57,749

## System configuration information

The table below presents detailed information on the systems we tested.

### Servers

Please note that the processor core counts differ significantly for each solution; we chose common configurations at a similar price point for the R740xd solutions. Performance from a 1st Gen Intel Xeon processor with more cores would see higher database performance than what was tested.

	Dell EMC PowerEdge R740xd	Dell PowerEdge R740xd (1st Gen)	Dell PowerEdge R720
BIOS name and version	Dell 2.1.6	Dell EMC 0.4.8	Dell EMC 2.5.4
Operating system name and version/build number	ESXi 6.7.0 build-13473784	VMware ESXi™ 6.5 4564106	VMware ESXi™ 6.5 4564106
Date of last OS updates/patches applied	05/03/19	4/27/17	4/27/17
Power management policy	Performance	Performance	Performance
Processor			
Number of processors	2	2	2
Vendor and model	Intel Xeon Gold 6230	Intel® Xeon® Gold 6134	Intel Xeon CPU E5-2697 v2
Core count (per processor)	20	8	12
Core frequency (GHz)	2.1	3.2	2.7
Stepping	H0	H0	C1
Memory module(s)			
Total memory in system (GB)	256	192	192
Number of memory modules	16	12	12
Vendor and model	Micron® MTA18ASF2G72PDZ-2G9E1TK	Hynix® HMA82GR7AFR8N-VK	Hynix HMT42GR7MFR4C-PB
Size (GB)	16	16	16
Type	DDR4	PC4-2666 Dual Rank	PC3-12800 Dual Rank
Speed (MHz)	2,933	2,666	1,600
Local storage A			
Number of drives	3	12	2
Drive vendor and model	Intel SSDPE2KE016T8T	Dell P/N 0XCRDV (PX05SRB384Y)	Seagate® ST300MM0006
Drive size (GB)	1.6	3.84 TB (used as a capacity tier)	300 (used as an OS drive)
Drive information (speed, interface, type)	NVMe 2.5" SSD	12Gbps SAS SSD	6Gbps 10K SAS HDD
Local storage B			
Number of drives	12	3	N/A
Drive vendor and model	Intel SSDSC2KB019T8R	Dell P/N 0JD6CH (PM1725a) PCIe NVMe	N/A

	Dell EMC PowerEdge R740xd	Dell PowerEdge R740xd (1st Gen)	Dell PowerEdge R720
Drive size (GB)	1.92	1.6 TB (used as a caching tier)	N/A
Drive information (speed, interface, type)	6Gbps SATA 2.5" SSD	NVMe PCIe SSD	N/A
Network adapter A			
Vendor and model	Broadcom Ethernet BCM5720 2P 10GbE 2P 1GbE	Dell P/N 0G8RPD (BCM57800)	Intel GbE 4P I350-t rNDC
Number and type of ports	2x 1GbE, 2x 10GbE	2 x 10GbE, 2 x 1GbE	4 x 1GbE
Driver version	ntg3, bnxtnet	lgb / ixgbe	lgb / ixgbe
Network adapter B			
Vendor and model	Intel XXV710 25GbE 2P	N/A	Intel 82599 10 Gigabit Dual Port
Number and type of ports	2 x 25GbE	N/A	2 x 10GbE
Driver version	i40en	N/A	lgb / ixgbe
Cooling fans			
Vendor and model	Nidec® UltraFlo XN44V-A00	Nidec UltraFlo 4VXP3-X30	AVC DBTC0638B2U
Number of cooling fans	6	6	6
Power supplies			
Vendor and model	Dell E750E-S1	Dell 750W D750E-S6	Dell EMC 750W D750E-S6
Number of power supplies	2	2	2
Wattage of each (W)	750	750	750

## VM configuration

To drive the workload, we ran the same number of threads but increased the number of vCPUs. The 2nd Generation Intel Xeon Scalable processors had more cores, thus we increased the vCPU count to ensure we were better utilizing the CPU.

VM configuration	2nd Generation Intel Xeon Scalable processor-powered Dell EMC PowerEdge R740xd solution	Previous-generation solution (Dell EMC PowerEdge R740xd with 1st Gen processors)	Legacy solution
vCPU count	24	4	4
Memory (GB)	8	8	8
Windows Server version	2019	2016	2012 R2
SQL Server version	2017	2016	2012

## Storage

	<b>Dell EMC PowerEdge R740xd with VMware vSAN</b>	<b>Dell EMC PowerEdge R740xd with VMware vSAN (1st Gen)</b>	<b>Dell EMC EqualLogic PS6000</b>
Number of controllers	N/A	N/A	2 (active-passive)
RAID level	Automatically managed by vSAN	Automatically managed by VSAN	RAID6
Number of drives, type 1	6 (used as cache tier)	6 (used as cache tier)	16
Vendor and model number	Intel SSDPE2KE016T8T	Dell P/N 0JD6CH (PM1725a)	Seagate ST3600057SS
Drive size	1.6TB	1.6TB	600GB
Drive type	NVMe SSD	PCIe NVMe SSD	SAS HDD
Number of drives, type 2	24 (used as capacity tier)	24 (used as capacity tier)	N/A
Vendor and model number	Intel SSDSC2KB019T8R	Dell P/N 0XCRDV (PX05SRB384Y)	N/A
Drive size	1.92TB	3.84	N/A
Drive type	SATA SSD	12Gbps SAS SSD	N/A
vSAN version	6.7 (Update 2)	6.5	N/A
vSAN Storage Policy	Default (Primary level of failures to tolerate = 1; Number of fault domains = 3)	Default (Primary level of failures to tolerate = 1; Number of fault domains = 3)	N/A
vSAN compression and encryption	Default (unchecked; no compression or encryption)	Default (unchecked; no compression or encryption)	N/A

## How we tested

We used a Dell EMC PowerEdge R730 for our infrastructure/client host. The steps below show how we tested the 2nd Generation Intel Xeon Scalable processor-powered Dell EMC PowerEdge R740xd. For step-by-step details for testing of both legacy solutions, see the previous report at [https://www.principledtechnologies.com/Dell/PowerEdge\\_R740xd\\_comparative\\_0318\\_v2.pdf](https://www.principledtechnologies.com/Dell/PowerEdge_R740xd_comparative_0318_v2.pdf).

### Installing VMware ESXi 6.7

1. Attach the installation media.
2. Boot the server.
3. At the VMware Installer screen, press Enter.
4. At the EULA screen, to Accept and Continue, press F11.
5. Under Storage Devices, select the appropriate virtual disk, and press Enter.
6. As the keyboard layout, select US, and press Enter.
7. Enter the root password twice, and press Enter.
8. To start installation, press F11.
9. After the server reboots, press F2, and enter root credentials.
10. Select Configure Management Network, and press Enter.
11. Select the appropriate network adapter, and select OK.
12. Select IPv4 settings, and enter the desired IP address, subnet mask, and gateway for the server.
13. Select OK, and restart the management network.
14. Repeat steps 1 through 13 on the rest of the servers.

### Deploying the VMware vCenter® Server 6.7

1. On a Windows server or VM, locate the VMware-VCSA installer image.
2. Mount the image, navigate to the vcsa-ui-installer folder, and double-click win32.
3. Double-click installer.exe.
4. Click Install.
5. Click Next.
6. Accept the terms of the license agreement, and click Next.
7. Leave the default vCenter Server with an Embedded Platform Services Controller selected, and click Next.
8. Enter the FQDN or IP address of the host onto which the vCenter Server Appliance will be deployed.
9. Provide the server's username and password, and click Next.
10. Accept the certificate of the host you chose to connect to by clicking Yes.
11. Provide a name and password for the vCenter Appliance, and click Next.
12. Set an appropriate Appliance Size, and click Next.
13. Select the appropriate datastore, and click Next.
14. At the Configure Network Settings page, configure the network settings as appropriate for your environment, and click Next.
15. Review your settings, and click Finish.
16. When the deployment completes, click Next.
17. At the Introduction page, click Next.
18. At the Appliance configuration page, select the time synchronization mode and SSH access settings, and click Next.
19. Select Create a new SSO domain.
20. Provide a password, and confirm it.
21. Provide an SSO Domain name and SSO Site name, and click Next.
22. At the CEIP page, click Next.
23. At the Ready to complete page, click Finish.
24. When installation completes, click Close.
25. Using the vSphere web client, log into the vCenter server using the credentials previously provided.

## Creating a cluster and adding the hosts to VMware vCenter

1. Log into the vCenter, and navigate to Hosts and Clusters.
2. Select the primary site management vCenter.
3. Right-click the vCenter object, and select New Datacenter...
4. Enter a name for the new datacenter, and click OK.
5. Right-click the new datacenter, and click New Cluster...
6. Enter vSAN as the name for the new cluster.
7. Click OK.
8. Repeat steps 1 through 6 and create a cluster called Infra/Witness.
9. Once you have created the cluster, right-click it, and click Add Host.
10. Enter the FQDN for the first server, and click Next.
11. Enter the root credentials for the server, and click Next.
12. To accept the server's certificate, click Yes.
13. Review the server details, and click Next.
14. Assign the desired license, and click Next.
15. Disable Lockdown mode, and click Next.
16. Click Finish.
17. Repeat steps 9 through 16 for the remaining servers in the cluster.

## Configuring the vSAN Networking

1. Log into the vCenter web client, and navigate to Hosts and Clusters.
2. Expand the primary site management vCenter, and expand the Infra/Witness cluster.
3. Select the infrastructure host, and navigate to the Configure tab.
4. Select VMkernel adapters, and click Add Networking.
5. Select Virtual Machine Port Group for a Standard Switch, and click Next.
6. Select New standard switch, change MTU (Bytes) to 9000, and click Next.
7. Click Add adapters, and select your desired physical adapter. We used both 25GbE connections.
8. Choose a network label, and click Next. We labeled our client traffic network `Priv_Net`
9. Click Finish.
10. In the Hosts and Clusters pane, expand the vSAN cluster.
11. Select the first host, and navigate to the Configure tab.
12. Under Networking, select VMkernel adapters, and click Add Networking.
13. Select VMkernel Network Adapter, and click Next.
14. Select New standard switch, change MTU (Bytes) to 9000, and click Next.
15. Click Add adapters, and select your desired physical adapter. We used our first 25GbE connection.
16. Type `vSAN` for the Network label, and select vSAN from the Available services below. Click Next.
17. Choose your network settings, and click Next.
18. Click Finish.
19. Click Add Networking.
20. Select VMkernel Network Adapter, and click Next.
21. Choose Select an existing standard switch, browse to the vSwitch created in step 14, click OK, and click Next.
22. Type `vMotion` for the Network label, and select vMotion from the Available services below. Click Next.
23. Choose your network settings, and click Next.
24. Click Finish.
25. Click Add Networking.
26. Select Virtual Machine Port Group for a Standard Switch, and click Next.
27. Select New standard switch, change MTU (Bytes) to 9000, and click Next.
28. Click Add adapters, and select your desired physical adapter. We used our second 25GbE connection.
29. Choose a network label, and click Next. The label should match the client traffic network label created in step 8. We used the label `Priv_Net`
30. Click Finish.
31. Repeat steps 11 through 30 for the other host in your vSAN cluster.

## Deploying the Witness Appliance and adding it to the cluster

1. Log into the vCenter web client, and navigate to Hosts and Clusters.
2. Expand the primary site management vCenter, and expand the Infra/Witness cluster.
3. Right-click your infrastructure host, and select Deploy OVF Template.
4. Select the location of your vSAN Witness OVA file, and click Next.
5. Select a target cluster for the Witness Appliance, and click Next.
6. Select a compute resource, and click Next.
7. Review details, and click Next.
8. Accept the license agreements, and click Next.
9. Select a deployment configuration, and click Next. We chose Medium for our deployment.
10. Select storage, and click Next.
11. Select networks for the Witness Appliance. Choose `Priv_Net` for the Witness Network, and `VM Network` for the Management Network. Click Next.
12. Type a password for the root account, and confirm it. Click Next.
13. Review the details, and click Next.
14. Once the Appliance has finished deploying, select it in the Hosts and Clusters pane, and power it on.
15. Launch the web console for the Witness Appliance. If desired, change networking option to static, and choose an IP. Otherwise, make a note of the address given by DHCP.
16. In vCenter, right-click the Infra/Witness cluster, and select Add host.
17. Enter the IP address of the Witness Appliance, and click Next.
18. Enter the root credentials for the server, and click Next.
19. To accept the server's certificate, click Yes.
20. Review the server details, and click Next.
21. Assign the desired license, and click Next. A built-in license comes with the Witness Appliance.
22. Disable Lockdown mode, and click Next.
23. Choose the VM location, and click Next.
24. Click Finish.
25. Once the Witness server shows up in the cluster, select it in the Hosts and Cluster pane, and navigate to the Configure tab.
26. Select Virtual switches under Networking, expand the witnessSwitch, and click Edit.
27. Change the MTU (Bytes) to 9000, and click OK.
28. Select VMkernel adapters, and select the vmk attached to the witnessSwitch.
29. Click Edit, and set the MTU to 9000.
30. Select IPv4 settings. Enter your desired network settings, and click OK.

## Enabling vSAN 2 Node with a Witness

1. Log into the vCenter web client, and navigate to Hosts and Clusters.
2. Expand the primary site management vCenter, and select the vSAN cluster.
3. Select the Configure tab, and under Virtual SAN, click General → Configure.
4. Select Configure two host Virtual SAN cluster, and click Next.
5. On the Network validation screen, verify that the correct vmks are selected, and click Next.
6. Select which disks should be claimed for cache and which for capacity in the vSAN cluster, and click Next.
7. Choose the Witness Appliance, and click Next.
8. Verify that there are a cache and a capacity disk for the Witness, and click Next.
9. At the Ready to complete screen, click Finish.

## Creating the SQL Server Master VM

1. In VMware vCenter, navigate to Virtual Machines.
2. To create a new VM, click the icon.
3. Leave Create a new virtual machine selected, and click Next.
4. Enter a name for the virtual machine, and click Next.
5. Place the VM on the desired host with available CPUs, and click Next.
6. Select the appropriate datastore to host the VM, and click Next.
7. Select the appropriate guest OS, and click Next.
8. In the Customize Hardware section, use the following settings:
  - a. Set the vCPU count to 24.
  - b. Set the Memory to 8GB.
  - c. Add 1x 80GB VMDK for OS, 1x 100GB VMDKs for database files, and 1x 60GB VMDK for database logs. Set OS VMDK to thin provisioning, and set all other VMDKs to thick provision eager zeroed.
  - d. Create three additional VMware Paravirtual SCSI controllers, and assign the VMDKs to the new controllers.
  - e. Attach the OS ISO to the CD/DVD drive.
9. Click Next.
10. Click Finish.

## Installing Windows Server 2019

1. Attach the Windows Server 2019 ISO to the virtual machine.
2. Open the VM console, and start the VM.
3. When prompted to boot from DVD, press any key.
4. When the installation screen appears, leave language, time/currency format, and input method as default, and click Next.
5. Click Install now.
6. When the installation prompts you, enter the product key.
7. Select Windows Server 2019 Datacenter Edition (Server with a GUI), and click Next.
8. Check I accept the license terms, and click Next.
9. Click Custom: Install Windows only (advanced).
10. Select Drive 0 Unallocated Space, and click Next. This starts Windows automatically, and Windows will restart automatically after completing.
11. When the Settings page appears, fill in the Password and Reenter Password fields with the same password. Log in with the password you set up previously.
12. Install VMware Tools in the VMs hosted on the ESXi servers.
13. From Server Manager, disable Windows Firewall.
14. Run Windows Updates.

## Installing SQL Server 2017

1. Attach the installation media ISO for SQL Server 2017 to the VM.
2. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2017 DVD, and double-click it.
3. In the left pane, click Installation.
4. Click New SQL Server stand-alone installation or add features to an existing installation.
5. Specify Evaluation as the edition you are installing, and click Next.
6. To accept the license terms, click the checkbox, and click Next.
7. Click Use Microsoft Update to check for updates, and click Next.
8. At the Feature Selection screen, select Database Engine Services, Full-Text and Semantic Extractions for Search, Client Tools Connectivity, and Client Tools Backwards Compatibility.
9. Click Next.
10. At the Instance configuration screen, leave the default selection of default instance, and click Next.
11. At the Server Configuration screen, accept defaults, and click Next.
12. At the Database Engine Configuration screen, select the authentication method you prefer. For our testing purposes, we selected Mixed Mode.
13. Enter and confirm a password for the system administrator account.
14. Click Add Current user. This may take several seconds.
15. Click Next.
16. At the Ready to Install screen, click Install.

17. Close the installation window.
18. In the SQL Server Installation Center, click Install SQL Server Management Tools.
19. Click Download SQL Server Management Studio.
20. Click Run.
21. When the Microsoft SQL Server Management Studio screen appears, click Install.
22. When the installation completes, click Close.

## Configuring and running the DVD Store 2 benchmark

### 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 20GB database size and the database platform we used. We ran the Install.pl script on a utility system running Linux® to generate the database schema.

After processing the data generation, we transferred the data files and schema creation files to a Windows-based system running SQL Server 2017. We built the 20GB database in SQL Server, then performed a full backup, storing the backup file remotely for quick access.

We used that backup file to restore the database when necessary.

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. Other than this file size modification, we created and loaded the database in accordance to the DVD Store documentation. Specifically, we followed these steps:

1. Generate the data, and create the database and file structure using database creation scripts in the DS2 download. Make size modifications specific to our 20GB database, and make the appropriate changes to drive letters.
2. Transfer the files from our Linux data generation system to a Windows system running SQL Server.
3. Create database tables, stored procedures, and objects using the provided DVD Store scripts.
4. Set the database recovery model to bulk-logged to prevent excess logging.
5. Load the data we generated into the database. For data loading, use the import wizard in SQL Server Management Studio. Where necessary, retain options from the original scripts, such as Enable Identity Insert.
6. Create indices, full-text catalogs, primary keys, and foreign keys using the database-creation scripts.
7. Update statistics on each table according to database-creation scripts, which sample 18 percent of the table data.
8. On the SQL Server instance, create 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. Set the database recovery model back to full.
10. Create the necessary full text index using SQL Server Management Studio.
11. Create a database user, and map this user to the SQL Server login.
12. Perform a full backup of the database. This backup allows you to restore the databases to a pristine state.

## Cloning additional SQL Server VMs

Once you have generated the DB, created the ds2user login, and stored the backup has been on the master SQL VM, you can clone the rest of your VMs from the master. For our testing, we created six SQL VMs.

1. From a web browser, log into vCenter.
2. Right-click the Master SQL VM, and select Clone → Clone to Virtual Machine.
3. Select a name for the VM and a datastore location to store it, and click Next.
4. Select the compute resource which the VM will reside on, and click Next.
5. Set Select virtual disk format to Same format as source.
6. Set VM Storage Policy to Keep existing VM storage policies.
7. Select the appropriate datastore, and click Next.
8. Deselect all clone options, and click Next.
9. Review your settings, and click Next.

## 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 that each target reported.

Each complete test cycle consisted of the following general steps:

1. Clean up prior outputs from the target system.
2. Drop the database from the target.
3. Restore the database on the target.
4. Pregrow the DB files as follows:
  - ind1-4: 3.5GB
  - ds\_misc: 1.2GB
  - ds\_log: 50GB
5. Reboot the target host.
6. Wait for a ping response from the server under test and the client system.
7. Let the test server idle for 10 minutes.
8. Start the DVD Store driver on the six clients.

We used the following DVD Store 2 parameters for testing:

```
ds2sqlserverdriver.exe --target=<target _ IP> --ramp_rate=10 --run_time=60 --n_threads=32 --db_size=20GB --think_time=0.00 --detailed_view=Y --warmup_time=15 --report_rate=1 --pct_newcustomers=20 --csv_output=<drivepath>
```

Read the report at [http:// facts.pt/4mw53ty](http://facts.pt/4mw53ty) ►

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